

SIEMENS



SITRANS F

Ultrasonic Flowmeters

SITRANS 1010AERWDP Portable Flowmeter

Operating Instructions

Edition

12/2014

Answers for industry.

SIEMENS

IMPORTANT NOTICE

Controlotron is now part of:

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

1010AERWDP UNIFLOW UNIVERSAL PORTABLE FLOWMETER



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

Field Manual A5E02617285 Rev AB
December 2014

For use with Operating System
Software Version 3.01.06F 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.**

MANUAL ADDENDUM

Operating System Software Version Update

**Manual Addendum
September 2008**

Operating System Software Version Update

INTRODUCTION

The following software operating system version update is for Version 3 flowmeters. Please refer to this addendum when using this technical manual with Version 3 operating system software and flowmeters that have been updated to Version 5.

Operating System Software Changes

1. The [Meter Type Menu] includes a [Language] menu item that allows the selection of multiple flowmeter menu foreign languages.
2. Version 3 and Version 5 Operating System Differences

The following table lists the differences between Version 3 and Version 5 operating system menu items and menu hint lines.

Version 3	Version 5
Select Pipe Class	Pick Pipe Class
Pick/Install Xdcr	Install Xdcr
Data/Span/Set/Cal	Span/Set/Cal
Strip Chart Setup	Display Setup
Dual Channel Flow	2 Channel Flow
Dual Beam Flow	Dual Path Flow
Datalogger Setup	Logger Setup
Temperature Range	Temp Range
Pipe Configuration	Pipe Config
Datalogger Setup	Logger Setup
Datalogger Mode	Logger Mode
Datalogger Data	Logger Data
Log Time Interval	Logger Interval
Display Datalogger	Display Logger
Recall Site Setup	Recall Site
Delete Site Setup	Delete Site
Install Completed?	Install Complete
Estimated Vs m/s	Estimated Vs M/S
Channel /Path Setup	Channel Setup
Reflexor Zero Fault/Set	Zero Fault/Set
Memory Delay (sec)	Memory Delay s)
Flow Volume Units	Flow Vol. Units
Flow Display Range	Flow Disp. Range
Flow Display Scale	Flow Disp. Scale
Total Volume Units	Total Vol. Units
Batch/Sample Total	Batch/Sample Tot
Calibrate Flowrate	Calib. Flowrate
Analog Input Setup	Analog Inp Setup
Flow Vel F/S	Velocity F/S
Vs m/s	Vs M/S
Valc %	Valc
Vaer %	Vaer
Vs Max m/s	Vs Max M/S

(continued)

Version 3	Version 5
Vs Min m/s	Vs Min M/S
Channel/Path Setup	Chan/Path Setup
Vfmax GAL/MIN	Vfmax
Date Site Created:	Site Created:
Empty %	Empty
Analog Output Trim	Analog Out Trim
Pick flowtube size and type	Select flowtube and start operation
Empty Flowtube Set	Empty Pipe Set

Gas Flowmeter Flow and VoS Unit Changes

1. Flowmeter Types

Flowmeter configurations included with this change include all SITRANS F Gas Flowmeters (7ME361*).

2. Flow Units

The table below describes the translation from the current gas flow units to the new gas flow units, where only Cubic Feet and Cubic Meter volume units are affected. Also note that M = thousands and MM = millions. Mass units and Velocity units remain unchanged.

Note: The flow legend changes depending upon the selection of Standard Volume enabled or disabled.

FLOW UNITS			
For STD VOLUME disabled		For STD VOLUME enabled	
<i>Version 3</i>	<i>Version 5</i>	<i>Version 3</i>	<i>Version 5</i>
CU FT/SEC	ACFS	CU FT/SEC	SCFS
CU FT/MIN	ACFM	CU FT/MIN	SCFM
CU FT/HR	ACFH	CU FT/HR	SCFH
CU FT/DAY	ACFD	CU FT/DAY	SCFD
KCU FT/SEC	MACFS	KCU FT/SEC	MSCFS
KCU FT/MIN	MACFM	KCU FT/MIN	MSCFM
KCU FT/HR	MACFH	KCU FT/HR	MSCFH
KCU FT/DAY	MACFD	KCU FT/DAY	MSCFD
MCU FT/SEC	MMACFS	MCU FT/SEC	MMSCFS
MCU FT/MIN	MMACFM	MCU FT/MIN	MMSCFM
MCU FT/HR	MMACFH	MCU FT/HR	MMSCFH
MCU FT/DAY	MMACFD	MCU FT/DAY	MMSCFD
CU M/SEC	M3/sec	M/SEC	NM3/sec
CU M/MIN	M3/min	CU M/MIN	NM3/min
CU M/HR	M3/hr	CU M/HR	NM3/hr
CU M/DAY	M3/day	CU M/DAY	NM3/day
KCU M/SEC	E3 M3/sec	KCU M/SEC	E3 NM3/sec
KCU M/MIN	E3 M3/min	KCU M/MIN	E3 NM3/min
KCU M/HR	E3 M3/hr	KCU M/HR	E3 NM3/hr
KCU M/DAY	E3 M3/day	KCU M/DAY	E3 NM3/day
MCU M/SEC	E6 M3/sec	MCU M/SEC	E6 NM3/sec
MCU M/MIN	E6 M3/min	MCU M/MIN	E6 NM3/min
MCU M/HR	E6 M3/hr	MCU M/HR	E6 NM3/hr
MCU M/DAY	E6 M3/day	MCU M/DAY	E6 NM3/day

3. Total Units

Total units are similar to flow units.

TOTALIZE UNITS	
For STD VOLUME disabled	
<i>Version 3</i>	<i>Version 5</i>
CU FT	ACF
KCU FT	MACF
MCU FT	MMACF
CUM	M3
KCU M	E3 M3
MCU M	E6 M3
TOTALIZE UNITS	
For STD VOLUME enabled	
<i>Version 3</i>	<i>Version 5</i>
CU FT	SCF
KCU FT	MSCF
MCU FT	MMSCF
CUM	NM3
KCU M	E3 NM3
MCU M	E6 NM3

4. Sound Velocity Units

Sound velocity will continue to be reported in units of meters/sec for metric units but will change to Feet/sec for English unit selection. The flowmeter will display M/S and F/S to represent these two variations.

Note: The units for Sound Velocity will be based on the [Preferred Units] menu item found in the [Meter Facilities] menu and can not be changed unless a new site is created.

5. Transducer Model Menu Name

The following table lists the operating system menu item differences between Version 3 Hi Precision and Version 5 Hi Precision transducer model names that appear on the [Install Xdcr] menu. Note that T1, T2 and T3 indicate the different temperature ranges of the transducer.

Version 3 Transducers	Version 5 Transducers
Hi Precision	Hi Precision
1011HG Hi Prec.	1011HP-T1 1011HP-T2 1011HP-T3

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

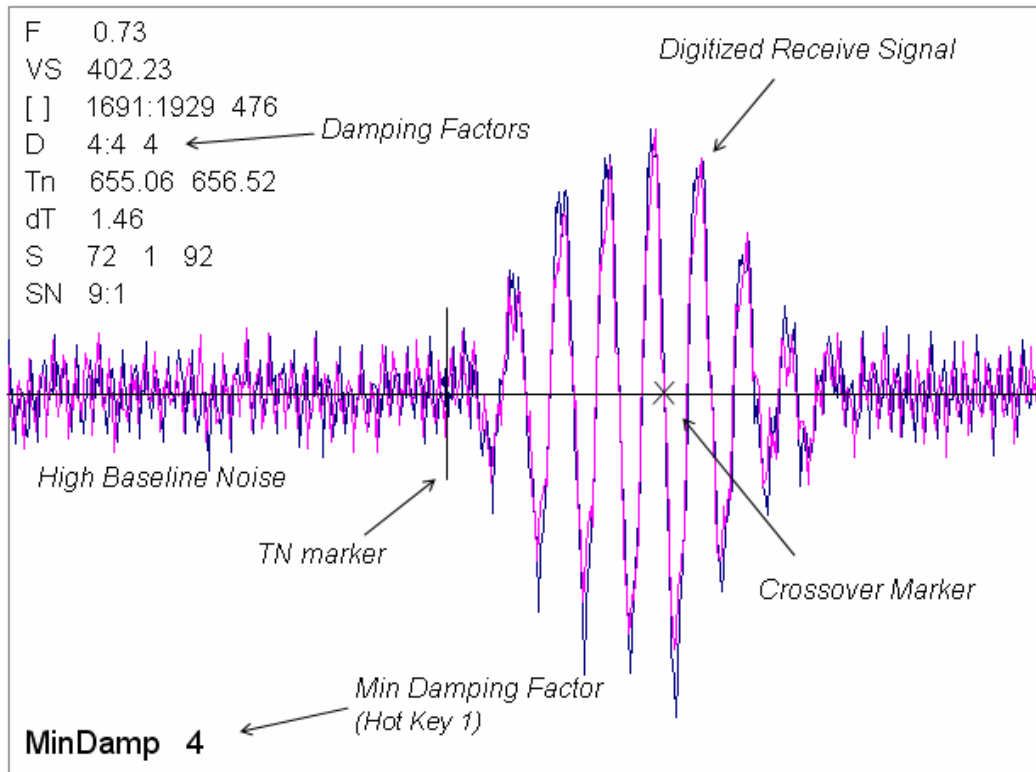
Pressing the <1> key will cause [MinDamp #] to appear on the command line at the lower left-hand corner of the screen. The number listed to the right of the command code represents the exponent in the FUG1010 exponential averaging routine, where the larger the number the greater the digital averaging. 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:

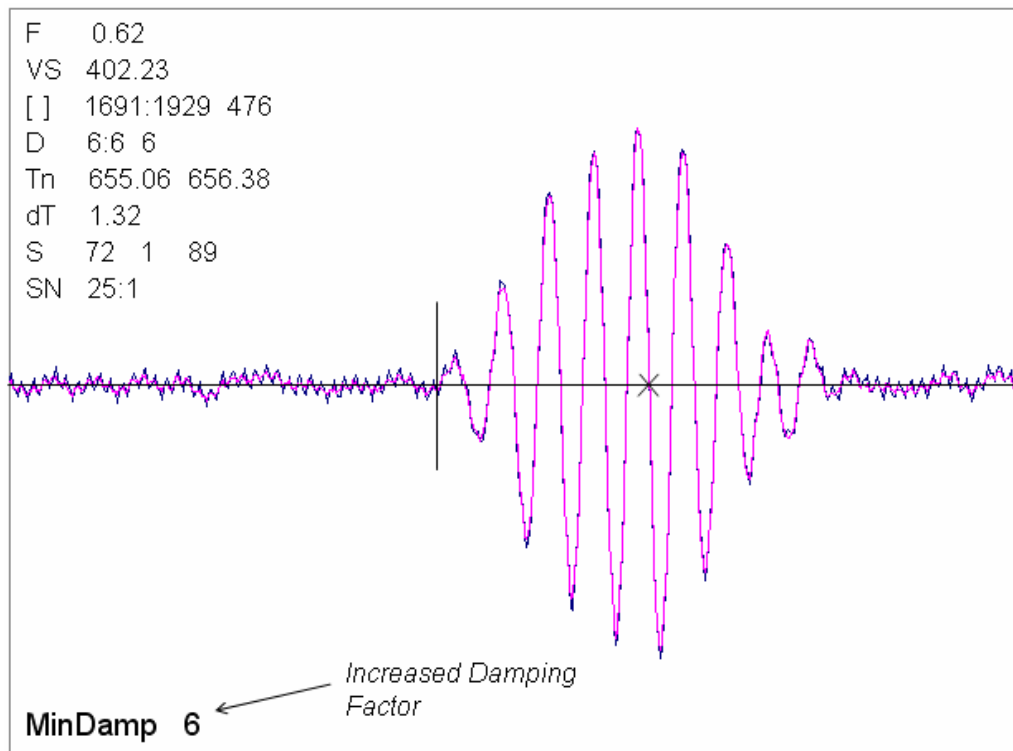
- Close proximity to pressure control valves which may generate in-band acoustic noise
- Very low acoustic signal levels (ALC < 40%)
- High electronic noise from variable frequency drives or other external equipment.

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:1010EPM-3)

Digital Damping Control: (Hot Key 1 and 2)

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

Test Facilities Graph Screen

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

[MinDamp] Command

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

[MaxDamp] Command

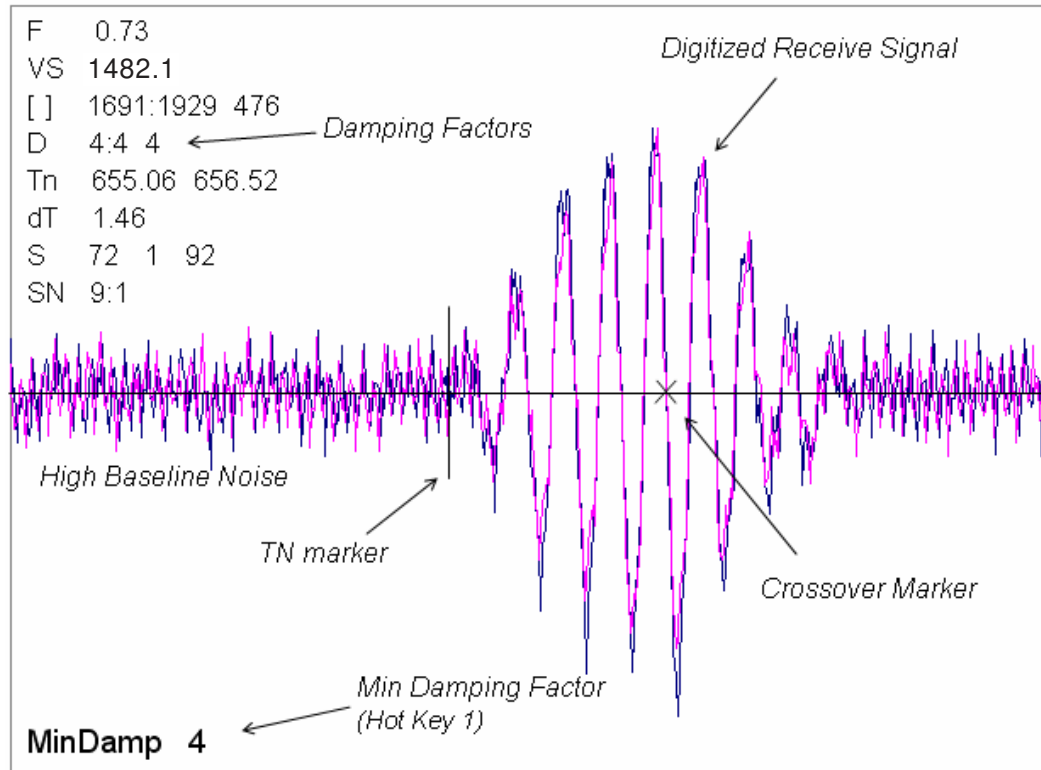
Pressing the <2> key will bring up the [MaxDamp] command. The function of this parameter is similar to the [MinDamp] command described above; however, the two parameters interact in the following manner. The MinDamp value must not exceed the MaxDamp value, therefore increasing the MinDamp value above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

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

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 liquid signal.

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

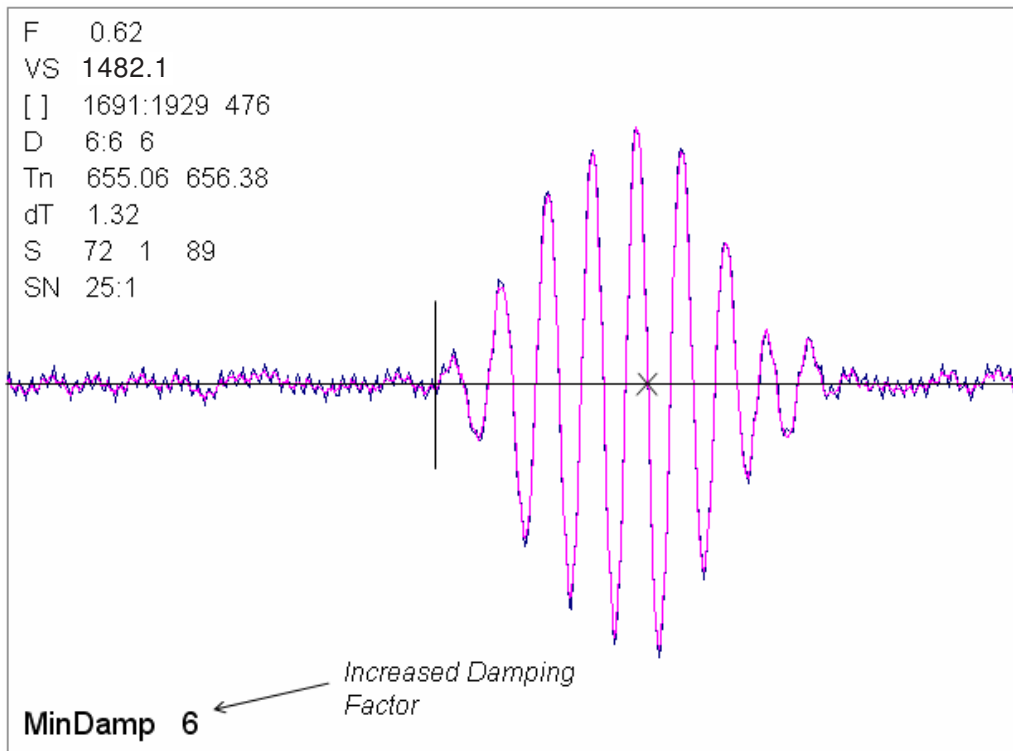
- Close proximity to pressure control valves which may generate in-band acoustic noise
- High un-dissolved gas solids content in liquid.
- High electronic noise from variable frequency drives or other external equipment.

To INCREASE the Digital Damping:

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

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

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



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

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

To DECREASE the Digital Damping:

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

SIEMENS

MANUAL

ADDENDUM

System 1010AP/AER

Ultrasonic Aerospace

Portable Flowmeter

Manual Addendum
1010FMA-22
March 2007

1010AERWDP TRANSDUCER INSTALLATION

1. INTRODUCTION

The System 1010AERWDP flowmeters are part of Siemens extensive System FUS 1010 Clamp-On Transit-Time Ultrasonic Flowmeter division. These meters have all the capabilities of the FUS1010 Clamp-On Series flowmeters plus all the added features of the Aerospace line, which is specifically designed to accurately and non-intrusively measure flow in steel, aluminum, and titanium tubing typically used in aircraft hydraulic and fuel systems.

NOTE: If not installing aerospace transducers refer to the FUP1010 Portable Flowmeter Field Manual instead.

2. FLOWMETER SETUP

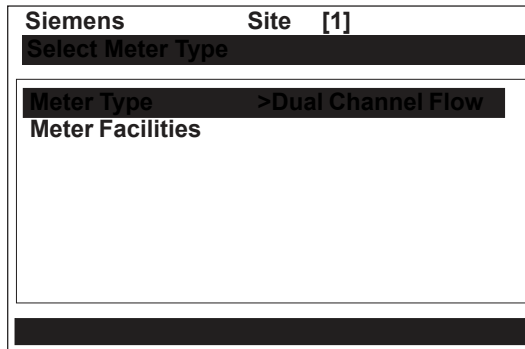
NOTE: If flowmeter is already installed at the site disregard the following set up procedure.

The following instructions require the use of the FUP1010 Flowmeter keypad and menus. The installer should become familiar with them before proceeding further. Refer to Tables 1 and 2 as needed for menu setup data. In addition, refer to Section 2 - *The Installation Menu* in the appropriate flowmeter field manual.

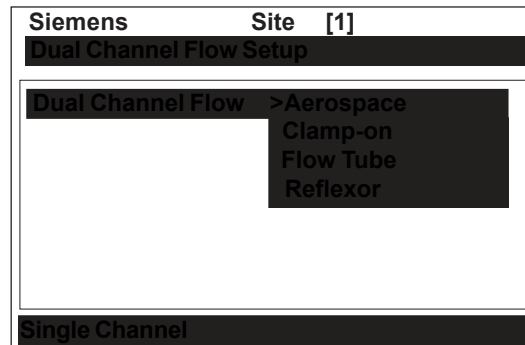
To set up the flowmeter with the Aerospace Transducer, proceed as follows:

Selecting Aerospace Transducer

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



- Press <Right> arrow key to select “Dual Channel Flow” mode. To select, press <ENT> key.
- Press <Right> arrow key and then the <Down> arrow key to select *Aerospace*, then press the <ENT> key.



Creating a New Site Setup (See also paragraph 2.1.3 in 1010P Field Manual)

This section provides an example of how to use the [Create/Rename Site] command to create a new site setup. *Always begin a new installation by issuing the [Create/Name Site] command.* Although you do not need to enter a site name to create a new site setup, you will have to provide one to save the site setup or to identify the source of logged data. In this example, [SITE1] will be used for the site name.

- To access the [Channel Setup] menu press the <Right> arrow, then move the highlight down to [Create/Name Site].

Siemens Site [1]	
Right Arrow & Enter Creates a new Site	
Recall Site Setup	No Sites
Channel Enable	No
Create/Name Site	
Site Security	Off
Delete Site Security	No Sites
Save/Rename Site	
Channel Setup	

- Press the <Right> arrow. Note that the cursor changes to a block that appears after a question mark (?). This indicates that you have accessed the first character position of an eight-character (maximum) alphanumeric entry field.

Siemens Site [1]	
Right Arrow & Enter Creates a new Site	
Recall Site Setup	No Sites
Channel Enable	No
Create/Name Site	? █
Site Security	Off
Delete Site Security	No Sites
Save/Rename Site	
Channel Setup	

This block cursor is currently placed at the first character position.

- You can create a site name (up to 8 characters) by scrolling through the list of available characters, using the <UP> or <Down> arrows or numeric keypad. Pressing the <Right> arrow advances the cursor to the next character space.
- Once the desired site name is filled in, press the <ENT> key to register the selection.
- Press the <Left> arrow to exit this menu.

Selecting Pipe Data

- Press the <Down> arrow to select *Pipe Data*, then press the <Right> arrow.

Siemens	Site	[1]	SITE1
Enter Pipe Outer Diameter manually			
Pipe OD (in)		1.000	
Pipe Material		Steel	
Wall Thickness		0.035	
Liner Material		None	
Liner Thickness		0.000	
Pipe Data			

- To select *Pipe OD (in)*, press the <Right> arrow. Use numeric keys to change pipe size. Press the <ENT> key to register data.
- Press the <Down> arrow to select *Pipe Material* if it is not displayed, then press the <Right> arrow to select option list.
- Use the <Up> and <Down> keys to scroll the option list for the desired pipe material. Press the <ENT> key to register data.
- Press <Down> arrow to select *Liner Material* if it is not displayed, then press the <Right> arrow to select option list.
- Use the <Up> and <Down> keys to scroll the option list for the desired liner material. Press the <ENT> key to register data.
- Press the <Down> arrow to select *Liner Thickness*, then press <Right> arrow. Use numeric keys to change pipe size. Press the <ENT> key to register data.

Liquid Data

- Press the <Down> arrow to select *Liquid Data* if it is not displayed, then press the <Right> arrow.

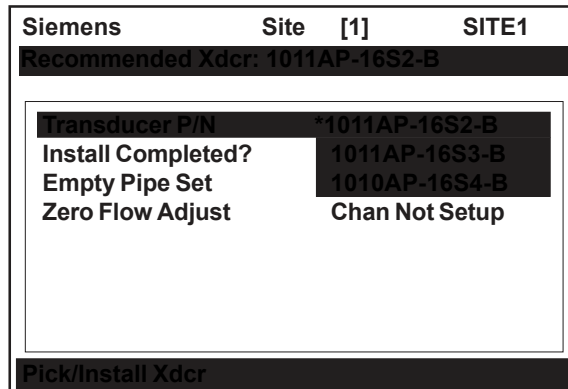
Siemens	Site	[1]	SITE1
Kinematic Viscosity of liquid			
Viscosity <cS>		1.00	
Density S.G.		1.000	
Liquid Data			

- Press the <Right> arrow and use numeric keys to change *Viscosity <cS>*. Press <ENT> to register data.
- Press the <Right> arrow and use numeric keys to change *Density SG*. Press <ENT> to register data.

Using the Pick/Install Xdcr Menu

- Press the <Down> arrow to select *Pick/Install Xdcr* if it is not displayed, then press the <Right> arrow. The meter will display only the transducers that are suitable for the entered tube diameter.

The prompt line will display the recommended transducer part number based on the entered wall thickness as indicated in Table 2 on page 9 of this addendum.



- Press the <Right> arrow and scroll to desired transducer P/N (e.g., P/N 1011AP-16S2-B).
- Press the <ENT> key to register your selection.

3. AEROSPACE TRANSDUCER INSTALLATION

Transducer Mounting Procedure

To install the Aerospace Transducer, refer to Installation Drawing 1011AP-8 in this addendum and proceed as follows:

- Apply a thin bead of Super Lube (CC128) to the active area of the transducer.
- Press the transducer onto the tube and snap it into place. Check to make sure that the transducer makes positive contact with the tube.

Connecting Transducer Cables

NOTE: The 1010 Aerospace Transducer is a bi-directional device. The upstream and downstream transducer cabling can be interchanged depending on which direction of flow is desired to be positive or negative.

- Connect one end of the BNC transducer cable to the *upstream* transducer connector (UP).
- Connect the other end of the flow transducer cable to the UP connector on flowmeter.
- Connect one end of another BNC transducer cable to the *downstream* transducer connector (DN).
- Connect the other end of the flow transducer cable to the DN connector on flowmeter.

- Press the <Down> arrow to select *Install Completed?*, then press the <Right> arrow.

Siemens	Site [1]	SITE1
Key [Install] after mounting transducers		
Transducer P/N	1011AP-16S2-B	
Install Completed?	No	
	*Install	
Empty Pipe Set	Chan Not Setup	
Zero Flow Adjust	Chan Not Setup	
Pick/Install Xdcr		

- Use the <UP> or <Down> arrows to move the cursor to *Install*.
- Press the <ENT> key to register selection. The meter will then perform an *Initial Makeup*, which conditions its operation to the selected transducer, pipe, and liquid. It then automatically sets the empty pipe and zero flow levels. Be patient, this process may take several minutes.

Siemens	Site [1]	SITE1
Drive 10 m 13	[6:-----:0]	
Transducer P/N	1011AP-16S2-B	
Install Completed?	Install	
Empty P	Measured Vs m/s Setup	
Zero Flow	1490 Chan	
Not Setup		
Pick/Install Xdcr		

- Upon completion the meter reports the measured liquid sonic velocity. To accept the Measured Vs, press the <Down> arrow.

NOTE: If you want to correct the reported sound velocity, press the <Right> arrow to edit the indicated Vs value, then press <ENT> to continue.

NOTE: The meter will now perform an AutoZero operation where the meter measures any zero flow offset, which is used to correct the flow reading.

Siemens	Site [1]	SITE1
Set Empty Pipe Detection Threshold		
Transducer P/N	1011AP-16S2-B	
Install Completed?	Yes	
Empty Pipe Set	MTYmatic	
Zero Flow Adjust	Actual Zero	
Pick/Install Xdcr		

After the meter completes its *Initial Makeup* command, the *[Installed Completed?]* option list changes to:

Install Completed?	Yes
	New Makeup

If you want to redo the Initial Makeup, move cursor to New Makeup, then press the <ENT> key. This resets the option list. You can now repeat the install routine described previously.

- Refer to the FUP1010 Portable field manual for the *Empty Pipe Set* procedure.
- Refer to the FUP1010 Portable field manual for the *Zero Flow Adjust* procedure.

NOTE: For additional FUP1010 flowmeter functions refer to the FUP1010PFM-3 field manual.

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6 - Data/Entry Level	Comments
Meter Type	Single Channel	Channel 1	Aerospace	Channel Setup		
			Flow Tube*			
			Clamp-on*			
			Reflexor*			
	Thickness Gauge Flaw Detector			Pipe Data	Pipe OD (in)	
					Pipe Material	
					Wall Thickness	
					Liner Material	
					Liner Thickness	
				Liquid Data	Viscosity cS	
				Density S.G.		
			Pick/Install Xdcr	Transducer P/N (Select Xdcr)		
				Install Completed?		
				Empty Pipe Set		
				Zero Flow Adjust		
				All other menu items are unchanged (see 1010P manual).		
Meter Facilities						Meter Facilities Menu does not include "Table Setups." See 1010P manual.

* For additional functions refer to the FUP1010 Portable field manual.

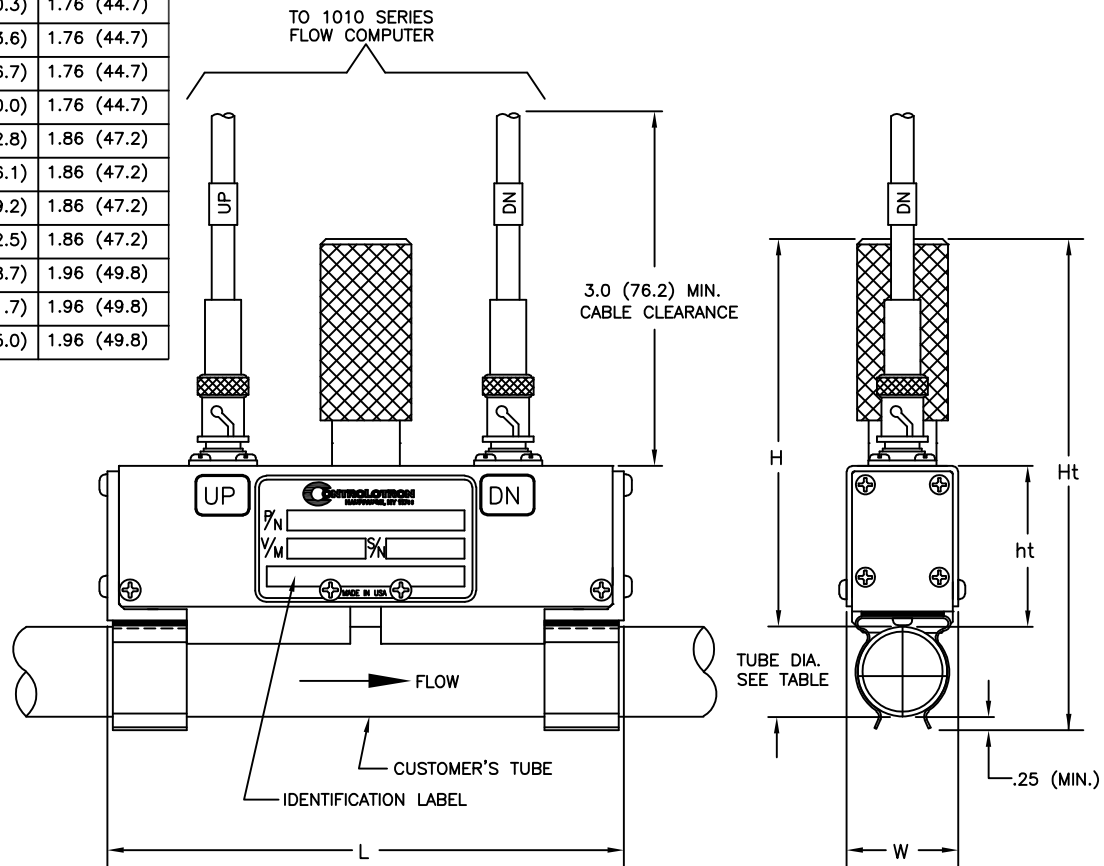
Table 1. System Menu

OD (in)	Wall Thickness Range (in)				
	0.015 to 0.042	0.015 to 0.042	0.043 to 0.061	0.062 to 0.084	0.085 to 0.116
1/4	1011AP-4S1-B				
1/3	1011AP-5S1-B				
3/8	1011AP-6S1-B				
1/2	1011AP-8S1-B	1011AP-8S2-B			
5/8		1011AP-10S2-B	1011AP-10S3-B		
3/4		1011AP-12S2-B	1011AP-12S3-B	1011AP-12S4-B	
7/8		1011AP-14S2-B	1011AP-14S3-B	1011AP-14S4-B	
1		1011AP-16S2-B	1011AP-16S3-B	1011AP-16S4-B	
1 1/8		1011AP-18S2-B	1011AP-18S3-B	1011AP-18S4-B	1011AP-18S5-B
1 1/4		1011AP-20S2-B	1011AP-20S3-B	1011AP-20S4-B	1011AP-20S5-B
1 1/2		1011AP-24S2-B	1011AP-24S3-B	1011AP-24S4-B	1011AP-24S5-B
2		1011AP-32S2-B	1011AP-32S3-B	1011AP-32S4-B	1011AP-32S5-B

Table 2. Pipe Outer Dimension and Wall Thickness Chart

NOTE: The 1011AP Aerospace Transducer part number designations are expressed in 1/16-inch increments (e.g., part number 1011AP-4S1-B indicates 4S = 1/4”).

ASS'Y P/N	TUBE DIA.	L	W	H	Ht	ht
1011AP-4S1-B	.25 (6.4)	3.85 (97.8)	.945 (24.0)	3.96 (101.0)	4.46 (113.3)	1.46 (37.1)
1011AP-5S1-B	.31 (8.0)	3.90 (99.1)	.945 (24.0)	3.96 (101.0)	4.52 (114.8)	1.46 (37.1)
1011AP-6S1-B	.37 (9.5)	3.97 (100.8)	.945 (24.0)	3.96 (101.0)	4.58 (116.3)	1.46 (37.1)
1011AP-8S1-B	.50 (12.7)	4.28 (108.7)	.945 (24.0)	3.96 (101.0)	4.71 (119.6)	1.46 (37.1)
1011AP-10S2-B	.62 (15.9)	5.17 (131.3)	1.07 (27.2)	4.26 (108.2)	5.13 (130.3)	1.76 (44.7)
1011AP-12S2-B	.75 (19.1)	5.53 (140.5)	1.07 (27.2)	4.26 (108.2)	5.26 (133.6)	1.76 (44.7)
1011AP-14S2-B	.87 (22.2)	5.65 (143.5)	1.07 (27.2)	4.26 (108.2)	5.38 (136.7)	1.76 (44.7)
1011AP-16S2-B	1.00 (25.4)	5.77 (146.6)	1.07 (27.2)	4.26 (108.2)	5.51 (140.0)	1.76 (44.7)
1011AP-10S3-B	.62 (15.9)	5.50 (139.7)	1.07 (27.2)	4.36 (110.7)	5.23 (132.8)	1.86 (47.2)
1011AP-12S3-B	.75 (19.1)	5.62 (142.8)	1.07 (27.2)	4.36 (110.7)	5.36 (136.1)	1.86 (47.2)
1011AP-14S3-B	.87 (22.2)	5.74 (145.8)	1.07 (27.2)	4.36 (110.7)	5.48 (139.2)	1.86 (47.2)
1011AP-16S3-B	1.00 (25.4)	6.23 (158.2)	1.07 (27.2)	4.36 (110.7)	5.61 (142.5)	1.86 (47.2)
1011AP-12S4-B	.75 (19.1)	5.76 (146.3)	1.07 (27.2)	4.46 (113.3)	5.46 (138.7)	1.96 (49.8)
1011AP-14S4-B	.87 (22.2)	5.88 (149.4)	1.07 (27.2)	4.46 (113.3)	5.58 (141.7)	1.96 (49.8)
1011AP-16S4-B	1.00 (25.4)	6.00 (152.4)	1.07 (27.2)	4.46 (113.3)	5.71 (145.0)	1.96 (49.8)



NOTES:

1. CONSULT THE 1010 FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.
2. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER, CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.
3. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-	CONTRACT NO.
	DR. H.J. DATE 4/18/01
	CHK. _____ DATE _____
	ENG. _____ DATE _____
MATERIAL:	PROD. _____ DATE _____
FINISH:	APPD. _____ DATE _____
	CERTIFIED _____
	DATE _____

CONTROLotron HAUPPAUGE, NY 11788		
INSTALLATION/OUTLINE SNAP ON TRANSDUCER		
SIZE C	CODE IDENT NO. 21614	REV. A
SCALE: NONE	WT.	SHEET 1 OF 1

MANUAL ADDENDUM

**SETUP PROCEDURE FOR
WET-FLOW CALIBRATED
Sitrans F SYSTEMS**

**Sitrans F Uniflow
Portable & NEMA
Flowmeter Systems**

Manual Addendum
July 2002

SETUP PROCEDURE FOR “WET-FLOW CALIBRATED” 1010 SYSTEM

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

1. INTRODUCTION

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

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

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

2. SETUP PROCEDURE

2.1 Transducer Installation

- 2.1.1 Refer to the diagnostic data sheet to find the mounting mode (Direct or Reflect) used during the wet-flow calibration. Review the transducer installation guidelines in your 1010 field manual.
- 2.1.2 Refer to the diagnostic data sheet for the transducer spacing index utilized during the flow calibration. Using the mounting configuration employed during the flow calibration, install the transducers on the pipe at the above noted spacing positions in accordance with the instructions provided on the transducer installation drawings.
- 2.1.3 Attach the transducer cables noting that the cable marked “UP” attaches to the transducer closest to the source of flow.

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

2.2 Flowmeter Setup

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

- 2.2.1 Switch the flowmeter on. Press the <MENU> key.
- 2.2.2 On multi-channel flowmeters, use the arrow keys to select [Dual Channel Flow] or [Dual Beam Flow] depending on the mode utilized for the wet-flow calibration.
- 2.2.3 Use the arrow keys to select either [Clamp-on], [Flow Tube] or [Clamp-on Spool].
- 2.2.4 Select [Full Site Setup] and use the <Right Arrow> to select [Channel Setup]; then select [Recall Site Setup].
- 2.2.5 Use the <Down Arrow> to scroll to the site name indicated on the Calibration Diagnostic Data Sheet. Then press <ENT>.
- 2.2.6 The meter will perform a momentary “Makeup” routine that will take a few seconds and then begin operation.
- 2.2.7 Refer to your 1010 field manual for instructions on setting zero flow.

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

- 2.2.8 Using the arrow keys, scroll to the Data Span/Set/Cal menu location. Verify that the [Kc] (calibration) factor matches the value indicated on the diagnostic data sheet.
- 2.2.9 If you are measuring a liquid other than ambient water, select the [Liquid Class] menu cell and <Down Arrow> from there to [Viscosity]. Enter the correct viscosity for the liquid you will be monitoring.
- 2.2.10 Setup is now complete. Press the <MENU> key twice to view the flow rate display. DO NOT utilize the [Save Site] command when it appears.
- 2.2.11 When measurements are completed, simply turn off the meter. DO NOT save the site. This might contaminate the wet-flow calibration data already stored.

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

3. TRANSFER INSTALL FUNCTION

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

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

3.1 Transfer Install Procedure

To initiate the Transfer Install function, proceed as follows:

- 3.1.1 In the Application Menu press the <Right Arrow> to select the [Liquid Class] menu cell. Scroll and highlight [Estimated Vs m/s] from the option list.
- 3.1.2 Use the numeric keys to change the Estimated Vs to the Estimated Vs value of the customer selected liquid.
- 3.1.3 To enter new Estimated Vs value press <ENT>.
- 3.1.4 Proceed to the Pick/Install Xdcr menu and select the same transducer, mounting mode and spacing offset that was selected for the water calibration.
- 3.1.5 Re-space the transducers to the index position indicated by the flowmeter.
- 3.1.6 Scroll to the [Install Completed?] menu cell and select [Transfer Install] from the option list.

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

- 3.1.7 For MultiPath systems repeat Step 3.1.6 above for the remaining paths.
- 3.1.8 The flowmeter should now be operational at the new spacing location.

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

3.2 Saving New Transfer Install Site

- 3.2.1 To save the Transfer Installed site, scroll to the Channel Setup menu and press the <Right Arrow>. Press the <Right Arrow> again to select the [Save/Rename] menu cell.
- 3.2.2 Use the numeric keys to rename the Transfer Installed site with the same site name used in Step 3.1.2 above, but with a "T" appended to the end of the site name (e.g., 3CS40T).
- 3.2.3 Press <ENT> to store data.

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1. INTRODUCTION

1.1 ABOUT THIS FIELD MANUAL

This field manual is designed to enable someone with no prior experience to setup and operate the Siemens SITRANS FUP 1010P Portable Flowmeter. Please visit our web site: www.siemens.com. There you will find additional documentation for downloading including updated news about the company and our products.

This field manual focuses on how to setup the flowmeter for dual-channel clamp-on transit-time operation.

- Section 1 gives an introduction to the 1010P flowmeter types.
- Section 2 explains the 1010P Installation Menu.
- Section 3 gives step-by-step transducer installation instructions.
- Section 4 shows basic Meter Facilities menu operations.
- Section 5 includes System 1010P Application Notes.
- Section 6 explains System 1010P operation with Flow Tubes.
- Section 7 shows how to use the flowmeter's Reflexor mode.
- Section 8 shows how to use the pipe wall Thickness Gauge.

1.1.1 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., [Pipe Data], [Channel Enable], etc.
- Each menu includes an image of its main screen and a diagram of its structure. The rightmost column of the structure diagram lists the option list choices of the menu cell, if applicable.

1.1.2 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.

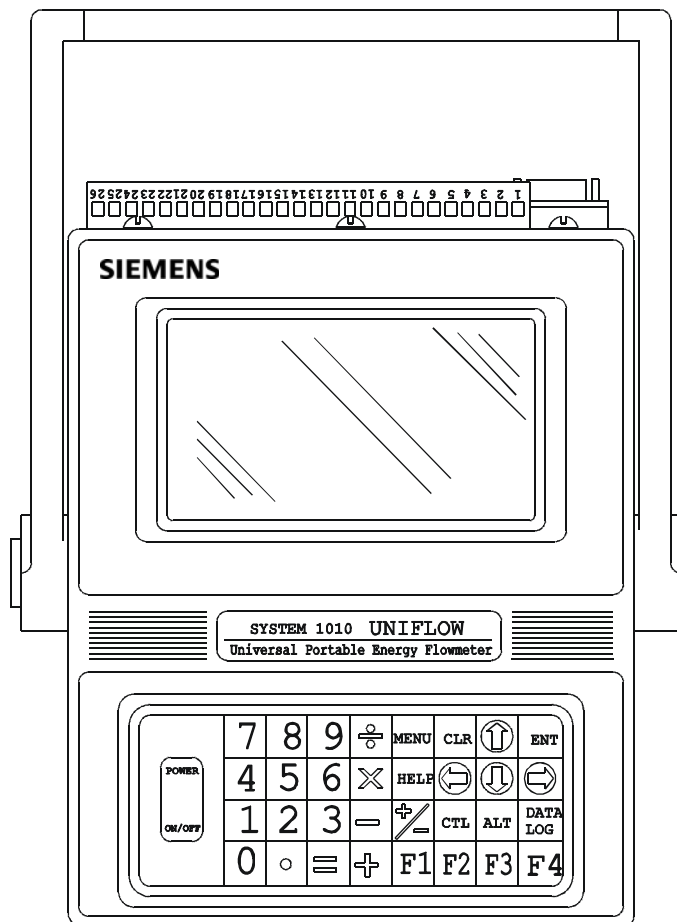
1.2 INTRODUCING THE FUP 1010P/WDP FLOWMETER

Congratulations on your purchase of the SITRANS FUP1010P/WDP Portable flowmeter. Our unique 1010 Portable models are small, lightweight and versatile transit-time flowmeters that are easy to set up and operate. They represent the state-of-the-art in computerized instrumentation. We are confident that in a very short period of time you will appreciate your meter's unrivaled performance and features, especially Siemens' ground-breaking enhanced transit-time Digitally Coded MultiPulse technology and the on-line automatic and interactive site setup help facility.

1.2.1 PORTABLE CONFIGURATIONS

We offer two basic chassis styles for 1010 Portable flowmeters. The 1010P and 1010DP miniaturized flowmeters use a lightweight plastic case for easy transporting and operation. The 1010WP and 1010WDP flowmeters use a compact and rugged submersible, weatherproof case. The following portable models are available:

- 1010P Single Channel Miniature Multi-Function Portable
- 1010DP Dual Channel Miniature Multi-Function Portable
- 1010WP Single Channel Miniature Multi-Function Portable
- 1010WDP Dual Channel/Path Miniature Multi-Function Portable



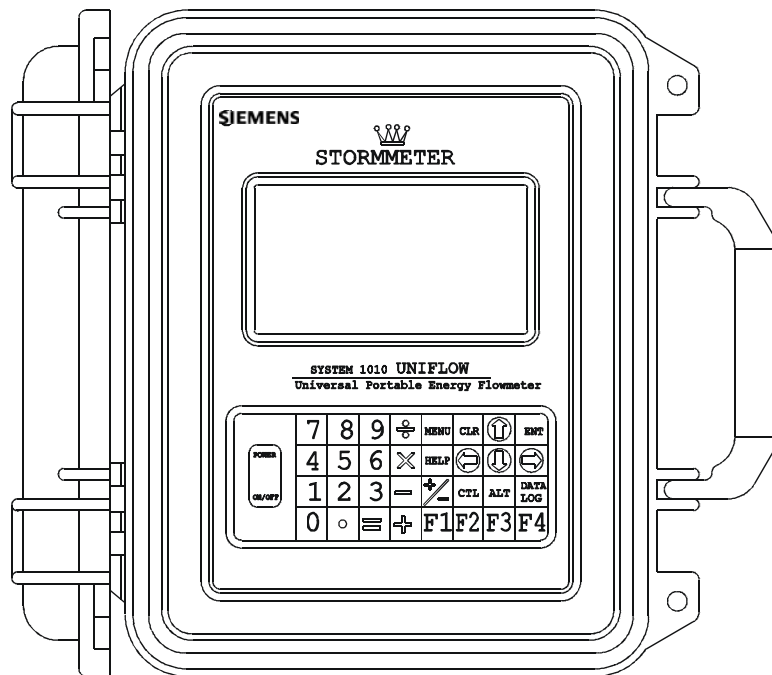
System 1010P(DP) Portable Flowmeters

1.2.2 STANDARD PORTABLE FEATURES

All 1010 models shown include the following standard features:

Large 240 X 128 Pixel Display with 1-1/8 inch Characters

- Viewable from over 40 feet (12 meters)
- Allows hands-free operation with portable systems
- Graphics ability allows simultaneous digital and stripchart displays
- Push-button scrolling through all available graphic displays



System 1010WP(DP) Portable Flowmeters

Single Path or Dual Channel/Path Operation

- Dual-channel systems provide two independent flowmeters in a single package for greater convenience and economy.
- The two measurement channels can be combined to form a single mathematical output (either subtractive or additive).
- Dual-beam operation combines two measurement paths into a single output (average of each path) that provides enhanced accuracy and immunity to most flow profile disturbances.
- Two independent channels allow the simultaneous use of Transit-Time and Reflexor flow measurement.

Operation with In-line Transducers

- 992DFT & 1011FT Flow Tubes are designed for small line sizes and extremely low flow applications

Compatibility with Clamp-on 990 transducers

- The Portable Installation Menu supports the use of both 991 and 1011 transducers. This benefits especially System 990 owners who upgraded to a 1010 model and still own 991 transducers.

Flexible Transducer Mounting Options

- EZ clamp and spacer bars make installing and spacing transducers fast and easy.
- Lightweight, rigid transducer mounting frames that can be coupled using spacer bars or installed separately for stand-alone mounting.
- Fixed length mounting tracks (for small transducers).

Mechanical, Electrical, Environmental and Safety Specifications

Weight, 1010P	7.5 lbs / 3.4 kg
Dimensions, 1010P	inches: 7.8 W x 10.5 H x 3.5 D
	millimeters:197 W x 267 H x 90 D
Weight, 1010WP	7.7 lbs / 3.5 kg
Dimensions, 1010WP	inches: 8.50 W x 10.68 H x 6.97 D
	millimeters:216 W x 271 H x 177 D
Power Input	NiCd Battery Operated Battery Charger: 100-240 VAC +/-10% 50-60 Hz Battery Charger Temperature Range: 5°C to 35°C (41°F to 95°F)
Flowmeter Operating Temperature Range	32°F to 122°F
	0°C to 50°C
Storage Temperature Range	-40°F to 160°F
	-40°C to 71°C
Operating Altitude Range	up to 6,563 ft
	up to 2,000 m
Transport Altitude Range	-2000 ft to 40,000 ft
	-609 m to 12,192 m
Humidity	90% from 32°F to 122°F
	90% from 0°C to 50°C
Service Rating	1010P Indoor use; NEMA Type 1, IP40 1010WP Indoor/Outdoor use; IP67
Safety	- UL Listed and UL Listed to Canadian Safety Standards, UL61010-1, File E304857 - Pollution Degree 2 - CAT II

1.2.3 PERFORMANCE

Under standard conditions (measurements taken on a straight run of 15 diameters upstream and 5 diameters downstream; flow rate above 1 fps; non-aerated Newtonian liquids flowing at Reynolds numbers <2000 or >10000).

Transit-Time Accuracy	At least 1% to 2 % of indicated flow (better than 0.5 % possible with calibration).
Flow Sensitivity	0.001 fps (0.0003 m/s) - even at zero flow.
Zero Drift Stability	less than 0.015 fps (0.005 m/s)
Repeatability (small volume)	better than 0.5 %
Response Rate (Damping)	SmartSlew effective from 0,2 seconds to 5 minutes.
Flow Velocity Range	Min. ± 40 ft/s (± 12 m/s), inc. zero flow
Linearity	0.003 ft/s (0.001 m/s)
Flow Profile compensation	Automatic Reynolds number correction of reported flow rate

Integral Datalogger

All portable 1010 models include an integral datalogger that automatically logs data at selected intervals. These systems use a memory management algorithm to dynamically distribute all available system memory to the datalogger that is not in current use for site data storage. This results in a maximum capacity of over 200 Kbytes of data (single channel, compressed). The Datalogger includes an automatic report trigger that responds to selected real-time events. The keypad includes a “hot-key” to generate instant datalogger reports.

Analog Outputs

The system provides all the industry standard analog outputs, which can be scaled and ranged as required. The menu allows you to assign any available data function to an analog output. The digital display, stripchart and datalogger screens allow local viewing of all data functions.

4 to 20 mA Outputs

- All portable 1010 models provide two independent scaleable 4 to 20 mA isolated, loop-powered, outputs. Dual-channel models provide one current output per measurement channel.

0 to 10 Volt Outputs

- All portable 1010 models provide two independent scaleable 0 to 10 Vdc outputs. Dual-channel models provide one voltage output per measurement channel.

0 to 5000 Hz Pulse Rate Output

- All portable 1010 models provide two 0 Hz to 5000 Hz pulse rate outputs in the form of a buffered TTL signal similar to the final outputs of flowmeters such as turbines. Dual-channel models provide one pulse output per channel. Pulse outputs usually represent volumetric flow.

Alarm Functions

The 1010P flowmeters offer several alarms (shown by letter codes on the digital screen and in data-logger reports). Alarm relays are not standard equipment in the 1010 Portable systems, since they use significant battery current to sustain fail-safe operation. However, System 1010P provides buffered logic outputs (3 - 5 Vdc high, 0 - 1 Vdc low) for external device control which can be used as triggers for external relays, etc.

1.3 METER TYPES

Those familiar with our 990 systems, will appreciate System 1010's many new features; especially its ability to operate as several different meter types to meet the needs of almost any conceivable portable application. These features are described in the following paragraphs.

1.3.1 DUAL CHANNEL FLOW

In Dual Channel Flow mode, the meter becomes two entirely independent flowmeters operating simultaneously on two different pipes. Each pipe can be of a different size, transporting different liquids. In addition, either measurement channel can be set to operate as a clamp-on or in-line transit-time flowmeter, or a clamp-on Reflexor flowmeter.

1.3.2 DUAL PATH FLOW

In Dual-Path mode, both measurement channels operate on the same pipe using transit-time technology. Both measurement channels contribute to a single combined average output. The Dual-Path flowmeter configuration provides the highest possible accuracy, with excellent immunity from flow profile aberrations.

1.3.3 CH 1+2 OR CH 1-2 (ARITHMETIC) Flow

In an Arithmetic mode, the meter measures the flow of two channels independently, then creates a "virtual" channel, whose output is either the sum (Ch 1+2) or difference (Ch 1-2) of the two flow rates. Arithmetic mode supports either clamp-on or in-line transit-time only.

1.3.4 THICKNESS GAUGE

The Thickness Gauge allows you to obtain an accurate wall thickness measurement at a mounting location. This eliminates any uncertainty about the value of this critical parameter. The measurement range covers pipe walls from 0.1" (2.5 mm) to 2" (50.8 mm), depending on pipe sonic conductivity and condition of the inner wall of the pipe.

The Thickness Gauge operation disables all flow measurement. Use the Channel Enable menu cell to re-establish flow measurement.

1.4 CHANNEL FUNCTIONS

The system's multi-tasking software allows you to operate one channel in Reflexor mode simultaneously with the other channel operating in Transit-Time mode. In addition, Transit-Time mode supports both clamp-on and in-line transducers.

1.4.1 TRANSIT-TIME MODE

All the 1010 models use transit-time flow measurement technology varying only in functionality and environmental housings. System 1010 improves the MultiPulse signal detection first used in 990 models by incorporating Siemens' new Digitally Coded MultiPulse technology (DCM) featuring AutoMark receive signal detection.

Clamp-On

- Entirely non-invasive - installs in minutes without having to cut pipe or interrupt flow.
- Eliminates calibration errors due to wear - no moving parts and no contact between transducer and liquid.
- Operates bidirectionally - no special meter runs required.
- Works with most liquids flowing through metal or plastic pipes, including pipes with plastic, glass, epoxy and cement liners.

Flow Tube

The 992DFT and 1011FT flow tubes are the ideal solution for line sizes of three inches or under and for extremely low flow applications. Our flow tubes feature considerably less pressure drop than competing flowmeters such as coriolis or vortex shedding types.

Clamp-on Spool

The 1013S clamp-on spool supports applications with typically larger line sizes and volumetric flow rates than the 990 DFT or 1011FT flow tubes. It is intended for users that require a known and guaranteed intrinsic calibration.

1.4.2 REFLEXOR MODE

The System 1010 transit-time flowmeter is immune to the effects of liquid non-homogeneity caused by the inclusion of air or solid particulate. However, sonic beam scattering may occur when mineral-based solids or gaseous content is a high percentage of the volume. This can cause difficulty in operating the 1010 in transit-time mode due to signal attenuation. Liquid conditions that may be unsuitable for transit-time operation, actually aid Reflexor flow detection.

Dual-channel portable systems allow operation with one transit-time channel and one Reflexor channel measuring flow on the same pipe. There are some conditions though, such as an empty pipe, which do not permit operation in either Transit-Time or Reflexor mode.

1.5 GETTING STARTED

This section shows how to install the System 1010P Portable Flowmeter with a minimum of effort. It will show how to use the Installation Menu to set-up the system for transit-time, Reflexor and Flow Tube operation. It also shows the basic connections to and from the meter. For additional information on connections, see Appendix A - Engineering Drawings. If fast installation procedures are needed, refer to paragraph 1.11 Using Faststart Setup.

IMPORTANT SAFETY CONSIDERATIONS

The FUP1010 Portable Flowmeter operates from an internal battery that is periodically charged by an external AC power source (see paragraph 1-10 for details). All electric safety codes that apply to your application must be observed. We recommend that only experienced personnel with knowledge of local electrical codes and operating safety procedures perform the installation and wiring. Since regulations vary by geographic location, industry, etc., it is solely the user's responsibility to operate this equipment safely.

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

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

All versions of Siemens Portable 1010W Flowmeters are equipped with an *E-Z Purge Pressure Control Valve* located on the right side of the case. To avoid case door lockup or damage during air travel or altitude changes, relieve vacuum by opening pressure purge valve counterclockwise. To re-establish weather resistance, thumb-tighten purge valve knob by turning clockwise. Secure the case latches and rear connector caps, where present, to preserve waterproof integrity.

The following symbol indicates that the Equipment is protected by Double-Insulation: 

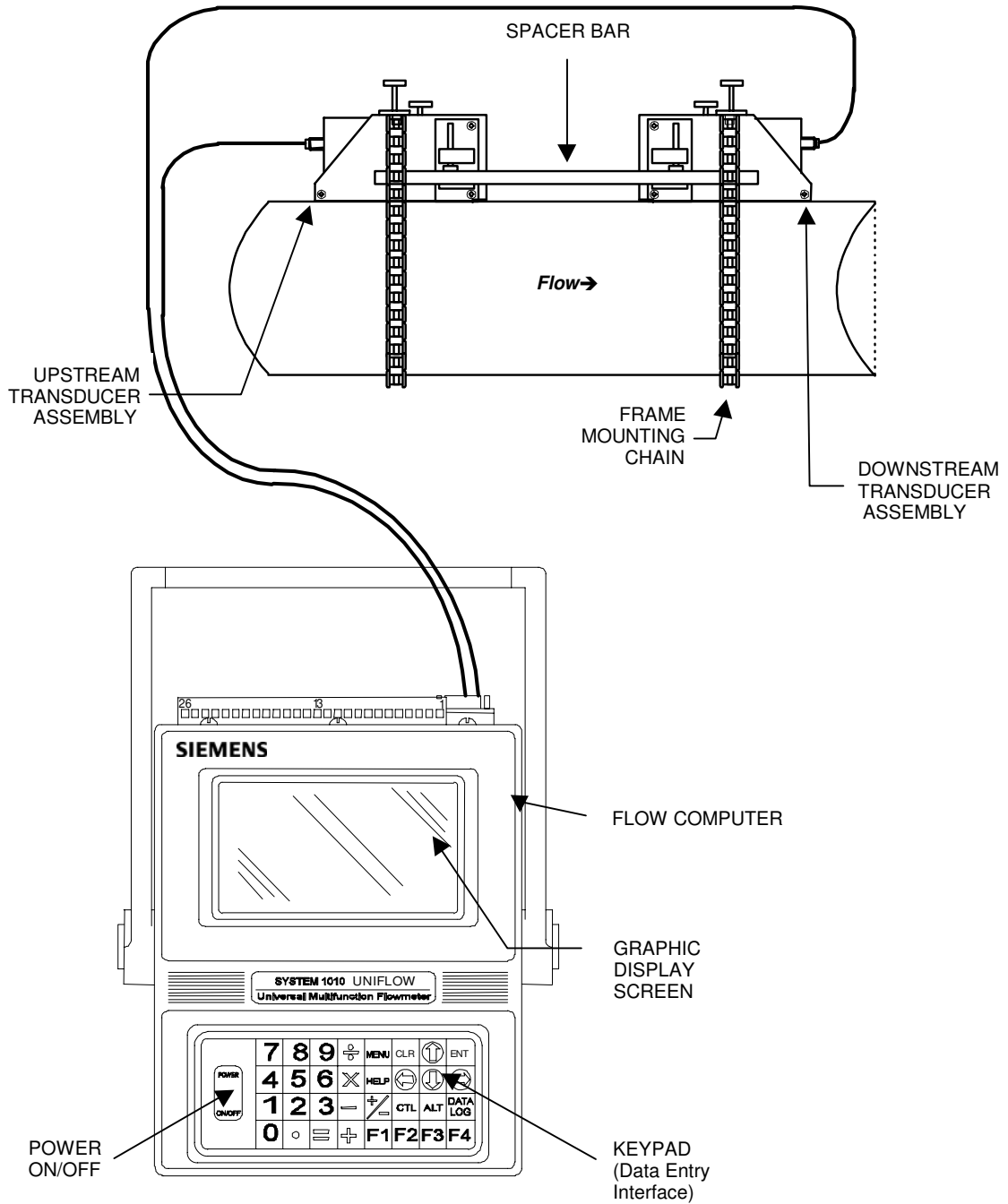
If you have concerns about any of the safety aspects of the FUP1010, contact the Technical Service Group.

1.6 FLOWMETER INSTALLATION STEPS

Typical steps to complete the installation procedure include:

- Collect the site data (pipe and liquid data, part numbers, etc.).
- Choose a mounting location for flow transducers.
- Prepare pipe for transducer mounting.
- Access the Installation Menu and create a site (paragraph 1.9.3).
- Enter pipe parameters (paragraph 2.2).
- Invoke transducer install procedure (paragraph 2.4).
- Mount flow transducers on pipe and connect to flow meter (Section 3).
- Complete transducer install menu operation (paragraph 2.4).

Please do not let the size of the Installation Menu intimidate you. Almost all menu cells already contain default parameters. To begin operation, you only need to access the menu cells that control a required parameter, such as the pipe outer diameter. You will see that by accepting most defaults, you can set up the meter in about five minutes.



TYPICAL SYSTEM - FUP1010 PORTABLE FLOWMETER INSTALLATION
Flow Measurement Sub-System

1.7 THE 1010P KEYPAD

The 1010P integral keypad provides 32 numeric and function keys (see table below). Use these keys to enter, review or edit the site data. Certain keys control the graphics display, Datalogger and Totalizer. "Blind Models," having no keypad or display, must be set up by using their serial data port.

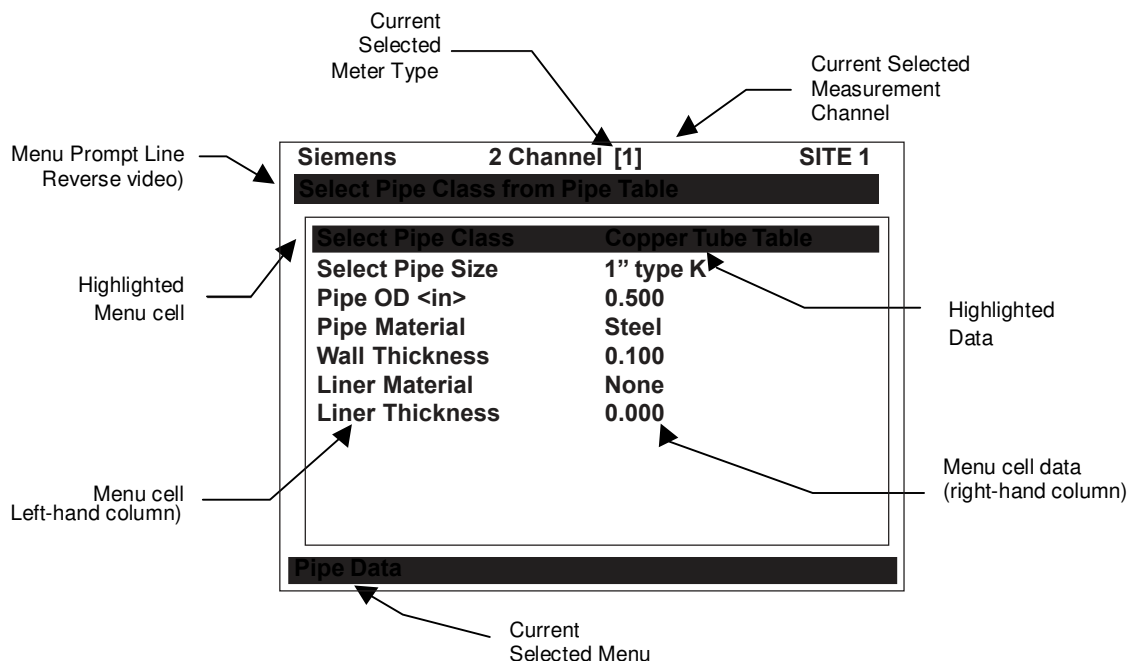
KEYPAD FUNCTION CHART

KEY	USAGE
MENU	Press to activate the Installation Menu.
ENT	Press <ENT> to store numeric data, select from option lists, etc.
LEFT, RIGHT ARROWS	Menu navigation keys move cursor in respective directions.
UP, DOWN ARROWS	Same as <Left> and <Right>. Also scrolls option list and graphic display screen.
CLR	Clear Key for erasing data, or selecting list options.
NUMBERS 0-9	Use to type numeric data.
DECIMAL POINT	Use for decimal points in numeric data.
MATH OPERATORS	Allows 4-function math operations in numeric entry cells.
"F" KEYS 1-3	Totalizer control and special function keys.
"F4" KEY	CAUTION: SYSTEM RESET KEY (during power up)
CTL & ALT	Used as shift keys for alternate key functions.
DATALOG	Triggers immediate Datalogger report.
PLUS/MINUS [+/-]	Changes the sign of numeric data.

NOTE: The keypad does not have alphabetic keys. Scrolling lists provide alpha-numeric characters as needed.

1.8 INTRODUCTION TO THE 1010P MENU SCREENS

The figure below shows a typical 1010P menu screen (e.g., Pipe Data Menu).



TYPICAL INSTALLATION MENU SCREEN

EXPLANATION OF THE CALL-OUTS

Menu Prompt Line	When you select a menu cell, a highlighted text prompt appears on the top of the screen to explain the function of the cell.
Current Selected Meter Type	[2 Channel] indicates Dual Channel meter operating mode selected.
Selected Channel	The [1] indicates that measurement Channel 1 is currently selected.
Highlighted Menu Cell	Highlighting a menu cell switches its left-hand and right-hand columns to being highlighted (white type on black).
Highlighted Data	The right-hand column shows the current value highlighted. Pressing the <Right Arrow> provides access to an option list or numeric field where you can change the current value as required.
Menu Cell	A menu cell is an individual location within a menu (in this case Pipe Data) that stores a parameter (either a numeric entry or an option list selection).
Menu Cell Data	The right-hand column shows the current value stored by left-hand column menu cell. The Pipe Data Menu includes option list items and numeric entries.
Current Selected Menu	The highlighted bar at the bottom of the screen shows the name of the menu that you accessed (e.g., Pipe Data).

1.9 HOW TO USE THE INSTALLATION MENU

This section introduces the System 1010P Installation Menu. It explains how to access and leave the Installation Menu, and how to enter site data. The Installation Menu consists of submenus, each providing individual menu locations (*menu cells*) that store site data. For convenience, this manual refers to sub-menus simply as menus (e.g., the Pipe Data Menu). Shown below is the Clamp-on, Full Site setup screen for Channel 1 of a dual-channel meter. Single channel systems are identical. For FastStart setup, refer to paragraph 1-11.

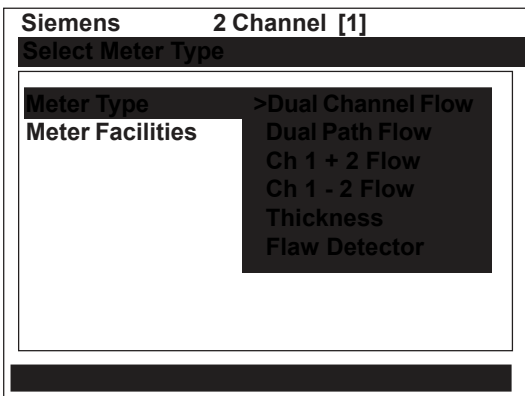
Seimens	2 Channel [1]
Create-Name-Recall-Enable & Delete Site	
Channel Setup	
Pipe Data	
Application Data	
Pick/Install Xdcr	
Operation Adjust	
Flow/Total Units	
Data Span/Set/Cal	
Stripchart Setup	
Datalogger Setup	
I/O Data Control	
Diagnostic Data	
Full Site Setup	

1.9.1 ACCESSING AND LEAVING THE MENU

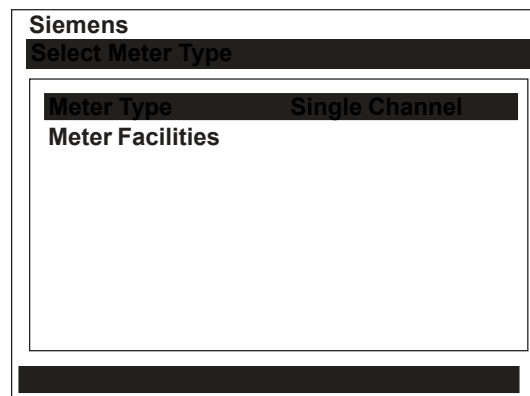
Upon first turning the meter on you see a Siemens graphic. This means that there is no active site setup currently stored in memory. Note that this screen identifies the software version of the meter on the upper right-hand corner of the display.



Press the <MENU> key to invoke the Installation menu. 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 <MENU> key to toggle between a graphic display screen and the last accessed menu location.



Top menu screen for dual-channel system



Top menu screen for single-channel system

When you press the <MENU> key, the cursor arrives at the first level of the installation menu. See screens above. The left screen is from a dual-channel model. The right screen, a single channel model. The first left-hand item, [Meter Type], is highlighted (white type on black). [Meter Type] allows you to choose a meter configuration from the highlighted right-hand column list. *With single channel models, the only option is [Single Channel]*. The next left-hand selection is Meter Facilities. Use the Meter Facilities Menu to set global meter options and controls.

1.9.2 HOW TO ENTER DATA



The left-hand column shows the menu cells. Another way to think about left-hand column items is to consider them as 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 (may become left-hand column items when selected).
- An item from a scrollable option list (e.g., a class of liquids).
- A numeric entry (e.g., a pipe outer diameter).
- An alphanumeric string (e.g., a site name).




Selecting Items from an Option List

This example shows how to use an option list to select a liquid for your application. Do not worry about how to access this menu right now. That will be explained later. Examine the screen below. Note that the menu name [Application Data] appears highlighted on lower left of the screen. Note also that the menu cell [Liquid Class] is highlighted and what is shown in the right-hand column is the current answer: [Water 20C/68F].


Siemens	2 Channel	[1]	Channel 1
Select Liquid Class from Liquid Table			
Liquid Class	Water 20C/68F		
Temperature Range	-40F to 250F		
Pipe Configuration	Fully Developed		
Anomaly Diams	10		
Application Data			

Pressing  changes the left-hand column to [Select Liquid]. Pressing  again accesses the option list. This expands the highlighted area to show the list contents. Note that a cursor (arrow) points to the top item on the list.

Siemens	2 Channel	[1]	Channel 1
Access Liquid Option List			
Select Liquid	>Water 20C/68F		
Estimated Vs m/s	Water 50C/122F		
Viscosity cS	Water 75C/167F		
Density SG	ens	Water 100C/212F	
		Water 125C/257F	
		Water 150C/302F	
		Water 175C/347F	
		Water 200C/392F	
		Water 225C/437F	
		Water 250C/482F	
		Acetic Acid	
Liquid Class			



Pressing   keys scroll the option lists in their respective directions. Every key press moves the cursor to the next item in sequence. Due to the size of the display screen, some option lists include more items than can be shown on the display. For example, on the screen above the last option shown is [Acetic Acid]. However, with this option list, you can continue to press  to see more liquid selections.




When you arrive at the last item on a list, pressing  again brings you back to the top of the list. The option lists are “wrap-arounds.”

To select an option list item, move the cursor to the item and then press . 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 on next page. The option list item: [Water 20C/68F] has been selected. Note that this appears on the right-hand column and that the highlighted area moves to the next menu cell in sequence: [Estimated Vs m/s].

Siemens	2 Channel [1]	Channel 1
Access Liquid Option List		
Select Liquid	20% Ethyl Glycl	
Estimated Vs m/s	1600	
Viscosity cS	2.00	
Density SG	1.030	
Liquid Class		



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   to move the cursor through the list.

However, if you press  to select an item, a plus sign (+) appears next to that item. The cursor remains within the option list so that you can make other selections. To deselect a previously selected item, move the cursor next to that item and then press . You press  to leave a multiple select option list.

Siemens	2 Channel [1]	1
Select Datalogger Data		
Datalogger Mode	+Site Id	
Datalogger Data	+Date	
Log Time Interval	+Time	
Datalogger Events	Flow	
Display Datalogger	+Average Flow	
	Raw Flow	
	Total	
	Vs	
	Valc	
Datalogger Setup		


Entering Numeric Data

When a menu cell requires a numeric answer, press  to access a number entry field; 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 <+/-> key to change the mathematical sign of the number. Press  to store the numeric data.



NOTE: All Numeric Data cells provide a four-function calculator via the keypad’s arithmetic function keys.

Siemens	2 Channel [1]	Channel 1
Enter pipe Outer Diameter manually		
Select Pipe Class	Manual Entry	
Select Pipe Size	N/A	
Pipe OD (in)	= 0.500	
Pipe Material	Steel	
Wall Thickness	0.100	
Liner Material	None	
Liner Thickness	0.000	
Pipe Data		



Entering Alphanumeric Strings


An alphanumeric string is a series of numbers and letters and also includes the Quotation Mark and the Pound Sign symbol. You can also use a space. The meter uses these to identify a specific site setup or user-modified table. The 1010P keypad does not provide letter keys. However, when you access a menu cell that requires an alphanumeric string answer, the menu cell right-hand column provides an eight-character entry field. Press  to access the field.

This selects the first character position. Note that the prompt changes to a question mark (?). With the cursor at the first character position, use the   keys to scroll through the single-character list.

At the first character position, pressing the  key (see below) produces an upper case [A]. Pressing the  key moves the cursor to the second position.

Siemens	Dual Path	Channel 1
Right Arrow & Enter Creates a new Site		
Recall Site Setup		
Channel Enable		No
Create/Name Site		?A
Site Security		Off
Delete Site Setup		No Sites
Save/Rename Site		
Channel/Path Setup		

Use the   keys to move through the character positions. If you wish to use numbers in your string, you can type them directly from the keypad.

After you finish selecting your string, press  to register it.

1.9.3 THE METER TYPE MENU

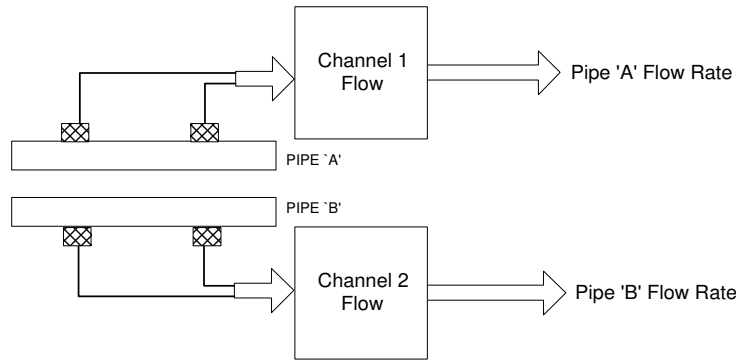
Meter Type is the first listing presented when first entering the Installation Menu.

Select the type of meter required for your application. The meter automatically adjusts the Installation Menu choices to suit the selected meter type. The following paragraphs explain the available meter types for dual channel systems.

NOTE: On Single Channel systems, you do not get a choice of meter types, since this requires two independent measurement channels. However, you can operate the single channel with any optionally supplied measurement technology.

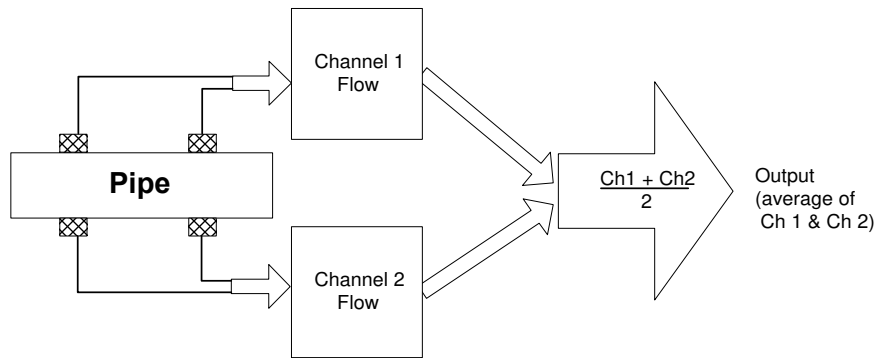
Dual Channel Flow

Dual Channel Flow provides two independent measurement channels that operate simultaneously. Depending on the specific model, Dual Channel Flow supports: Clamp-on Transit-time, In-line Transit-time, and Reflexor.



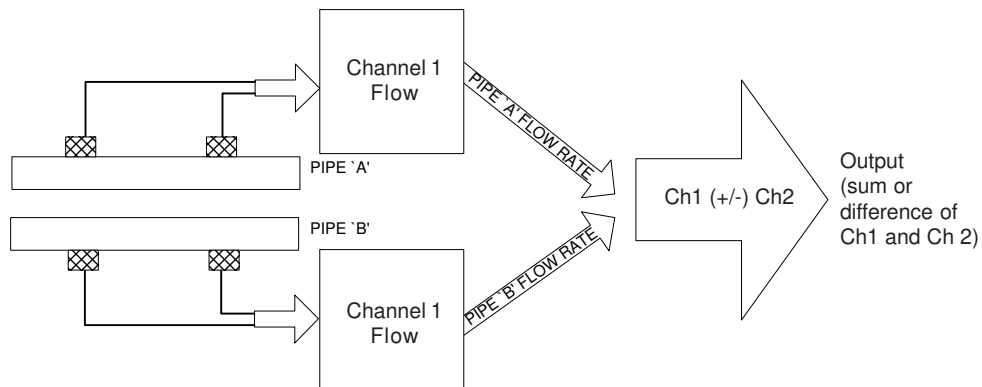
Dual Path Flow

Dual Path Flow uses two measurement channels to achieve a single output via a “virtual” third channel. The resultant data is the average of the two channels. Only clamp-on or in-line transit-time operation is allowed. Benefits include the highest available precision and enhanced immunity to distorted flow profile conditions.



Channel 1+2 and Channel 1-2

Arithmetic operation produces data output via a virtual Channel 3, proportional to sum or difference of the liquid flow of two independent pipes. This requires setting the two channels to operate independently. Only clamp-on or in-line transit-time operation is supported.



Multi-Channel Meter Types

If your 1010 Model provides Multi-Channel Mode it offers you two independent measurement channels. The meter's resources are divided among these channels equally. This means that analog Input/Output, relays, and digital command lines will be fewer than for single channel machines. We will show you later how to "get around" this limitation for cases where you need all the meter's resources for a single measurement channel. Your **datalogger and site storage**, being bulk resources, are not divided up at all, and remain available for each channel's use. You will be able to **Save and Recall sites** to and from the various channels as long as they share an identical measurement technology (Reflexor, clamp-on, flowtube, etc.). Be aware, however, that moving a site from one channel to another like this, will likely require a new Initial Installation to achieve its best potential. This is especially true if the new target installation is not on the same pipe or uses another pair of transducers. Note that datalogger reports will be interleaved in memory and their frequency is controlled by the interval that was selected for each channel. Providing each site with a unique name will enable you to sort these out when analyzing the data later.

Arithmetic Operation

The dual channel instruments provide a modality of operation which permits the user to arithmetically combine (through addition or subtraction) the results of the two independent measurement channels. Installation of each channel is done via the dual channel menu. **Site Saving and Recalling** automatically recall the contributing sites. While the displays for each physical channel provide you with all the data (flow rate, totals, etc.) that are provided via independent channel operation, user Input/Output is largely oriented toward the virtual channel—Channel 3.

Multi-Path Operation

In many cases, the performance of an ultrasonic transit time meter can be improved by allowing it to interrogate the flow field with more than one beam. Imperfect flow profile conditions such as non-axial or cross-flow or an off-center higher-rate flow core, which can cause a single path machine to misreport the flow rate, are often remedied in this way. The **multi-path installation** is similar to arithmetic operation, except for the fact that the virtual, or output, channel has pipe dimension attributes which in the arithmetic meter channel it does not. This means that when you install a multi-path meter, pipe data **MUST** be installed in Path 3. Your 1010 facilitates this by copying pipe data that you install in Path 3 to the other paths. It is seldom, if ever, necessary to "trim" the pipe data for the individual path channels—although you may install different size or type transducers for each path. Once you define the pipe, move the menu to the individual paths using **Select Path** for the physical installation of each channel. This is accomplished in the same way that individual channels are installed.

Save and Restore Operations for multi-path sites execute on all the component channels simultaneously—the individual paths of multi-path sites do not have any existence or autonomy as single channel sites. You will also find that individual path channels possess a **reduced set of user-accessible menu functions**. For example, although you may zero each individual path, the meter provides Kc control (slope correction) for the virtual channel (system channel) only. You will find that the features and functions provided for each physical channel sensibly focus on the physical measurement task. User output data, however, is largely reserved for the virtual or system channel. This includes the totalizer functions, analog outputs, and datalogger. In some instances, access is provided to the path channels data as well to facilitate the gathering of diagnostic data. While minimizing menu clutter, we have tried to preserve as much functionality as practical. Totalizer control via lead-in function key is provided by <F3> for the dual path meter.



The Diagnostic Menu area has been similarly conditioned to provide the data generated by the physical measurement channels when those are selected but suppress elements that are only provided by the virtual channel. Once you install a multi-path application, explore the diagnostic menus and, using the Path Select menu item, note those data items which are enabled for each path.



As mentioned above, you should use a partially installed multi-path site in order to direct all meter Input/Output to a single measurement path. Simply install the single available physical path and you will find that the meter will produce data based on only this physical input. In this way, you obtain the same functionality which is provided to the single channel 1010 user.

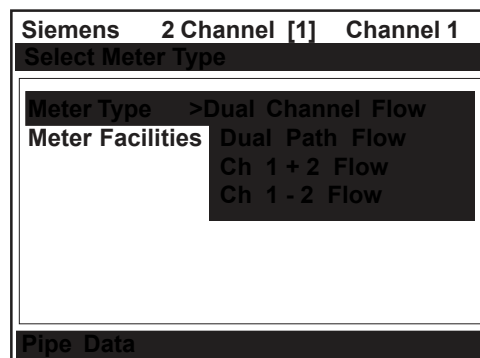
Selecting a Meter Type


The following example explains how to select a dual-channel clamp-on meter and initiate site programming for the measurement channel. Your [Meter Type] selection, as well as other menu selections, are “remembered” through power cycles.

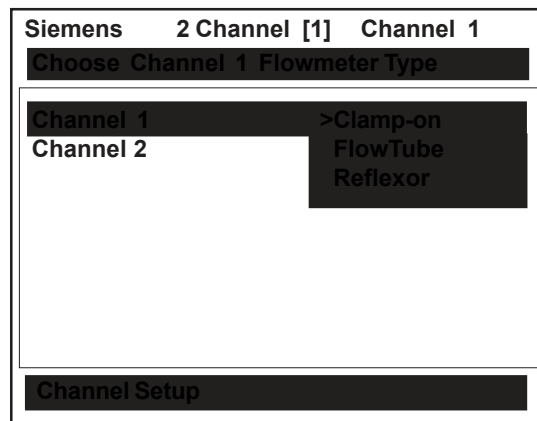
NOTE: If you have a single-channel system, all you have to do is select a measurement technology and then go directly to Channel Setup. The site setup procedure for a single-channel system is identical to setting up a measurement channel on a dual-channel system.


As shown in the steps below, selecting this mode only requires pressing the  key as needed. This is because dual-channel clamp-on is the default configuration for this instrument. To select a different configuration, move the cursor to the desired Meter Type and then press  to select it.

Turn on power and press  to access the [Meter Type] screen. Refer to the figure below. Note that on the left-hand column, [Meter Type] is highlighted as are all the available meter types on the right-hand column. Press . This places a cursor next to [Dual-Channel Flow].




Press  twice. This selects the [Dual-Channel Flow] menu cell first and then places the cursor next to [Clamp-On] menu cell for Channel 1.

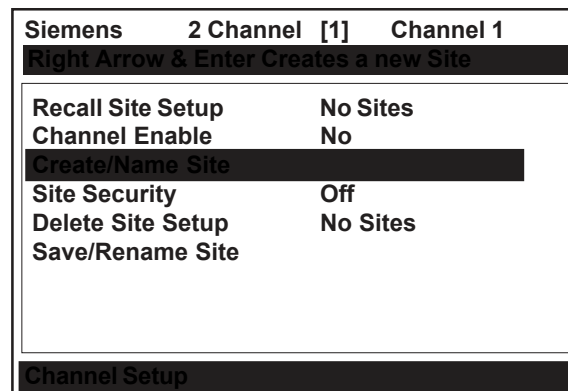



To select [Clamp-on] press . This selects the Clamp-on installation menu for Measurement Channel 1. Note that the first menu, [Channel Setup], is highlighted.

Creating a New Site Setup (See also paragraph 2.1.3)

The Channel Setup section of this manual provides detailed instructions on how to use all the Channel Setup menu commands. This section provides an example of how to use the [Create/Rename Site] command to create a new site setup. *Always begin a new installation by issuing the [Create/Name Site] command.* Although you do not need to enter a site name to create a new site setup, you have to provide one to save the site setup or to identify the source of logged data. In this example, we will use [SITE1] for the site name.


To access the [Channel Setup] menu press  then move the highlight down to [Create/Name Site] with the  key.



Press . Note that the cursor changes to a block, which appears after a question mark (?). This indicates that you have accessed the first character position of an eight-character (maximum) alphanumeric entry field.

Siemens	2 Channel [1]	Channel 1
Right Arrow & Enter Creates a new Site		
Recall Site Setup	No Sites	
Channel Enable	No	
Create/Name Site	?■	
Site Security	Off	
Delete Site Setup	No Sites	
Save/Rename Site		
Channel Setup		



This block cursor is currently placed at the first character position.

Press and hold .

Note that the character position begins to scroll upward through the alphabet of capital letters. Continue to scroll until the block cursor shows [S]. Press .


Note the character [S] remains at the first character position and that the block cursor moves to the second character position.

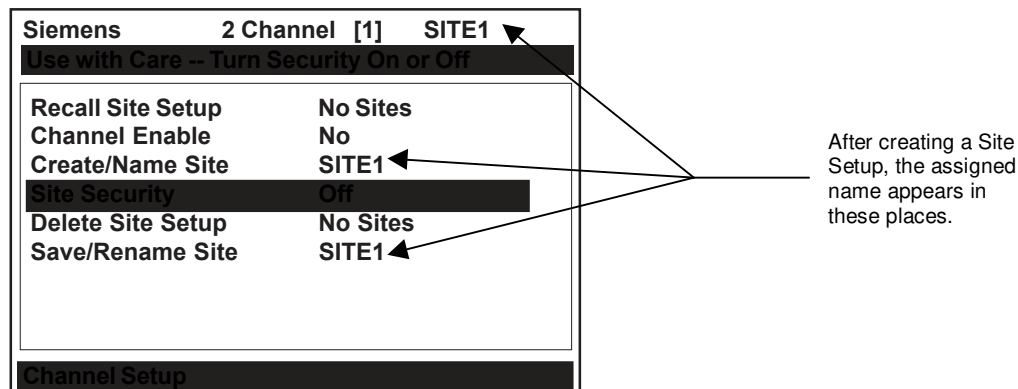
Siemens	2 Channel [1]	Channel 1
Right Arrow & Enter Creates a new Site		
Recall Site Setup	No Sites	
Channel Enable	No	
Create/Name Site	?S■	
Site Security	Off	
Delete Site Setup	No Sites	
Save/Rename Site		
Channel Setup		

Press and hold . Note that the capitalized alphabet list begins to scroll downward through the alphabet from [S]. Stop scrolling at letter [I]. Press  to move the block cursor to the third character position. Scroll back up to letter [T].

Move the cursor to the fourth character position. Scroll down to letter [E]. Move the cursor to the fifth character position. Type [1] on the numeric keypad to complete the site name.

Siemens	2 Channel [1]	Channel 1
Right Arrow & Enter Creates a new Site		
Recall Site Setup	No Sites	
Channel Enable	No	
Create/Name Site	?SITE1■	
Site Security	Off	
Delete Site Setup	No Sites	
Save/Rename Site		
Channel Setup		

Press  to create the site setup named [SITE1]. Note that the name now appears in the [Save/Rename Site] menu cell and on the upper right corner of the graphic screen.



1.10 BATTERY OPERATION

This section describes the battery sub-systems for the 1010P portable family. All 1010P portable systems include battery chargers that operate from an AC voltage source. We strongly recommend that you “form” and charge the battery before operating the system for the first time (see 1.10.2).

1.10.1 THE CHARGE INDICATOR LED

System 1010P includes a battery status indicator to show the status of its internal battery and charging circuits. The indicator LED color switches between red or green based upon the current operation:

LED	Battery Condition
Green	Trickle charge in progress
Red	Rapid charge in progress

NOTES:

1. A [LOBAT] flag appears on the 1010P graphic screen when the battery’s remaining operating time is less than 20 minutes (approximately).
2. If the system detects that the voltage output of both the internal battery and external power input is less than 10 volts, it turns off power automatically to avoid the possibility of power supply damage and/or loss of operating data.
3. Turning the system power on with the charger connected terminates the rapid charge cycle. This limits the flow computer power consumption to avoid excess heat generation.
4. A rapid charge cycle can only occur if:
 - The charger is connected
 - The system is OFF.
 - Charge controller determines that the pre-programmed battery voltage, battery temperature, and the time of charge conditions are satisfactory for fast charging.

Depleted Battery Symptoms and Recommendations

STATUS	INDICATION	ACTION
Battery Warning Beeper	Normal operation, periodic audible alarm	Connect a Battery Charger for continued operation
Battery Discharge	Unit will not turn on (no display screen)	Connect to Battery Charger for at least 1.5 hours before attempting to operate.

1.10.2 FORMING THE BATTERY (Optimizing Operating Time)

System 1010P uses a special Ni-Cad internal battery pack designed for a rapid charge cycle. Ni-Cad batteries have to be “formed” to deliver their optimum operating time. This is accomplished by performing a minimum of two complete discharge/charge cycles.

To Produce Charge/Discharge Cycle:

1. Turn System to ON without connecting an external power source. Leave it ON until an automatic shutdown occurs.
2. Connect the charger and charge the internal battery until the charge indicator LED changes from red to green.
3. Repeat the charge/discharge cycle again. The battery should now be “formed” to provide its maximum operating time.

To maintain the battery “forming,” we recommend that whenever possible, discharge the battery completely before recharging. If the operating time during battery use appears to be unusually short, then a discharge/charge cycle should lengthen the operating time. If this does not correct a short operating time, then the internal battery should be replaced.

1.10.3 HOW TO USE THE BATTERY CHARGER

The 1015BC-1 Battery Charger is designed specifically for use with our Series 1010WP Waterproof Flowmeters.

1015BC-1 Battery Charger

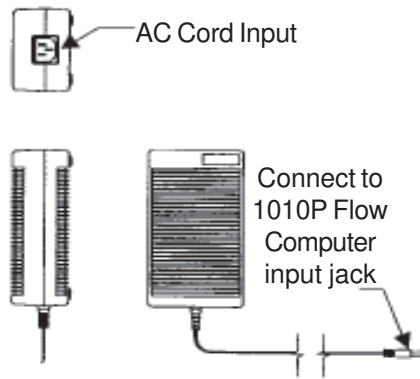
1. Do not use any other external Battery Charge/Pack combination with the 1010P Flowmeter unless reviewed and pre-approved by Siemens.
2. Do not leave the Battery Charger connected to the Battery Pack during transportation or storage. The battery/charger connector may be damaged or the battery may be discharged.

3. Do not modify or disassemble the Battery Charger or Battery Pack, unless under direct permission and supervision of qualified Siemens personnel.
4. The 1015BC-1 Battery Charger operates from a 100, 110, and 220 VAC (50/60 Hz) power source. It features a universal power input. Therefore, no user switching is required.
5. The AC power input of the 1015BC-1 uses a standard IEC 320 connection. Siemens can provide the appropriate power cord for proper connection to the AC outlets from most countries in the world.
6. Recharge the battery for at least 8 hours before using it for the first time.

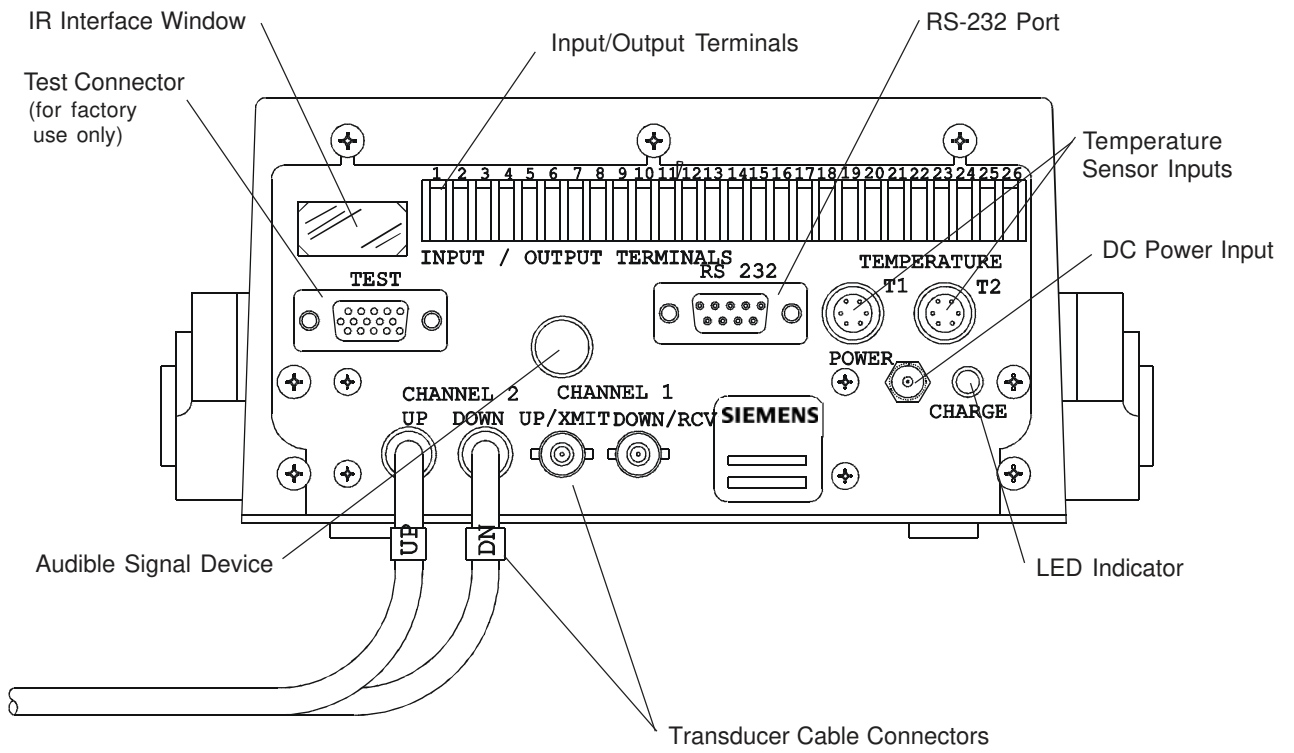
CAUTIONS

The 1015BC-1 Battery Charger is NOT waterproof. Do not allow it to become wet, or attempt to use it when wet. Exposure to a wet or submerged environment will result in damage to the unit that cannot be repaired and could expose the user to the risk of electric shock.

The flowmeter is not intended for use while the Battery Charger is connected and the ambient temperature is above 35°C (95°F).

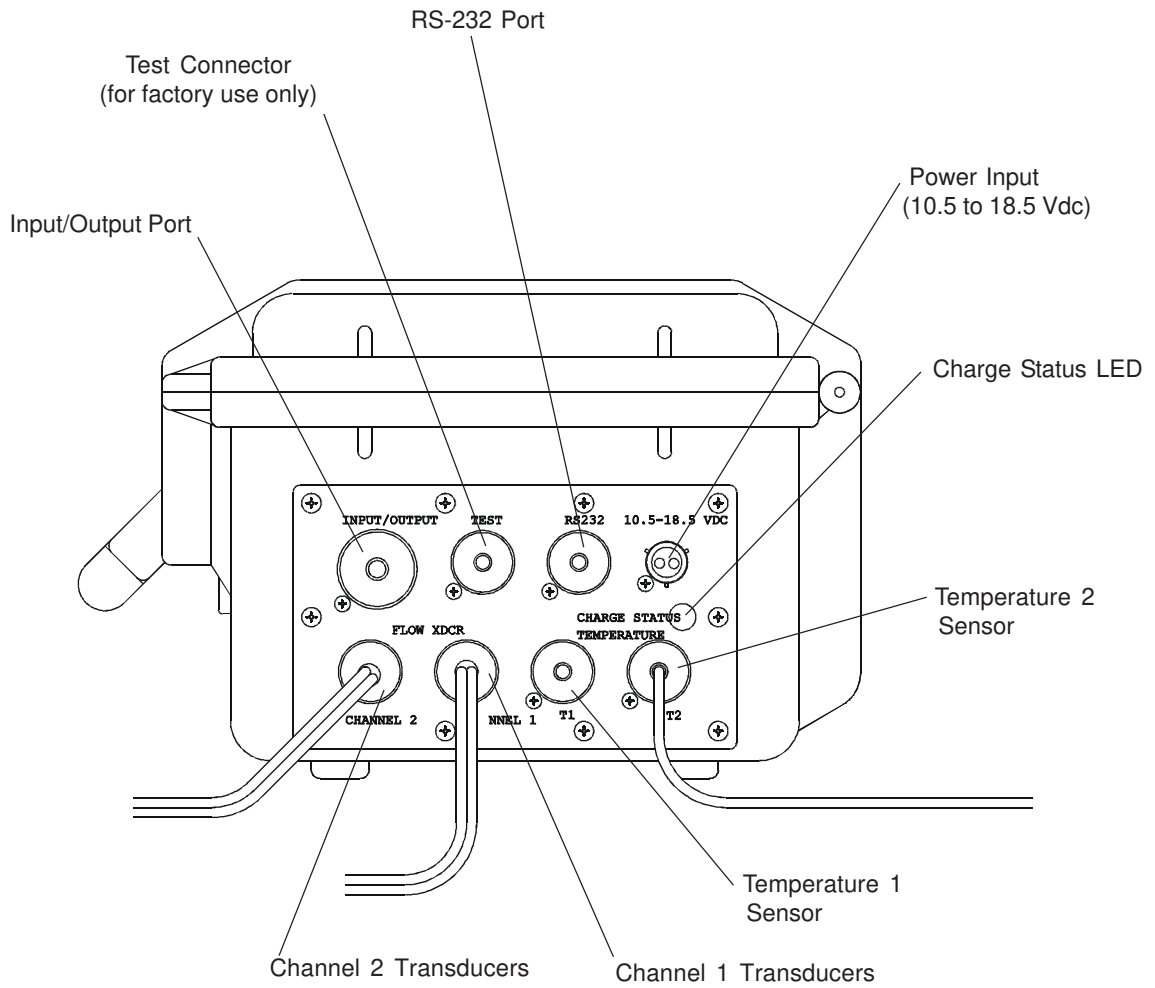


1015BC Power Adapter/Charger



1010DP Dual Channel Portable Flowmeter, Rear View

1010DP INPUT/OUTPUT TERMINALS		
PIN	SIGNAL	DESCRIPTION
1	GND	Signal Return Terminal [24 GA. (MIn) Max. Length: 1000 ft.]
2	N/C	N/C
3	R1B	External Control Signal (HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc)
4	N/C	N/C
5	R2B	External Control Signal (HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc)
6	N/C	N/C
7	R3B	External Control Signal (HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc)
8	N/C	N/C
9	R4B	External Control Signal (HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc)
10	PGEN1	Pulse Frequency Output (0 to 5 khz). 5V TTL CMOS Logic
11	PGEN2	Pulse Frequency Output (0 to 5 khz). 5V TTL CMOS Logic
12	Vo1	Voltage output (0 to 10 Vdc) [min. Load=5k ohms]
13	Vo2	Voltage output (0 to 10 Vdc) [min. Load=5k ohms]
14	Io1	4 to 20 mA output [0 to 1k ohms @ 30 Vdc; 0 to 450 ohms @ 18 Vdc]
15	Io2	4 to 20 mA output [0 to 1k ohms @ 30 Vdc; 0 to 450 ohms @ 18 Vdc]
16	Io PWR	Loop power input for mA outputs [User Supplied 18 to 30 Vdc @ 25 mA min.]
17	GND	Signal Return Terminal [24 GA. (MIn) Max. Length: 1000 ft.]
18	CNTRL1	NOTOT CH. 1 [Load=100k ohms, [HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc]
19	CNTRL2	NOTOT CH. 2 [Load=100k ohms, [HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc]
20	CNTRL3	CLRTOT CH. 1 [Load=100k ohms, [HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc]
21	CNTRL4	CLRTOT CH. 2 [Load=100k ohms, [HIGH=5 to 3 Vdc; LOW=1 to 0 Vdc]
22	lin1	External sensor input (4-20mA) [Load = 250 ohms]
23	lin2	External sensor input (4-20mA) [Load = 250 ohms]
24	Vin1	External sensor input (0 to 10 Vdc) [Load = 100k ohms]
25	Vin2	External sensor input (0 to 10 Vdc) [Load = 100k ohms]
26	GND	Return For SignalsSignal Return Terminal [24 GA. (MIn) Max. Length: 1000 ft.]



Note: You may obtain cables for the Input/Output Port and RS-232 Port under the following part numbers:

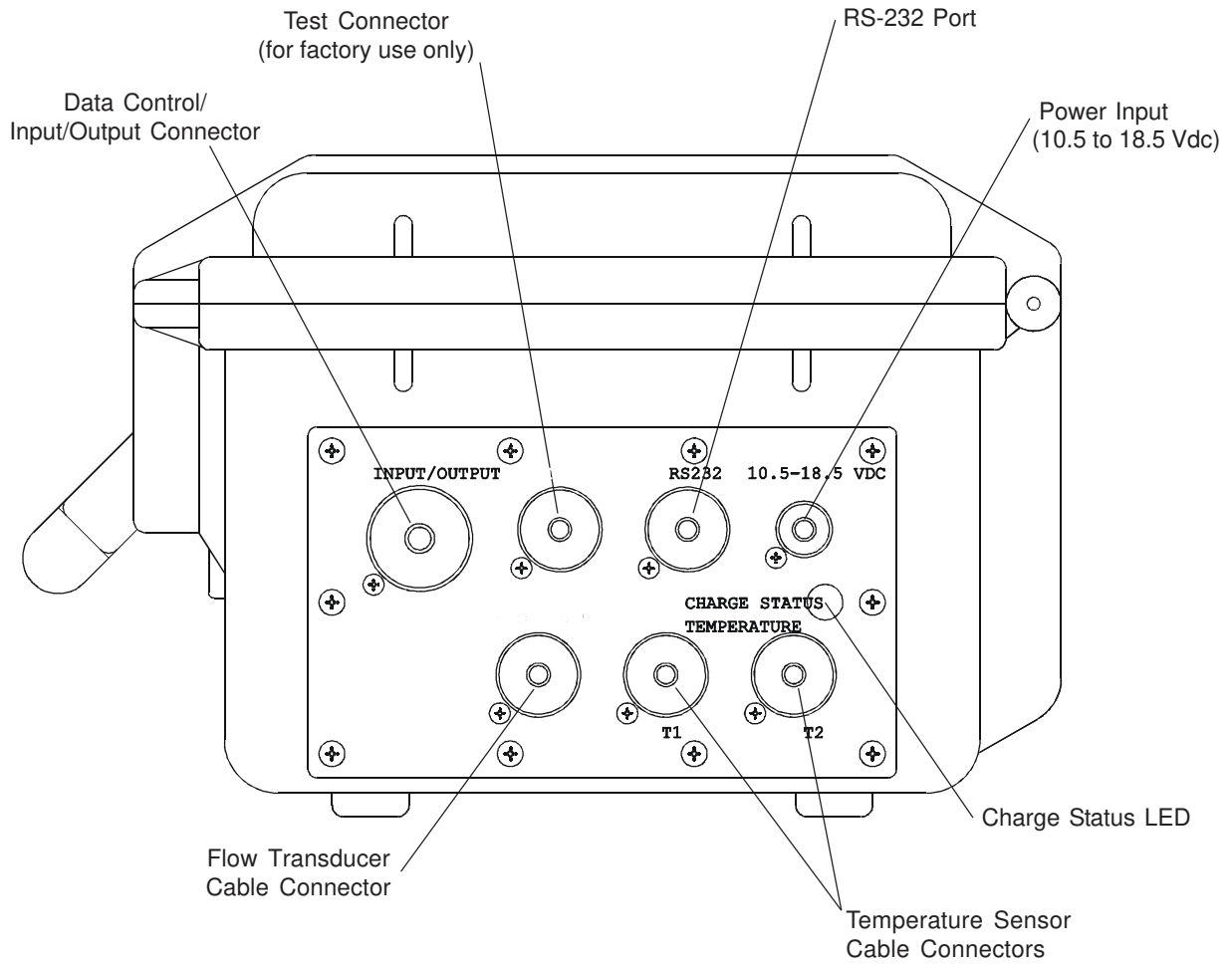
1015WP26 - Input/Output Port to Breakout Box

1015CPC-WP - RS-232 Port to 9-pin and 25-pin DB Connectors

1010WDP Portable Flowmeter, Rear View

1010WDP INPUT/OUTPUT TERMINALS			
TERMINAL	SIGNAL	FUNCTION	DESCRIPTION
A	GND.	SIGNAL GROUND	Return For signals
B	N/C	N/C	
C	R1B	LOGIC OUT 1	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
D	N/C	N/C	
E	R2B	LOGIC OUT 2	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
F	N/C	N/C	
G	R3B	LOGIC OUT 3	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
H	N/C	N/C	
J	R4B	LOGIC OUT 4	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
K	PGEN1	FREQUENCY OUTPUT 1	Assignable Logic Level Pulse Train [5V TTL CMOS Logic]
L	PGEN2	FREQUENCY OUTPUT 2	Assignable Logic Level Pulse Train [5V TTL CMOS Logic]
M	Vo1	VOLTAGE OUTPUT 1	Assignable 0 TO +10 Vdc
N	Vo2	VOLTAGE OUTPUT 2	Assignable 0 TO +10 Vdc
P	Io1	CURRENT OUTPUT 1	Assignable 4 TO 20 mA
R	Io2	CURRENT OUTPUT 2	Assignable 4 TO 20 mA
S	Io POWER	EXTERNAL CURRENT LOOP POWER	User Supplied 18 TO 30 Vdc
T	GND.	SIGNAL GROUND	Return For Signals
U	CNTRL1	LOGIC IN 1	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
V	CNTRL2	LOGIC IN 2	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
W	CNTRL3	LOGIC IN 3	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
X	CNTRL4	LOGIC IN 4	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
Y	Iin1	CURRENT INPUT 1	4 TO 20 mA - Flowmeter Load
Z	Iin2	CURRENT INPUT 2	4 TO 20 mA - Flowmeter Load
a	Vin1	VOLTAGE INPUT 1	0 to +10 Vdc
b	Vin2	VOLTAGE INPUT 2	0 to +10 Vdc
c	GND.	SIGNAL GROUND	Return For Signals

NOTE: Refer to Installation Drawing 1010WDP-7 (Sheet 2) for additional details.



1010WP Single Channel Weatherproof Portable Flowmeter

1010WP INPUT/OUTPUT TERMINALS			
TERMINAL	SIGNAL	FUNCTION	DESCRIPTION
A	GND.	SIGNAL GROUND	Return For signals
B	N/C	N/C	
C	R1B	LOGIC OUT 1	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
D	N/C	N/C	
E	R2B	LOGIC OUT 2	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
F	N/C	N/C	
G	R3B	LOGIC OUT 3	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
H	N/C	N/C	
J	R4B	LOGIC OUT 4	Logic Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
K	PGEN1	FREQUENCY OUTPUT 1	Assignable Logic Level Pulse Train [5V TTL CMOS Logic]
L	PGEN2	FREQUENCY OUTPUT 2	Assignable Logic Level Pulse Train [5V TTL CMOS Logic]
M	Vo1	VOLTAGE OUTPUT 1	Assignable 0 TO +10 Vdc
N	Vo2	VOLTAGE OUTPUT 2	Assignable 0 TO +10 Vdc
P	Io1	CURRENT OUTPUT 1	Assignable 4 TO 20 mA
R	Io2	CURRENT OUTPUT 2	Assignable 4 TO 20 mA
S	Io POWER	EXTERNAL CURRENT LOOP POWER	User Supplied 18 TO 30 Vdc
T	GND.	SIGNAL GROUND	Return For Signals
U	CNTRL1	LOGIC IN 1	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
V	CNTRL2	LOGIC IN 2	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
W	CNTRL3	LOGIC IN 3	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
X	CNTRL4	LOGIC IN 4	TTL Level State [HIGH=5 TO 3 V; LOW=1 To 0 V]
Y	Iin1	CURRENT INPUT 1	4 TO 20 mA - Flowmeter Load
Z	Iin2	CURRENT INPUT 2	4 TO 20 mA - Flowmeter Load
a	Vin1	VOLTAGE INPUT 1	0 to +10 Vdc
b	Vin1	VOLTAGE INPUT 2	0 to +10 Vdc
c	GND.	SIGNAL GROUND	Return For Signals

NOTE: Refer to Installation Drawing 1010WP-7 (Sheet 2) for additional details.

1.11 USING FASTSTART SETUP


The dual-channel clamp-on mode offers a choice of using FastStart Setup or Full Site Setup to create your site setup. As its name implies, FastStart Setup is a quick way to start up the meter. FastStart inserts default settings into all applicable menu cells. However, these can be edited later via the Full Site Setup menu. In order to use FastStart Setup:


- Your pipe must be included on the meter's pre-set pipe table.
- Your liquid is water, or has similar sonic characteristics.

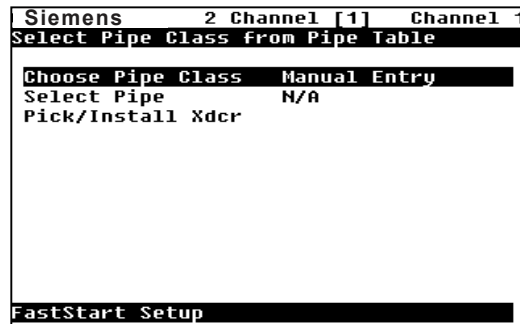
FastStart setup is actually a shortcut to these two menu locations (where data entry is mandatory for a successful start-up):


- Pipe Data: The Pipe Data Menu is limited to the selection of pipe pre-sets only. There are no provisions for manual pipe editing.
- Pick Install Xdcr: This is the same menu as Full Menu Setup (see paragraph 1.9).

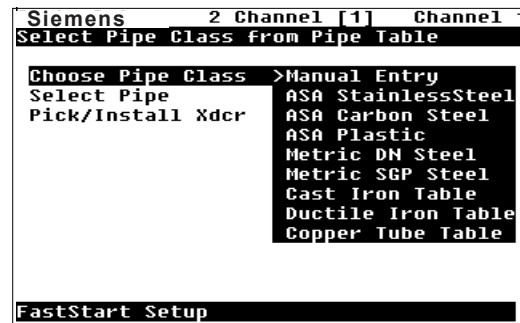
1.11.1 CHOOSING THE PIPE CLASS/SIZE


Press the  to access [FastStart Setup]. This selects [Choose Pipe Class]. There are over sixty English and metric pipe sizes for eight different classes of pipes. Picking a pipe class and size automatically sets all the required pipe parameters using industry standard dimensional data.

Press  to access the Pipe Class option list. Note that although [Manual Entry] exists on this list, it is inactive for FastStart Setup (see paragraph 2.2.1).



In this example, we will pick the pipe class: [ASA Carbon Steel] by moving the cursor to the selection and then pressing .



Next, we will pick the pipe size: [1CS80] by moving the cursor to the selection and then pressing . This is all there is to setting up the pipe parameters.

Now, we will select and install the transducers.


```

Siemens      2 Channel [1] Channel 1
Opens Transducer Select/Install Menu

Choose Pipe Class   ASA Carbon Steel
Select Pipe         1CS80
Pick/Install Xdcr

FastStart Setup
  
```

1.11.2 PICKING AND INSTALLING THE TRANSDUCERS

Press  to access the Pick/Install Xdcr menu, then select the appropriate Transducer Model. The meter then analyzes your pipe data and registered transducer list before calculating the recommended transducer size(s). The top-line prompt shows a series of transducer recommendations, that are listed in order of priority from left to right. Select the appropriate transducer size with consideration given to the computed transducer recommendations. In the example below we will install the “B3” transducer size.

After you make your transducer selection, the meter automatically computes the preferred mounting mode and transducer spacing index.

```

Siemens      2 Channel [1] Channel 1
Recommended Xdcrs: B3,B2

Transducer Model   1011 Universal
Transducer Size    Select Xdcr
Xdcr Mount Mode    Invalid
Letter Index       Invalid
Number Index       Invalid
Spacing Method     Invalid
Ltn Value          Invalid
Install Completed? No
Empty Pipe Set     Chan Not Setup
Zero Flow Adjust   Chan Not Setup

Pick/Install Xdcr
  
```

NOTE: The meter only indicates the part number of the 1011 Universal Transducer mounting track or spacer bar. It does not indicate this information for other transducer types.

Note the Number Index value.

This value corresponds to the index marked on the spacer bar or mounting track. The value of Ltn represents the actual distance in inches or mm, between the front surfaces of the upstream and downstream transducers.

```

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

Transducer Model    1011 Universal
Transducer Size     B3
Xdcr Mount Mode     Reflect
Spacing Offset      Minimum
Number Index        7
Spacing Method       Track 1012TP
Ltn Value (in)     0.778
Install Completed?  No
Empty Pipe Set      Chan Not Setup
Zero Flow Adjust    Chan Not Setup

Pick/Install Xdcr

```

NOTE: You are allowed to override the transducer type and size mounting mode and spacing offset. See paragraph 1.9.

Now you have to mount the transducers in accordance with the data recommended on the screen. Refer to the Section 3 for detailed instructions. The pipe must be completely filled with a liquid for the initial installation of the meter. Make sure that you do not install your transducers backwards or reverse the Upstream and Downstream cables.



```

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

Transducer Model    1011 Universal
Transducer Size     B3
Xdcr Mount Mode     Reflect
Spacing Offset      Minimum
Number Index        7
Spacing Method       Track 1012TP
Ltn Value (in)     0.778
Install Completed?  No
Empty Pipe Set      >Install
Zero Flow Adjust    Chan Not Setup

Pick/Install Xdcr

```

Use the [Install Completed?] menu cell to inform the meter that you have finished mounting the hardware. Press . Move the cursor to [Install]. Press .

The meter performs an Initial Makeup which conditions its operation to the selected transducer, pipe and liquid and then sets the empty pipe and the zero flow levels automatically. Be patient! The Initial Makeup performs a number of operations including a frequency sweep of the pipe wall resonance, which could take several minutes.


```

Siemens      2 Channel [1]  Channel 1
Drive 11 m 14 [6:-----:0]


Transducer Model    1011 Universal
Transducer Size     B3
Xdcr Moun           [REDACTED]
Spacing 0 Measured Us m/s
Number In          1506
Spacing M           [REDACTED] 2TP
Ltn Value (in)     0.778
Install Completed?  Install
Empty Pipe Set      Chan Not Setup
Zero Flow Adjust    Chan Not Setup


Pick/Install Xdcr

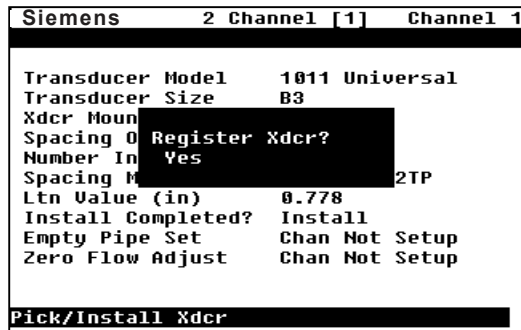
```

Upon completion, the meter reports the measured liquid sonic velocity. Press the  key. The meter will then automatically perform an AutoZero operation, where the meter measures any zero flow offset, which is used to correct the flow reading. This operation occurs only when the transducers are mounted in the reflect configuration and is independent of whether or not the liquid is flowing.


After the AutoZero operation is complete, the meter may ask you to register the transducer used in this installation. It is advisable that you register your transducers, since the registration list is used to condition the transducer recommendation.

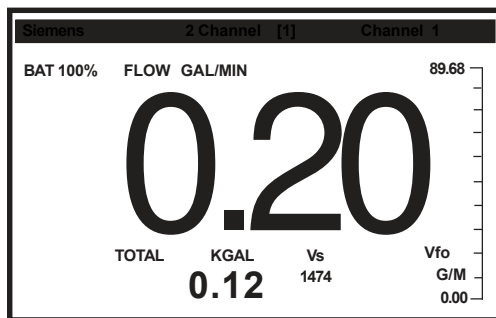
Press  and select [YES], or [NO] if you do not want to register this transducer.



Press  to register transducer.



The meter is now ready to report flow. Press the  key. The meter will then ask you to save the Site. Saving the Site is optional and will therefore be covered in paragraph 1.9.

To abort this item, press . This brings up a Flow Display Screen.



Once your site has successfully installed, you can press   to scroll between the available display screens.

Now that you are familiar with the 1010P setup, take the time to read the information about the Installation Menu in Section 2. Becoming acquainted with the various flowmeter setups in the Main Menu will help further your understanding of the 1010P.

2. THE 1010P INSTALLATION MENU

Programming System 1010P 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 Portable meters. Please refer to the Reflexor and Flow Tube sections for instructions specific to those operating modes.

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

Review of 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., [Pipe Data], [Channel Enable], etc.
- Each menu includes an image of its main screen and a diagram of its structure. The rightmost column of the structure diagram lists the option list choices of the menu cell, if applicable.

Review of 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.

2.1 THE CHANNEL SETUP MENU

The Channel 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 channel. Be aware that site* name option lists only show sites that are consistent with the currently selected meter type.

CHANNEL SETUP MENU STRUCTURE

Channel Setup ⇕	⇒	Recall Site Setup	*Site Name 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 Channel, operating with Channel 1 active.

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

Siemens 2 Channel [1] XYZ

Scroll saved Site Setup list and Enter

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

Channel Setup

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

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

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

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

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

2.1.1 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)

To access the list of saved site names press 

To move the cursor to the Site Name press 

Press  to trigger 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.

If you can not recreate the original transducer installation, then press  to change the pop-up list from [Original] to [New]. Press .


This disables the measurement channel until you repeat the Pick/Install Transducer routine.



2.1.2 HOW TO ENABLE AND DISABLE A MEASUREMENT CHANNEL

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

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


To disable a channel that is operating:



To access the [Channel Enable] option list press 


Move the cursor to [No] by pressing  

To disable the measurement channel press 

To enable a channel:



To access the [Channel Enable] option list press 

Move the cursor to [Yes] press  

To enable the measurement channel press 


2.1.3 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  to access the menu cell entry field and then pressing .

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:

To access the first character position press .

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

To select the second character press  .

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

To create the new Site Setup press .

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


2.1.4 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 ON/OFF option list until you enter the correct password. Therefore, it is essential that you never forget or misplace the password. The only way to deactivate Site Security without knowing the password is to return the unit to Siemens. However, the process the factory uses to remove site security will eliminate any existing site data as well.


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


To activate Site Security:

To access Site Security option list press .


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

To select the first character, use the numeric keys or press  .


To move the cursor to the first character position press .

To move the cursor to the second character position press .

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

To store code press . [Confirm Code ?] appears at the top of the display screen.

Re-type the code exactly as described above.

Pressing  moves the cursor to the Site Security option list.

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

To activate Site Security press .

2.1.5 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 Facility/Memory Control Menu).

To delete a stored Site Setup:


To highlight [Delete Site] press .

To access the [Delete Site] option list press .

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


To delete the obsolete site setup press .

2.1.6 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  to save the Site Setup.


You can change the listed site name by following the procedure below. You may select up to eight characters. If you decide to use numbers or a decimal point in the site name, you can type these characters directly from the keypad.

To Save or Rename a Site Setup:

To access the first character position press 

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

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

To save the site data present in Active Memory press 

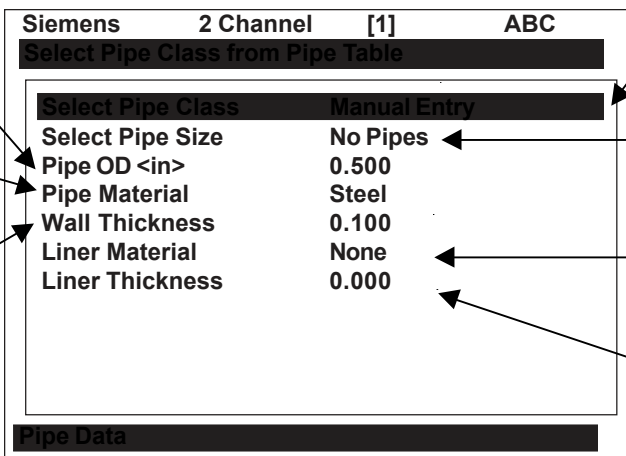
If Siemens *Flowtalk* software is used to save or restore sites, you can avoid ceating illegal file names by not using spaces or decimal points (.) in your site names.

2.2 THE PIPE DATA MENU

This menu becomes available after picking a Meter Type, Measurement Channel and Measurement Technology. We recommend that you edit the Pipe Data immediately after creating a new Site Setup. The Pipe Data menu allows you to define the application’s pipe parameters. Select a pipe from one of the meter’s stored pipe tables (see menu structure below); or input the pipe size and description manually. Manual entries include Pipe Material, Outer Diameter (OD) and pipe Wall Thickness. Liner Material and Liner Thickness entries are included to support pipes with liners. The meter requires the pipe outer diameter (OD) and wall thickness to operate. You must define these parameters to complete the installation.

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

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



The screenshot shows the 'Siemens 2 Channel [1] ABC' menu with the following options:

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

Annotations on the left side:

- Use this menu cell to edit the pipe outer diameter. (points to Pipe OD <in>)
- Use this menu cell to edit the pipe material. (points to Pipe Material)
- Use this menu cell to edit the wall thickness. (points to Wall Thickness)

Annotations on the right side:

- 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. (points to Select Pipe Class Manual Entry)
- After picking a pipe class, use this menu cell to select a pipe from within that class. (points to Select Pipe Size)
- Use this menu cell to select a pipe liner material. (points to Liner Material)
- Use this menu cell to edit the pipe liner thickness. (points to Liner Thickness)

THE PIPE DATA MENU STRUCTURE

Pipe Data ⇒	Select Pipe Class ⇒	⇅ Manual Entry ASA Stainless Steel* ASA Carbon Steel ASA Plastic Metric DN Steel Metric SGP Steel Cast Iron Table Ductile Iron Table Copper Tube Table		
	Select Pipe Size ⇒	Manual Entry ASA Stainless Steel* ⇅ 1SS10 ⇅ 2SS10 ⇅ 3SS10 ⇅ 4SS10 ⇅ 6SS10 ⇅ 8SS10 Metric DN Steel ⇅ 50 DN 100 DN 200 DN 400 DN 800 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 M 1" type K 1" type L 2" type M 2" type K 2" type L 4" type M 4" type K 4" type L 6" type M 6" type K 6" type L	Set pipe parameters manually ASA Carbon Steel ⇅ 1CS40 1CS80 2CS40 2CS80 3CS40 3CS80 4CS40 Steel 4CS80 6CS40 6CS80 8CS40 8CS80 10CS XSteel 10CS40 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 Cast Iron Table ⇅ 6" cls C 10" cls C 12" cls C 16" cls C 20" cls C	
	Pipe OD (in)	xx.xx (numeric entry).	Auto if specific pipe is selected)	

(continued)

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


THE PIPE DATA MENU STRUCTURE *(continued)*



⇄	⇄	⇄ ⇄ 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
	⇄	
	⇄	⇄ ⇄ x.xxx <i>(numeric entry)</i>
	⇄	⇄ ⇄ None Cement Coal Tar Enamel Glass Plastic HDPE Teflon Rubber
	⇄	⇄ ⇄ x.xxx <i>(numeric entry)</i>


2.2.1 HOW TO SELECT A PIPE CLASS

The 1010P 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.

2.2.2 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 

2.2.3 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 

2.2.4 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  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 

2.2.5 HOW TO ENTER THE WALL THICKNESS


The wall thickness of the pipe is one of the required parameters. The flow computer needs this data to generate accurate transducer size and spacing data recommendations. Selecting a pipe class/size inserts a wall thickness value. If this data is inaccurate, then use this menu cell to set the pipe's wall thickness (in English or Metric data units).

NOTE: Do not use ASA schedule code to specify the wall thickness. You must enter actual dimensions. We recommend that you use the 1010P Thickness Gauge to obtain an accurate dimension.

To enter the Pipe Wall Thickness:

To enable numeric entry press 

Use the keypad's numeric keys to type exact wall thickness in inches or millimeters.

To register the pipe wall thickness press 

2.2.6 LINER MATERIAL



For lined pipes, select a pipe liner from the material option list. If the pipe liner material does not appear on the list then select the closest type available. If necessary, call Siemens Customer Service for additional help. The system default Liner Material is [None].

If the pipe does not have a liner, press  twice to bypass to the next two menu cells.

The Liner Material option list offers a selection of common liner materials.

To select a Liner Material:

To access the [Liner Material] option list press 


To scroll to the required liner material press  

To register selection press 


2.2.7 LINER THICKNESS

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

To enter a Liner Thickness:

To enable numeric entry press 

Use the number keys to type the exact liner thickness value.

To register the data press 

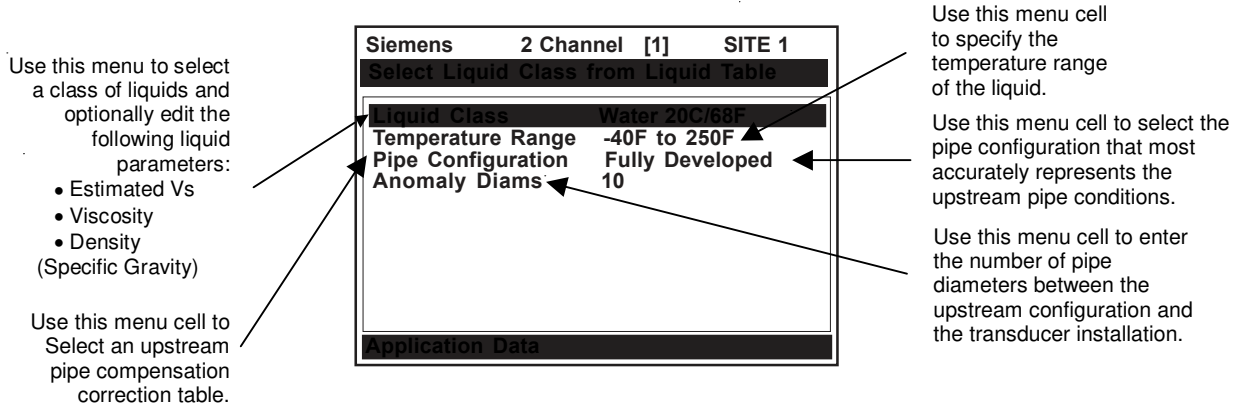
2.3 THE APPLICATION DATA MENU

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

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

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

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



APPLICATION DATA MENU STRUCTURE

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

(continued)

APPLICATION DATA MENU STRUCTURE *(continued)*

⇕	⇐ Application Data ⇐	⇐ Liquid Class ⇐ ⇕	⇐ Select Liquid ⇐ ⇕	⇕	Estimated Vs m/s Viscosity (cS) Density S.G.	xxxx <i>(numeric entry)</i> x.xx <i>(numeric entry)</i> x.xxx <i>(numeric entry)</i>
		⇐ Temperature Range ⇐ ⇕	-40F to 450F -40F to 250F -40F to 375F			
		⇐ 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

2.3.1 HOW TO SELECT A LIQUID CLASS

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

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

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

Siemens	Dual Path	ABC
Access Liquid Option List		
Select Liquid	Water 20C/68F	
Estimated Vs m/s	1482	←
Viscosity cS	1.00	←
Density SG	1.000	←
Liquid Class		

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

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

To select a Liquid Class:

To access the option list press

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

To register selection press


How to Edit the Estimated Vs (liquid sonic velocity)

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


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

NOTE: During the transducer install procedure (see paragraph 2.4), you can ignore a respacing request by pressing the <Down Arrow> instead of the <ENT> key. If this triggers a Spacing Alarm, check Diagnostic/Data [Site Setup Data] menu cell to make sure the measured Vs value does not exceed the Vs max or Vs min items.


To edit the Estimated Vs m/s:

To activate numeric entry press 

Type the sonic velocity value using meters-per-second.


To register the data press 

How to Edit the Viscosity (cS) Setting


The Viscosity (cS) menu cell shows the kinematic viscosity of the selected liquid (in centi-stokes). The viscosity value is particularly important for high viscosity liquids. The meter requires an accurate liquid viscosity to compute the flow profile compensation. If the displayed viscosity is correct, bypass this menu cell by pressing .

Please be aware that the viscosity of the liquid affects the Reynolds Number compensation applied to the final rate output. Therefore, inaccurate data could cause flow data errors. *Edit this entry only if you know the true viscosity of your liquid.* If necessary, our Technical Service Group can provide reliable viscosity data for most liquids.

To edit the Viscosity setting:

To activate numeric entry press 

Use the numeric keys to type the Viscosity value, which must be in centistokes.


To register the data press 

How to Edit the Density (SG) Setting


Use the Density (SG) menu cell to edit the nominal specific gravity of the selected liquid. This allows the flow computer to provide a flow rate output in mass units, if required. This mode suits applications where the density is not only known, but also fixed, due to well-controlled liquid temperature and chemistry.

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

To edit the Density SG setting:

To activate numeric entry press 

Use the numeric keys to type the Density SG value.


To register the data press 

2.3.2 HOW TO SELECT A PIPE TEMPERATURE RANGE


This menu cell informs the flow computer about the expected temperatures that the transducers will be subjected to during operation. The default setting, -30°F to 225°F corresponds with the rated temperature range of our standard 991 or 1011 series transducers. The other selections provide higher upper limits of 375°F and 450°F, respectively.

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

To select a temperature range:

To access the option list press 


To highlight the desired range press  



To register your selection press 

2.3.3 PIPE CONFIGURATION

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

To select a Piping Configuration:

To access the option list press 

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.

Pipe Configuration Menu Structure

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

* Default

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

Siemens	Dual Path [1]	Path 1
Disignate Pipe Shape Near Transducers		
Liquid Class	Water 20C/68F	
UniMass Table	Create/Edit Table	
Temperature Range	-40F to 250F	
Pipe Configuration	Fully Developed	
Anomaly Diams	1 Elbow DbI Elbow + DbI Elbow - Valve Expander Reducer Norm Entry Header Inlet Intrusions	
Application Data		

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

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.
- DbI 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.

2.4 THE PICK/INSTALL XDCR (TRANSDUCER) MENU

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

Based on pipe data (and optional application data) entries, the Pick/Install Xdcr menu automatically identifies the most suitable transducers for the application. It recommends the appropriate mounting mode (direct or reflect) and lists the Spacer Bar or Mounting Track part number and spacing index. Ideally, you will be able to use the primary recommendations. However, you can edit the menu entries as required to accommodate different transducers or mounting configurations.

The flow computer will adjust its parameters to optimize performance based on your selections. The Ltn menu cell shows the required spacing distance (in inches or millimeters) between the upstream and downstream transducers. Use the [Install Completed?] menu cell to inform the flow computer that you completed the physical mounting of the transducers. You can define the empty pipe and zero flow values once the transducers are operational.

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

Use this menu cell to select the type of transducer to be installed.

These menu cells identify the spacing indices on the spacer bar. You must use these settings to mount the transducer properly.

This menu cell shows the actual spacing distance required between the transducers.

Once you select the type, use this menu cell to specify the transducer size.

This menu cell allows you to select a mounting mode. **Use Reflect Mode whenever possible.*

This menu cell indicates the model number of the appropriate spacer bar for your transducers and spacing requirements.

Use this menu cell to inform the meter that you completed the transducer mounting.

After the transducers are operating, you can use this menu cell to set the empty pipe threshold.


After the transducers are operating, use this menu cell to manually set the zero flow correction.

Siemens 2 Channel [1] FLOW1	
Scroll List and select desired Model	
Transducer Model	1011 Universal
Transducer Size	B3
Xdcr Mount Mode	Reflect
Spacing Method	Spacer Bar PB-1
Letter Index	C
Number Index	0
Ltn Value (in)	0.565
Install Completed?	No
Empty Pipe Set	Chan Not Setup
Zero Flow Adjust	Chan Not Setup
Pick/Install Xdcr	

PICK/INSTALL XDCR MENU STRUCTURE



Pick/Install Xdcr ⇨	Transducer Model ⇨ ⇕	991 Universal 1011 Universal 1011H Hi Precision		
⇕	Transducer Size ⇨ ⇕	1011 Universal	991 Universal	1011H High Precision
		⇕ A1A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 E1 E2 E3	⇕ 0A0A 0 1 2A 2 3A 3 4A 4 5A 5	⇕ A1HA1H A2H A3H B1H B2H C1H C2H D1H D2H D4H
	Xdcr Mount Mode ⇨ ⇕	⇕ Direct Reflect		
	Spacing Offset ⇨ ⇕	⇕ Minimum Nominal Maximum		
	Number Index ⇨	4 (generated)		
	Spacing Method ⇨	Spacer Bar [P/N]	⇨ *auto P/N generation	
	Ltn Value ⇨	2.00 (generated)		
	Install Completed? ⇨ ⇕	No [Yes] Install		*[Yes] indicates successful install
	Empty Pipe Set ⇨ ⇕	MTYmatic ⇕ Set Empty Actual MTY		
	Zero Flow Adjust ⇨ ⇕	⇕ AutoZero ZeroClr Reversamatic Actual Zero Zeromatic		*Reflect mount only

2.4.1 HOW TO SELECT A TRANSDUCER MODEL

Use the [Transducer Model] menu cell to define the type of transducer for use with your application. This allows the flow computer to adjust its transmit/receive functions accordingly. You can choose from either the [1011 Universal] or [1011H High Precision] transducer lists, or from a list of [991 Universal] models. You should consider using high precision transducers for extremely critical applications. We usually recommend these transducers for custody transfer, leak detection or nuclear power applications. The system default is [1011] Universal]. If this suits the application, bypass this menu cell by pressing .

To select a Transducer Type:

To access the [Xdcr Type] option list press 


To move the cursor to the required transducer model press  


To store your selection press 


2.4.2 HOW TO SELECT A TRANSDUCER SIZE

When you move the cursor to Transducer Size, the highlighted prompt at the top of the display screen shows a list of recommended transducer sizes. For example **[Recommended Xdcrs: D3,D2,D1,C1,C3]**. The flow computer generates this list automatically based on your pipe and your application data entries. The left-most transducer size (e.g., D3) is the primary (most appropriate) choice. The right-most transducer (e.g., C3) is still acceptable (but the least desirable) choice. Since these are simply recommendations, not requirements, you can override the flow computer and use any size, as long as the mounting method accommodates the pipe's diameter. The flow computer shows that your selection is acceptable if it is able to calculate transducer spacing (Ltn).

To select a Transducer Size:

To access the [Transducer Size] option list press 

To move the cursor to the desired transducer size press  

To select the transducer press 

2.4.3 HOW TO SELECT A TRANSDUCER MOUNT MODE



The flow computer recommends the transducer mounting mode [Direct or Reflect]. In almost all cases it will be Reflect, since this is the most desirable configuration. Reflect mode allows you to mount the transducers on pipes that do not permit back or side access. Reflect mode provides inherent compensation for flow profile distortion (crossflow) that could be the result of unfavorable application conditions such as an insufficient upstream straight run. In addition, Reflect mode supports the AutoZero function, which sets the zero flow velocity automatically.

Direct mounting may produce a stronger transducer signal and requires less mounting length than Reflect mounting. This can be important if the liquid or pipe material exhibits high sonic attenuation, thereby preventing operation in the Reflect configuration.

NOTE: We recommend using Direct Mount with Plastic pipes.

To select a Xdcr Mounting Mode:

To access the [Xdcr Mount] option list press 

To move the cursor to the required mounting type press  

To store selection press 

2.4.4 REVIEWING THE SPACING METHOD

The flow computer analyzes your transducer selection, mounting mode and pipe size to determine the best way to install your transducers. It will recommend the use of either a mounting track, a spacer bar, or independent mounting. The flow computer will list the part number of a mounting track or spacer bar. (Note: If you select 991 Universal Transducers, this function is not provided.) If it decides upon independent mounting, it will report the distance required between the two transducers. In this case, you have to make sure that when you mount the transducers, the space between them equals the length specified in the Ltn menu cell. See Section 3 for details on how to accomplish this.

2.4.5 HOW TO USE THE SPACING OFFSET

After you select the mounting method, the flow computer checks your entries for pipe size, transducer type, etc. and then recommends a spacing offset. This is the first step in establishing the correct distance between the transducers. Spacer bars and mounting tracks utilize number indices (i.e., pre-determined mounting locations) 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. (Note: This mounting method is different for the System 991 Flowmeter.)



If the flow computer reports "Use Ltn," you have to measure the distance between the upstream and downstream transducers. The flow computer issues the actual distance between the transducers in inches or millimeters (See Ltn). Please consult Section 3 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 so 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 enables the meter to 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 

2.4.6 LETTER INDEX (1011 Transducer) - LETTER and NUMBER INDEX (990 Transducer)

The 1011 Transducer

Note: The 1011 transducers utilize a different spacing method than the 990 transducers. After selecting the mounting method, the flow computer checks entries for pipe size, transducer type, etc., and then recommends a number index. Use this number index to position the transducers at the proper distance apart when using a track or spacer bar. One transducer is positioned at the REF point and the other is positioned at the given Number Index. While this positioning provides the best signal strength in most cases, there are situations where either more signal quality or more amplitude is desired. This can be accomplished by moving the cursor to [Spacing Offset] and selecting either "Min" for a better signal quality, or "Max" for greater amplitude. After selecting "Min" or "Max", the computer will recompute a different Number Index. Move the transducer to that new position.

The 990 Transducer

This menu provides both a Letter Index and a Number Index. The Number Index (like the 1011) provides the spacing between transducers while Letter Index provides for changes, if necessary, for signal strength and amplitude. Higher letter indices provide greater signal levels but, in some cases, slightly decreased signal quality. For transducers mounted independently and where manual measurements of the distance between transducers must be determined (e.g., 1011 Transducers in direct mode), the flow computer issues the actual distance between the transducers in inches or millimeters (Ltn). Please review Section 3 for details on how to use the Ltn measurement. You must connect the Up transducer cable to the transducer mounted on the upstream end of the mounting track. This lets the meter report the flow direction correctly.

It is important that you note each transducer's serial number, its Index position during the original installation, and whether it is in the upstream or downstream position. If you cannot recreate the original installation's exact physical arrangement, it will be necessary to do a "New Install." In addition, please note that transducer pairs have matching serial numbers except for the appended letters "A" and "B." These letter designations help you identify each transducer.

2.4.7 THE NUMBER INDEX MENU CELL

Selecting the Spacing Offset allows the flow computer to calculate the Number Index. The Number Index establishes the spacing between a pair of transducers. You cannot override this recommendation. To complete the transducer installation, you must accept the Number Index by mounting the transducer at that point on your spacer bar or mounting track. Initially, the flow computer bases its Number Index selection on the pipe diameter and estimated liquid sonic velocity (Vs) you entered in the Application Data menu. When you Invoke the [Install Completed?] routine, the flow computer actually measures the liquid sonic velocity (Vs). In some cases, it may prompt you to re-space the transducers to another number index.

2.4.8 THE Ltn MENU CELL

This view only menu cell shows the distance in inches or millimeters between the front faces of the transducers along the axis of the pipe. If you are mounting the transducers without a track or spacer bar, you will have to space them according to this value (see Section 3 for details). Note that Ltn may be a negative number for direct mount on very small pipes where the transducer spacing overlaps.

2.4.9 HOW TO USE [INSTALL COMPLETED?]

Use the [Install Completed?] menu cell to inform the flow computer that you have mounted the transducers according to the selected mode and spacing requirements and are ready to start operation.

To start the [Install Completed?] routine for an original installation:

Select any transit-time mode (e.g., Clamp-On or Flow Tube) and press the <Right Arrow>.

Press <Down Arrow> and scroll to the [Pick/Install Xdcr] menu cell. Press <Right Arrow>.

Install transducers as required (refer to Section 3 for procedures).

NOTES

- *Mount the transducers using the selected mode (direct or reflect). Please refer to the transducer mounting procedures detailed in Section 3.*
- *When using a mounting track or a spacer bar in reflect mode, locate the first transducer at the Reference Index and the second transducer at the recommended Number Index.*
- *If you are mounting the transducers independently, you must use the recommended distance; Ltn to space the transducers.*
- *You must use the proper sonic coupling compound. See "Recommended Sonic Coupling Compounds" in Section 5 for appropriate type and part number.*
- *The pipe must be completely filled with a liquid, which can be either flowing or at zero flow.*

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

To access the [Install Completed?] option list, press the <Right Arrow>.

Press <Down Arrow> and scroll to the [Install Completed] menu cell and then press <ENT> (unless otherwise directed to do so by the Technical Service Department).

Siemens 2 Channel [1] SITE1	
Key [Install] after mounting transducers	
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 Completed?	No
Empty Pipe Set	Channel Not Setup
Zero Flow Adjust	Channel Not Setup
Pick/Install Xdcr	

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

Siemens	2 Channel	[1]	SITE1
Key [Install] after mounting transducers			
Transducer Model	1011 Universal		
Transducer Size	B3		
Xdcr Mount Mode	Direct		
Spacing Offset	Minimum		
Number Index	(631) 248 77774		
Spacing Method	Track 1012TP		
Ltn Value (in)	0.217		
Install Completed?	Yes		
Empty Pipe Set	Channel Not Setup		
Zero Flow Adjust	Channel Not Setup		
Pick/Install Xdcr			

To complete the Install process, disregard the following paragraphs explaining the Force Transmit and Force Frequency diagnostic software routines.

NOTE: If the transducers have been installed successfully but the Estimated Vs (sonic velocity) has been changed, the Pick/Install Xdcr menu cell [Install Completed?] 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. After [Install] is selected press <ENT>. While the meter is going through the drives (see menu screen below), press the <ALT> and <MENU> keys simultaneously.

Siemens	2 Channel	[1]	SITE1
Key [Install] after mounting transducers			
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 Completed?	No		
Empty Pipe Set	Channel Not Setup		
Zero Flow Adjust	Channel Not Setup		
Pick/Install Xdcr			

Siemens	2 Channel	[1]	SITE1
Drive 11			
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 Completed?	Install		
Empty Pipe Set	Channel Not Setup		
Zero Flow Adjust	Channel Not Setup		
Pick/Install Xdcr			

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

Siemens 2 Channel [1] SITE1	
Drive 11	
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 Completed?	Install
Empty Pipe Set	Channel Not Setup
Zero Flow Adjust	Channel Not Setup
Pick/Install Xdcr	

2. A typical menu screen will appear as shown below and indicate the current ALC (e.g., 50). This ALC number indicates the current receive signal strength and can be used for further diagnostic purposes.

Siemens 2 Channel [1] SITE1	
ForceN fx=8	m=7 ALC=50
Transducer Model	1011 Universal
Transducer Size	B3
Xdcr Mount Mode	Direct
Spacing Offset	Minimum
Number Index	4
Spacing Method	Track 1012TP
Ltn Value (in)	0.217
Install Completed?	Install
Empty Pipe Set	Channel Not Setup
Zero Flow Adjust	Channel Not Setup
Pick/Install Xdcr	

Siemens 2 Channel [1] SITE1	
Transducer Model	1011 Universal
Transducer Size	B3
Xdcr Mount Mode	Direct
Spacing Offset	Detection Fault
Number Index	Press [ENT]
Spacing Method	2TP
Ltn Value (in)	0.217
Install Completed?	Install
Empty Pipe Set	Channel Not Setup
Zero Flow Adjust	Channel Not Setup
Pick/Install Xdcr	

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

Drive =0

Using numeric keys enter the frequency and press <ENT>.

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

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

Immediately after you press <ENT>, the computer starts an internal process called an Initial Makeup. The current Initial Makeup activity, for example **Drive 14 m 10 [—]** appears at the top of Display Screen. During the Initial Makeup, the flow computer verifies your site data, records the sonic characteristics of the pipe and liquid and then adjusts internal parameters to optimize flow measurement. Please remain patient. This process can take several seconds or several minutes to complete. There is no relationship between the length of an Initial Makeup and the meter's subsequent performance. An Initial Makeup for larger pipes (and more demanding application conditions) simply takes a little longer. Upon successful completion of the initial makeup, the 1010 will show you a pop-up window with the measured Vs as shown below.



Measured Vs m/s
1470


This means that the flow computer was able to complete the Initial Makeup and is now actively measuring flow. This pop-up window allows you to “fine-tune” the Measured Vs by pressing the <Right Arrow> to activate numeric entry. You can then use the numeric keys to type a different value. However, only edit the Measured Vs when you are certain of your liquids actual sonic velocity. If, however, there is a large discrepancy between the “measured” Vs and the “actual” Vs, then consider that an accurate Vs measurement depends on certain parameters that the flow computer cannot sense directly (e.g., pipe dimensions or transducer placement). In other words, entering incorrect pipe parameters or not using the recommended spacing could result in an erroneous Vs measurement.

The meter is now ready to report flow. Press the MENU key to display flow.


In cases where the actual Vs differs noticeably from the estimated Vs, the computer may issue a re-space command. This requires that you re-space the Number Index transducer at the new Number Index, then press <ENT> again. Repeat the initial makeup process. You can override a re-space command by simply keying the [Down Arrow]. However, after the meter completes begins operating, you must confirm that the sonic velocity (Vs) of the liquid falls between the [Vs max] and [Vs min] items in [Diagnostic Data / Site Setup Data].

Therefore, only consider editing the measured Vs after you remove all the primary causes for an inaccuracy. Check your pipe dimensions and pipe material entries. Re-check the transducer spacing and part numbers. Large Vs discrepancies are almost always due to erroneous pipe data or incorrect transducer placement.


To accept the Measured Vs:


Press  or  moves the cursor to the [Empty Pipe Set] menu cell.

If you decide to edit the Measured Vs:

To activate numeric entry press 

Use 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 flow computer completes its Initial Makeup command, the [Install Completed?] option list changes to:

```
Install Completed?  Yes
                   New Makeup
```

If you want to redo the Initial Makeup, move cursor to New Makeup, then press .

This resets the option list. You can now repeat the install routine described previously.

2.4.10 THE EMPTY PIPE SET MENU

The flow computer performs the MTYmatic routine automatically during its Initial Make-up to establish a standard setting for the Empty Pipe alarm. The [Empty Pipe Set] option list allows you to re-invoke MTYmatic, use an Actual MTY routine (if application conditions allow you to empty and refill the pipe) or use the Set Empty routine to set the empty pipe threshold by direct numeric entry.



How to Use the Actual MTY Command

If application conditions allow you to empty and refill the pipe, then you should perform the Actual Empty procedure. This is the recommended way to define the empty pipe threshold.

WARNING: NEVER perform this procedure when the pipe cannot be emptied.

To perform the Actual MTY Procedure:

To access the [Empty Pipe Set] option list press .

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

 appears on the menu prompt line.

Empty the pipe completely, then press .  appears on the menu prompt line.

Refill the pipe completely, then press .


How to Use the MTYmatic Command

You can repeat MTYmatic (performed during the Initial Makeup) to correct an inaccurate Actual MTY setting if conditions did not allow you to complete the Actual Empty procedure.

NOTE: Only use the MTYmatic procedure when the pipe is full.

To start MTYmatic:

To access the [Empty Pipe Set] option list press .

Move the cursor next to [MTYmatic] press .


To invoke MTYmatic press .


How to Use the Set Empty Command

Use the Set Empty command to enter a number that represents the signal strength level consistent with an empty pipe. Set Empty uses non-linear scaling. There is no direct correlation between the number you enter and any standard amplitude unit. If you set the number too low, the meter may not detect a true empty pipe. If you set it too high, it could trigger the empty pipe alarm, suspending flow measurement, even though the liquid is flowing.

To enter an Empty Pipe Alarm Threshold:

To access the [Empty Pipe Set] option list press 

To move the cursor to [Set Empty] press 

Press  The current empty threshold number appears in a pop-up window.

Use the numeric keys to type a new *Set Empty* number.

To store the *Set Empty* number press 

2.4.11 ZERO FLOW ADJUST MENU

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

AutoZero

When the 1011 transducers are mounted in the Reflect Mode configuration (see paragraph 3.1.5) the AutoZero routine is automatically invoked at the end of the Initial Makeup. Flow does not have to be stopped to perform AutoZero since only the pipe wall signal is used in determining the zero offset and not the liquid component. The AutoZero routine performs a one-time analysis of the pipe wall component of the ultrasound signal to quantify any residual mismatch in the hardware. Once the AutoZero routine is complete, the system memorizes this measured zero offset and subtracts this value from the flow reading.

Actual Zero

The “Actual Zero” function simply averages the indicated “zero flow” readings (over a user defined time period) then stores this average value in memory. Under normal operation the indicated flow reading is zero compensated by simply subtracting this memorized value from the uncompensated flow reading. Actual Zero is the most positive method for zeroing the system, however, *flow must be stopped with the line blocked (if possible) before invoking this function*. If stopping flow is not possible then an alternate zeroing method should be selected.

ReversaMatic

This routine involves swapping the Up and Down transducers on the pipe (while keeping the cables attached) such that the difference in the transit-time change represents the zero offset. The fixed zero offset value is stored in memory in the same manner as described in Actual Zero. This routine would generally be used whenever flow cannot be stopped and the transducers cannot be mounted in the Reflect Mode configuration. Flow must be stable during the entire process.

ZeroMatic (not present in MultiPulse operation)

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


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


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

Using Actual Zero

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

To invoke Actual Zero:

Access the [Zero Flow Adjust] option list by pressing 

Press . 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 you do not know the current flow rate, then you can use the ReversaMatic routine to establish the zero flow level. You should perform the ReversaMatic procedure as quickly as possible to ensure that the flow rate remains constant throughout the procedure.

To invoke ReversaMatic:

- To access the [Zero Flow Adjust] option list press 
- Move the cursor to [ReversaMatic]. Press  to invoke the routine.

- The meter begins to measure the positive flow rate. “Positive” flow refers to flow moving from upstream transducer location to the downstream transducer location. Note top prompt line shows:

Reversamatic Action

- Upon completion, the meter beeps and the display screen shows **Reverse Xdcrs / Press ENT**
- Now remove then remount the upstream and downstream transducers in their reversed positions. Mount the Up transducer (without removing its cable) in the Down transducer/cable location. Mount Down transducer with its cable in the Up transducer/cable location. When remounting the transducers, couple them to the pipe properly. Press <ENT> (after re-installing the transducers).
- The flow computer measures the negative flow rate briefly, then beeps and repeats the prompt:

Reverse Xdcrs / Press ENT

- Now remount the transducers for normal operation (in their original orientation). When remounting transducers, couple them to the pipe properly. Press <ENT> (after re-installing the transducers).

This completes the ReversaMatic procedure. The system’s zero accuracy will be very close to that obtainable using the Actual Zero method, providing flow remained constant during this procedure.

Important Note: *A caution on the use of upper and lower flow limits (used to prevent flow mis-registration) prior to using the Reversal Zero technique (ReversaMatic): If the negative flow rate that the meter reads in the step during which the transducers are reversed is more negative than the lower flow limit, the meter will re-register positive and the Reversal Zero cycle will thus be corrupted.*


Therefore, postpone the installation of upper and lower flow limits until the reversal zero procedure is executed successfully. For pipes that combine large diameters with very high flow velocities, it may be necessary to move the upper and lower flow limits out of the way until the reversal zero is completed. Moreover, pipes of this size frequently have excellent intrinsic zero performance and may not even need zeroing.

ZeroMatic (optional function) REYNOLDS TABLE

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.

Siemens	Dual Path	SITE1
Conformans Indicated flow to Actual Zero		
Transducer Model	1011 Universal	
Transducer Size	B3	
Xdcr Mount Mode	Reflect	
Spacing Offset	Minimum Flow	
Number Index	7	
Spacing Method	Track 1012TP	
Ltn Value (in)	ReversaMatic	
Install Completed?	ZeroMatic	
Empty Pipe Set	Auto Zero	
Zero Flow Adjust	Actual Zero	
	ZeroCir	
Pick/Install Xdcr		

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



Siemens	Dual Path	SITE1
ZeroMatic Active [6:.....:0]		
Transducer Model	1011 Universal	
Transducer Size	B3	
Xdcr Mount Mode	Reflect	
Spacing Offset	Minimum Flow	
Number Index	7	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.778	
Install Completed?	Installc	
Empty Pipe Set	Channel Not Setup	
Zero Flow Adjust	ZeroMatic	
Pick/Install Xdcr		

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

Siemens	Dual Path	SITE 1
Conforms operation to user Preferences		
Channel/Path Setup		
Pipe Data		
Application Data		
Pick/Install Xdcr		
Operation Adjust		
Flow/Total Units		
Data Span/Set/Cal		
Stripchart Setup		
Datalogger Setup		
I/O Data Control		
Diagnostic Data		
Dual Path Flow		

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.

2.5 THE OPERATION ADJUST MENU

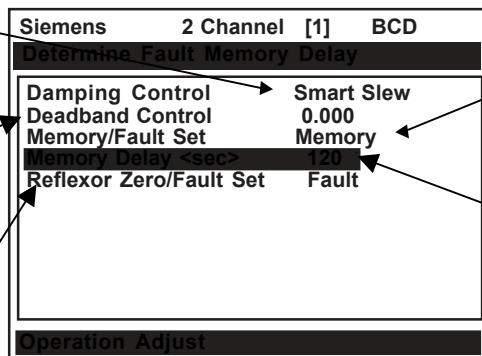
This menu becomes available after picking a meter type and measurement channel. We recommend that you use it after the transducers are installed and operating to “fine-tune” the meter’s output characteristics.

Each application presents different data display and output requirements due to unique pipe and liquid conditions. Use the Operation Adjust menu to match meter operation to the site. You can set damping controls for the primary flow rate output. You can define an energy or flow 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 flowrate deadband threshold. Flowrates below this level will be reported as zero flow.

Use this menu cell to change the Reflexor response to a Zero Fault indication by selecting [Zero] in the [Zero/Fault Set] menu.



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)	
		Reflexor/Zero/Fault Set		Fault/Zero (Reflexor Mode only)	


2.5.1 DAMPING CONTROL

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

Time Average integrates the instantaneous flow rate over a selectable time period. You enter a value (in seconds), 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:

To access the SmartSlew option list, press  three times.

Scroll the numeric list to the desired choice press  

To register the new value press 


To select Time Average:

To access the [Damping Control] option list press 

To move the cursor down to [Time Average] by pressing 

To enable [Time Average] entry press 


Use the numeric keys to type the new Time Average setting.

To register the new value press 


2.5.2 DEADBAND CONTROL

Use Deadband Control to instruct the meter to report zero flow if the flow rate falls below a specified level (usually a very low rate). It will prevent the possibility of data scatter (a natural result of digital computation) from causing false totalizer accumulation during long non-flowing periods. Inspect the actual data scatter during zero flow conditions to find the proper deadband setting for your application.

To edit the default setting (0.000):

To enable numeric entry press 

Use the numeric keys to type in the desired rate (using selected flow rate units).

To register the new value press 

2.5.3 MEMORY/FAULT SET

Certain situations (e.g., an empty pipe or excessive aeration) will interrupt data production. Use Memory/Fault Set to select the meter response to such an interruption. The Fault setting (default) will zero the flow rate output and declare an alarm on a flow display screen, Datalogger report and an assigned relay output.

For some applications, however, occasional temporary Fault conditions may be a normal part of the process and would not require an alarm response. The system offers a Memory operating mode to support such an application. Memory Mode suspends the system's Fault response by preventing the flow outputs from dropping to zero for the interval specified in the Memory Delay menu cell. During the Memory duration, the meter will maintain the last valid flow reading measured before the onset of the fault condition. The default Memory Delay is 60 seconds. You may select any duration from 3 to 604,800 seconds (one week).

To select Memory Mode:

To access the [Memory/Fault Set] option list press 

Move the cursor down to [Memory] press 


To make selection press 

This moves the highlight to Memory Delay (sec).


Memory Delay (sec)

Selecting [Memory] activates the suppressed Memory Delay menu cell. It allows you to specify the number of seconds that the meter maintains its last valid flow reading. When the memory delay expires, it triggers the fault alarm response described previously.

To specify the Memory delay:

To enable numeric entry press 

Use the numeric keys to type the delay in seconds.

To register the new value press 

2.5.4 REFLEXOR ZERO/FAULT SET OPTION (Reflexor Mode only)

NOTE: The [Zero/Fault Set] menu option only appears on the display if the selected Channel is the Reflexor mode.

The System 1010 Reflexor declares a Fault when the receive signal drops below the Doppler detection threshold. To change the Reflexor response to a Zero Flow indication rather than a Fault, select [Zero] in the [Zero/Fault Set] menu option. Note the following:

- a. **FAULT** – When selected the system will declare the Reflexor channel to be in Fault and the flowmeter will indicate “F” on the display screen. Note that when a new Reflexor channel is created the [Fault] option is the default mode. Also note that the sum (or difference) channel will also be declared to be in Fault.
- b. **ZERO** – When selected the Reflexor channel will be declared to be at Zero Flow instead of in Fault and the flowmeter will indicate 0.00 on the display screen.

2.6 THE FLOW/TOTAL UNITS MENU

This menu is available after selecting a meter type and measurement channel. Use the Flow/Total Units menu to select volumetric flow units and an associated time base for the flow rate and total outputs. After making your selections, a view-only menu cell shows the resultant scaling.

Use this menu cell to select either volumetric or mass flow rate units.

Use this menu cell to select a time base for the flow rate units.

Use this menu cell to select a range for the flow rate display screen.

Use this menu cell to select either volumetric or mass flow total units.

Use this menu cell to set the resolution of the totalizer.

Use this menu cell to enter a volume accumulation for the batching or sampling totalizer relay trigger.

Use these menu cells to set the scaling for the flow rate and flow total outputs.

Use this menu cell to select how the totalizer accumulates flow.

Siemens 2 Channel [1] FLOW1	
Choose desired Flow rate volume units	
Flow Volume Units	Gallons <US>
Flow Time Units	MIN
Flow Display Range	Autorange
Flow Display Scale	GAL/MIN
Total Volume Units	Gallons <US>
Totalizer Scale	KGAL
Total Resolution	00000x00
Totalizer Mode	NETFLOW
Batch/Sample Total	0.000
Reset Totalizer	Yes/No
Flow/Total Units	

THE FLOW/TOTAL UNITS MENU STRUCTURE

Flow/Total Units ⇨	Flow Volume Units ⇨	⇕ Gallons (US)
		Liters
		Cubic Feet
		Cubic Meters
		Cubic Inches
		Cubic Cm
		Ounces (U.S.)
		Imperial Gal
		31.0 GAL BBL
		31.5 GAL BBL
		42.0 GAL BBL
		55 GAL Drum
		Acre-feet
		Pounds
		Kilograms
		Tons
		Metric Tons
		Ft/Sec (Vel)
		M/Sec (Vel)
⇨	Flow Time Units ⇨	⇕ MIN
		HR
		DAY
		SEC
⇨	Flow Display Range ⇨	⇕ Autorange
		High

(continued)


THE FLOW/TOTAL UNITS MENU STRUCTURE *(continued)*


⇕	Flow/Total Units ⇨	⇕	Flow Display Scale ⇨	⇕	mGAL/MIN GAL/MIN KGAL/MIN
	⇕	⇕	Total Volume Units ⇨	⇕	<i>Same list as Flow Volume Units</i>
	⇕	⇕	Totalizer Scale ⇨	⇕	GAL KGAL mGAL
	⇕	⇕	Total Resolution ⇨	⇕	00000X00 000000X0 0000000X
	⇕	⇕	Totalizer Mode ⇨	⇕	NEGFLOW NETFLOW POSFLOW
	⇕	⇕	Batch/Sample Total ⇨	⇕	x.xxx <i>(numeric entry)</i>

2.6.1 FLOW VOLUME UNITS

The Flow Volume Units option list allows you to select the rate units the meter uses to report volumetric or mass flow. If you select mass units, the meter uses the specific gravity parameter (see Application Class section) to convert volumetric flow to mass flow. The default English Units is [Gallons].

To select a Volumetric or Mass Unit:

To access the [Flow Volume Unit] option list press 


To move the cursor to the required units press  



To store selection press 

2.6.2 FLOW TIME UNITS

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

To select a Time Unit:

Press  to access the [Time Unit] option list.

Press   to move the cursor to the required time units.



Press  to store the time units.

2.6.3 FLOW DISPLAY RANGE

The [Display Range] option list offers a choice of Autorange (default), or High Range. The Autorange selection increases resolution automatically at low flow rates and reduces resolution at high flow rates as required to prevent data overflow. If you select High Range, the meter controls its screen resolution to prevent data overflow at the highest possible flow.

To edit the Display Range:

Press  to access the [Display Range] option list.


To move the cursor to the required display range press  


To store selection press 

2.6.4 FLOW DISPLAY SCALE

After you select rate units, the meter automatically computes a prefix to provide the best combination of capacity and resolution (e.g., KGAL/MIN). The [Flow Display Scale] menu cell shows the results. If the displayed scaling is not suitable, you can edit it by accessing the option list. Note that this scaling applies to all flow rate data displayed on the flow display screen, even if the units do not appear next to the data (because there may not be room on the screen). Therefore, always keep this prefix in mind when you enter flow related data.


To select a different Flow Display Scale:

To access the [Flow Display Scale] option list press 


Move the cursor to the desired display scale by pressing  


To register selection press 

2.6.5 TOTAL VOLUME UNITS

This menu cell allows you to select which units the meter uses for the flow total output. If you select mass units, the meter uses the specific gravity parameter (see paragraph 2.3) to convert volumetric flow to mass flow. The default English Flow Total Units is [Gallons] (US). If this suits the application, press  to bypass this menu cell.

To change the default setting:

To access the [Total Volume Units] option list press 


To move the cursor to the desired Total volume units press  

To store selection press 

2.6.6 TOTALIZER SCALE

After you select totalizer units, the meter automatically computes a prefix to provide the best capacity (e.g., mGAL, GAL, and KGAL). The [Totalizer Scale] menu cell shows the results. If the displayed scaling is not suitable, you can edit it by accessing the option list. Note that this scaling applies to all flow total data displayed on the flow display screen, even if the units do not appear next to the data (because there may not be room on the screen). Always keep this prefix in mind when you enter totalizer-related data.

To select a different Totalizer Scale:

To access the [Totalizer Scale] option list press 

Move the cursor to the desired display scale by pressing  

To register selection press 

2.6.7 TOTAL RESOLUTION

The meter assigns multiplier prefixes for the flow total units you have selected (e.g., MGPM). It provides three resolution (or capacity) levels:

00000x00 (where x represents the decimal point)
 000000x0
 0000000x


Actual Totalizer display units depend on the selected multiplier. Check the total units by accessing the Totalizer Scale menu cell.

If you use the totalizer (TOTCNT) relay output, take into account:

- The TOTCNT relay output pulses at a maximum rate of .5 pulses per sec. (.5 Hz).
- The meter sends a totalizer output pulse for every advance of the rightmost visible totalizer digit.

It is possible for a high flow rate to persist long enough to exceed the relay output's .5 Hz rate. If this occurs, the meter will store excess pulses in an overflow buffer, and route them back to the relay when the flow rate drops enough to allow the TOTCNT output to catch-up. Exceeding the .5 Hz rate for long periods could cause an excessive accumulation of buffered pulses and continue to trip the relay after the flow rate lessens, or even stops. If this occurs, the meter will be unable to indicate the current flow total. Therefore, select a resolution to ensure that, even at the maximum expected flow rate, the TOTCNT pulse will not be activated more than .5 times per second for any appreciable length of time. Note that resetting the Totalizer also clears the overflow buffer.

To change the default resolution:

To access the [Total Resolution] option list press 


Move the cursor to the required resolution by pressing  

To store selection press 


2.6.8 TOTALIZER MODE



The Totalizer function operates in any of the modes listed below:

MODE	FLOW DIRECTION	NOTES
POSFLOW	Positive Flow	Accumulates flow in positive direction only
NEGFLOW	Negative Flow	Accumulates flow in reverse direction only
NETFLOW	Positive or Negative	Adds to positive total; subtracts from reverse total.

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  to accept the default setting.

To select a Totalizer Mode:

To access the [Totalizer Mode] option list press 

Move the cursor to the required Totalizer mode by pressing  

To store selection press 


2.6.9 BATCH/SAMPLE TOTAL

The 1010 system maintains a separate totalizer register for Batching or Sampling applications. For example, if a sample of an oil product needs to be taken once every thousand barrels, the user can set the flowmeter’s relay to trigger an external sampling device at that interval.


Unlike the Flow Total registers, you cannot view this register directly. It is used for relay control only. If you assign the system relay to this function, a momentary relay pulse occurs whenever the BATCHTOT register accumulates a specified liquid quantity. You enter the total flow volume required to activate the relay in the Batch/Sample Total menu cell. The numeric entry must reflect the selected flow total units. The Totalizer Display Scaling menu cell shows the applicable flow total units. The sign of the Batch/Sample Total determines positive or negative accumulations.

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




To enter a Batch/Sample Volume:

To activate numeric entry press 

Use the numeric keys to type the desired Batch/Sample Total accumulation.

To store data press 

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

F1 } F2 } F3 } F4 }		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>
F1 } F2 } F3 } F4 }		NOTOT (Totalizer Freeze)	Invoking the NOTOT command disables the Totalizer. Totalization will not resume until you repeat the Fn and Numeric 2 key sequence. When you activate NOTOT, an N precedes the TOTAL symbol (i.e., [NTOTAL]) on the LCD Screen.
F1 } F2 } F3 } F4 }		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.

(continued)

TOTALIZER CONTROLS (the “n” in <Fn> = channel number)* continued

F1 F2 F3 F4		CLEAR (Batch/Tot Register)	Clears the Batch Sample totalizer register. See Batch/ Sample Tot.
F1 F2 F3 F4		CLEAR (Makeup Latch)	Clears the Makeup Latch. See paragraph 2.7 The Data Span/Set/CAL Menu and subparagraph 2.7.1 Span Data.

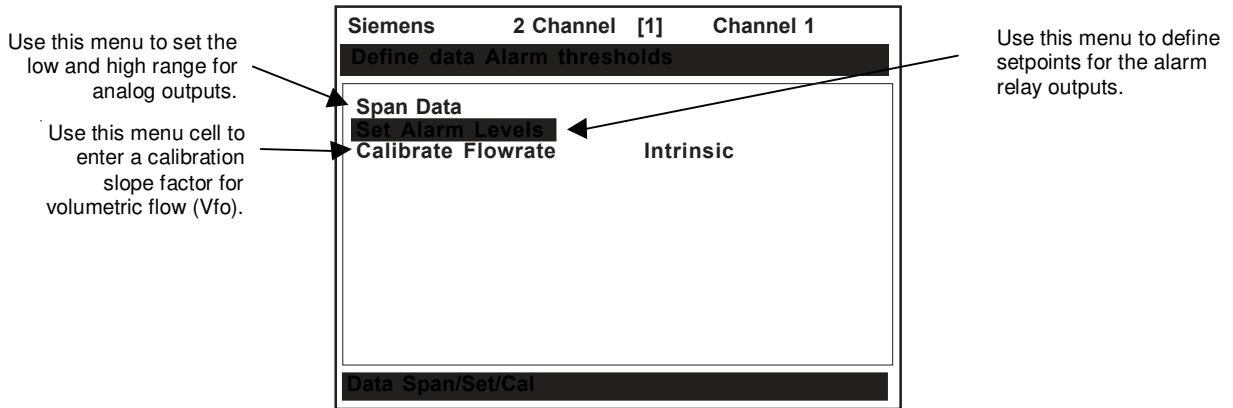
*Use the <F1> key as the “Lead-in command” for 4-Path Totalizer operations.

2.7 THE DATA SPAN/SET/CAL MENU

This menu becomes available after picking a Meter Type and Measurement Channel. However, some functions will only be active after the transducers are installed and operating properly. Use the Data/Span/Set/Cal menu to set the range for analog outputs and set-points for Alarm relay outputs. Additionally, the Calibrate Flow Rate menu allows you to apply external adjustments to the meter’s intrinsic primary outputs.

THE DATA SPAN/SET/CAL MENU STRUCTURE

⇕	Data Span/Set/Cal ⇨	⇨ Span Data	⇨ ⇕	⇨ Max Flow (Units) ⇨	⇕	⇨ x.xxx (numeric entry)	
		⇕		⇨ Min Flow (Units) ⇨		⇨ x.xxx (numeric entry)	
				⇨ Max Vs m/s ⇨		⇨ x.xxx (numeric entry)	
			⇨ Min Vs m/s ⇨			⇨ x.xxx (numeric entry)	
			⇨ Max Temperature ⇨			⇨ x.xxx (numeric entry)	
			⇨ Min Temperature ⇨			⇨ x.xxx (numeric entry)	
		⇨ Set Alarm Level	⇨ ⇕	⇨ High Flow ⇨	⇕	⇨ x.xxx (numeric entry)	
			⇕	⇨ Low Flow ⇨		⇨ x.xxx (numeric entry)	
				⇨ High Temperature ⇨		⇨ x.xxx (numeric entry)	
				⇨ Low Temperature ⇨		⇨ x.xxx (numeric entry)	
				⇨ Interface Vs m/s ⇨		⇨ x.xxx (numeric entry)	
				⇨ Aeration % ⇨		⇨ x.xxx (numeric entry)	
				⇨ Makeup Latch ⇨	⇕	⇨ Off	
						⇨ On	
		⇨ Calibrate Flowrate	⇨ ⇕	⇨ Intrinsic			
			⇕	⇨ Kc ⇨		⇨ numeric entry	
				⇨ Multipoint	⇕	⇨ Point # ⇨	⇨ xx (numeric entry)
				⇨		⇨ Indicated Rate ⇨	⇨ x.xxx (numeric entry)
				⇨		⇨ % Correction ⇨	⇨ x.xxx (numeric entry)



2.7.1 SPAN DATA

The Span Data menu allows you to set 0% and 100% output limits for volumetric flow (Vfo), absolute flow (Vfab) and sonic velocity (Vs). Each menu cell shows appropriate rate units and time base. If you change flow rate units after spanning the system, the computer automatically updates the output data setup to reflect the change. Span limits apply to both the analog outputs and the on-screen stripchart. In addition, temperature ranges can be set if an optional temperature sensor is supplied.

The flow outputs operate as follows:

<p>Vfo <i>Spanned Volumetric Flow Rate:</i></p>	<p>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 GPM to +10 GPM, the 4 mA span will be -30 GPM, and the 20 mA span will be +10 GPM.</p>
<p>Vfab <i>Spanned Absolute Volumetric Flow Rate:</i></p>	<p>Vfab is the absolute magnitude of the volumetric flow rate (Vfo). There are no menu cells provided to span this output. Vfab shares the Vfo span entries. The Vfab minimum span is always zero. The maximum span for Vfab is the largest absolute value of either the min. or the max. flow rate (Vfo) entries. For example, a span between +10 GPM and -30 GPM, spans the Vf output from 0 GPM to 30 GPM.</p>
<p>Vs <i>Spanned Liquid Sonic Velocity:</i></p>	<p>Vs is the sonic velocity in meters-per-second (m/s) of the flowing liquid. The min. and max. Vs entries establish the Vs span. Max Vs (m/s) defines 100% of span. The Min Vs (m/s) defines 0% of span.</p>


<p>Maximum span values represent:</p> <ul style="list-style-type: none"> 100% of span Current output of 20 mA Voltage output of 10 Vdc Pulse output of 5000 Hz 	<p>Minimum span values represent:</p> <ul style="list-style-type: none"> 0% of span Current output of 4 mA Voltage output of 0 Vdc Pulse output of 0 Hz
---	--

NOTE: If necessary, analog outputs can be “trimmed” in the Meter Facilities mode.


Max Flow

The [Max Flow] menu cell stores the maximum range for the flow rate output (Vfo). It can be a positive or negative value. Enter the data using the flow rate units you selected. This entry also spans the unsigned flow variable (Vfab).

To enter the Max Flow Range Setting:

To activate numeric entry press 


Use the numeric keys to type the maximum flow rate (100% of range).

To store the data press 


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:

To activate numeric entry press 


Use the numeric keys to type the minimum flow rate (0% of range).

To store data press 


Max Vs m/s

The [Max Vs m/s] menu cell stores the maximum range for the sonic velocity output. The sonic velocity (Vs) appears on the Stripchart display and can drive any analog output or the alarm relay. The [Max Vs m/s] menu cell restricts this parameter to a maximum range of 2100 m/sec.

To set the maximum Vs output range:

To activate numeric entry press 


Use the numeric keys to type the 100% range for the Vs output.

To store the data press 


Min Vs m/s

The [Min Vs m/s] menu cell stores the minimum range value for the sonic velocity output. The sonic velocity (Vs) can be displayed on the Stripchart and drive any analog output or the alarm relay. The [Min Vs m/s] menu cell restricts this parameter to a minimum range of 400 m/sec.

To set the minimum Vs output range:

To activate numeric entry press 

Use the numeric keys to type the 0% range for the Vs output.

To store data press 

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.

2.7.2 SET ALARM LEVELS


The [Alarm Setpoints] 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 those functions to the system's relays. You may select from high or low flow rate, liquid interface (Vs) and liquid aeration alarm functions. Entry of all alarm setpoints is accomplished using the selected rate units.

To access the Alarm Setpoints menu press 


High Flow

The [High 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:

To activate numeric entry press 


Use numeric keys to type the High Flow Alarm setpoint in the selected flow rate units.

To store data press 


Low Flow

The [Low Flow] menu cell allows you to set the LO Alarm relay trip-point and 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.

To set the Low Flow Alarm:

To activate numeric entry press 

Use the numeric keys to type the Low Flow alarm setpoint.

To store data press 

High Temperature

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

Low Temperature


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

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


The meter continuously measures liquid sonic velocity (Vs) and tracks changes in this parameter dynamically. It can compare sonic velocity differences in real-time. Its sonic velocity detection is so sensitive, it quickly distinguishes between two different liquids flowing through the same pipe. To set the [Interface Vs m/s] alarm menu cell, select a detection setpoint that falls between the Vs values of the two liquids. For example, if Liquid “A” has a sonic velocity of 1249 m/s, and Liquid “B” has a sonic velocity of 767 m/s, then you should enter 1008 m/s for the interface setpoint. The Interface Alarm becomes active when the measured Vs meets or exceeds the user reference value entered in this menu cell.

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

To enter an Interface Vs alarm setpoint:

To activate numeric entry press 

Use the numeric keys to type the Interface Vs value in meters-per-second.


To store the data press 

Aeration %


The System 1010 surpasses all other transit-time systems in its ability to operate with substantial aeration (caused by entrained gases, mixing condition or cavitation). Some applications may require an alarm indication if aeration exceeds a particular level. The meter detects this aeration level and provides this data as an output. The aeration percentage triggers the alarm relay whenever it meets or exceeds the threshold you set in this menu cell. The aeration percentage (Vaer %) appears in the Liquid Data section of the Diagnostic Menu. The digital display screen also shows the current aeration percentage.

NOTE: Severely aerated conditions may induce 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 Aeration % Alarm:

To move the cursor to activate numeric entry press 

Use the numeric keys to type the Aeration percentage setpoint.



To store data press 


Makeup Latch

A fault condition (caused by an empty pipe or a transient loss of power, etc.) could temporarily interrupt operation. After recovery from the fault, the meter automatically executes an in-process makeup to restore operating parameters. During the makeup, the meter sets a Makeup Alarm flag, which clears upon completion. Therefore, unless you were monitoring the unit continuously, you could miss the fact that an in-process Makeup occurred and subsequent Totalizer counts were lost. The Makeup Alarm Latch alerts you that the system implemented a Makeup by holding the Makeup Alarm active until you reset it manually by the simultaneous keystrokes: <Fn>6 (where “n” represents the measurement channel). In addition, if the Datalogger is active with Status Alarms selected, generating a Datalogger report will reset the Makeup Alarm Latch. This ensures that the Alarm does not appear on succeeding Datalogger reports. A Makeup Alarm appearing on a subsequent report indicates that an In-Process Makeup must have occurred since the last Datalogger report.

To Enable (or Disable) the Makeup Latch:

To access the [Makeup Latch] option list press 

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

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

2.7.3 CALIBRATE FLOWRATE

Numerous laboratory and field trials under diverse application conditions have confirmed that System 1010's intrinsic calibration is excellent. We are thus confident that in any given application, the majority of conventional flowmeters can not possibly match the system's measurement range or its linearity. However, some applications may require an output adjustment to match an official external reference.

The "Calibrate Flowrate" menu allows you to select a calibration mode. The right-hand column shows the active calibration mode. You can select Intrinsic (factory), Kc (Slope Correction) or Multipoint (Non-linear) Calibration. Selecting either of the external calibration modes will not eliminate the Intrinsic (factory) calibration. You can use this menu cell to switch between Intrinsic, Kc or Multipoint at any time.


Kc Calibration

For most applications, the measured flow range produces a linear meter response. Therefore, the Kc (slope correction) calibration is the preferred method since it only requires a single correction factor for all the flow rates encountered. Changing the calibration can cause profound changes in a flowmeter's operating characteristics. Use only the most respected flow standard, as a reference, to obtain a correction factor. The percentage you enter will provide an accurate and consistent shift across the entire flow range anticipated for the application.


To obtain the Kc factor, compare flow total data taken simultaneously from the 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. For example, entering [-0.29] will produce a reduction of 0.29% in the calibration at all flow rates.

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

To enter the Kc Factor:

To enable numeric entry press 

Use the numeric keys to type the required Kc (as calculated above). Note that 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 new value. Also note that this Kc value can be viewed on the site printout.

MultiPoint Calibration

MultiPoint calibration serves applications that require a non-linear meter calibration. You can enter correction factors for up to ten significant points over the entire measurement range. This is accomplished by:

- Selecting up to 10 separate calibration points by entering a raw (uncalibrated) flow rate.
- Entering a negative or positive correction for each calibration point that you select.

Like the Kc slope correction described in the previous section, you locate critical flow rate points by comparing flow total data taken simultaneously from the 1010P and a reference meter whose accuracy meets the required standard. Again, it is important to note that you must allow both meters to accumulate flow total data for a period long enough to average out any differences due to flow fluctuation between the meter locations.

Compare the two flow total readings to identify up to ten separate points (termed raw flow rates) where there are significant deviations between System 1010P and the reference meter. Calculate correction factors (either negative or positive percentages) for up to ten points along the flow range. For example, entering [-0.1] for point 1 produces a negative 0.1% change in the meter output whenever the system measures the raw flow rate specified for point 1, etc. The valid range for each percent correction is from -50% to +50%. If you enter a value outside of this range, the flow computer will set the calibration factor to the nearest limit.

This function is used to match System 1010P's output with the reference meter's response curve. Selected calibration points must increase in magnitude from point 1 to point 10 (or the last point that you wish to calibrate).

NOTE: You must enter the raw flow rates in ascending order.



To perform a MultiPoint Calibration:


To access the [Calibrate Flow Rate] option list press 

Move the cursor up to [MultiPoint], then press 


This selects the MultiPoint calibration screen, which shows:

Point #	(point 1 selected)
Indicated Rate	(shows current rate for point # 1)
% Correction	(amount of correction applied either (-) or (+) percentage)


Press  to move to the [Indicated Rate] field, then  to enable numeric entry.


Use the numeric keys to type a flow rate for point # 1, then press 


NOTE: Enter absolute value of the flow. Flow rate is not direction sensitive. The same calibration applies to both negative and positive flow rates.

The highlight moves to the [% Correction] field for point # 1. Press  to enable numeric entry.

Use the numeric keys to type the required % correction for point # 1.


Press  and the highlight returns to the [Point #] field.

To enable numeric entry press  then type [2] (for the second calibration point).


Press  and the cursor moves to the point # 2 [Indicated Rate] field.

Use the numeric keys to type a flow rate for point # 2. The value entered here must be of a greater magnitude than the value entered for point #1.

Press  and the cursor moves to the [% Correction] field.

To enable numeric entry press 

Use the numeric keys to type the required % correction for point # 2 then press 

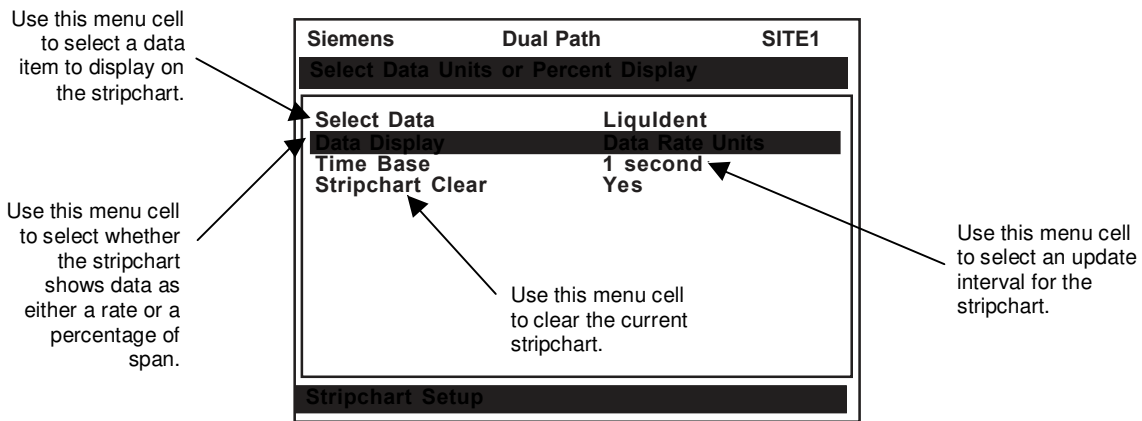
Repeat this procedure for all required calibration points. After entering the last Flow Calibration Point press  to exit MultiPoint calibration.

2.8 THE STRIPCHART SETUP MENU

This menu becomes available after picking a Meter Type and Measurement Channel. Use Stripchart Setup to select a data category, the type of scaling and the update interval for the on-screen stripchart display. You can also clear the stripchart screen.

THE STRIPCHART SETUP MENU STRUCTURE

⇕	⇒ Stripchart Setup	⇒ ⇕ Select Data	⇒ ⇕ Vfo Vfab Temp Vs Valc Vaer
		⇒ Data Display ⇕	⇒ ⇕ Data Rate Units Percent of Span
		⇒ Time Base ⇕	⇒ ⇕ 1 Second 3 seconds 6 seconds 12 seconds 24 seconds 1 minute 3 minutes 6 minutes 12 minutes 24 minutes 1.2 hours
		⇒ Stripchart Clear ⇕	⇒ ⇕ Yes No



2.8.1 SELECT DATA

The [Select Data] option list allows you to select a data function for the on-screen stripchart display. The stripchart provides a data plot using the selected data units and time base. All data items except Valc and Vaer use the span settings from the Data Span/Set/Cal menu. The following Data Items are available for the Stripchart Display:

- Vfo (spanned flow) *default
- Vfab (spanned unsigned flow magnitude)
- Temp (Temperature)
- Vs (sonic velocity)
- Valc (signal amplitude)
- Vaer (aeration/cavitation)

To select a data item for the stripchart:

To access the [Select Data] option list press

Move the cursor to the desired item by pressing

To store your selection press

2.8.2 DATA DISPLAY

The [Data Display] option list allows you to select a format for the stripchart plot. It offers the choice of displaying data either in the current data rate units or as a percent of span defined in the Data Span/Set/Cal menu. [Data Rate Units] is the default selection.

To select a format for the data display:

To access the [Data Display] option list press

To move the cursor to the required scale unit press


To store your selection press



2.8.3 TIME BASE

The [Time Base] option list defines the stripchart x-axis display interval. The stripchart plots an average of readings obtained during the elapsed time between reports. Stripchart resolution is 1 data point per pixel. There are approximately 100 on the short strip-chart plot and approximately 200 on the full screen stripchart plot. Five pixel reports occur between major stripchart divisions.

NOTE: The stripchart display identifies the “real time” when the computer records the most recent graduation. You can time-stamp any graduation by counting back in graduation intervals. The default interval setting is 1 second.

To select a Time Base:

To access the [Time Interval] option list press 

Move the cursor to the desired interval by pressing  



To store your selection press 


2.8.4 STRIPCHART CLEAR

Use this menu cell to clear the stripchart. Selecting [Yes] erases all current stripchart data.

To erase the Stripchart plot:

To access the [Stripchart Clear] option list press 

Move the cursor to [Yes] by pressing  

To clear the current Stripchart plot press 

2.9 THE DATALOGGER SETUP MENU

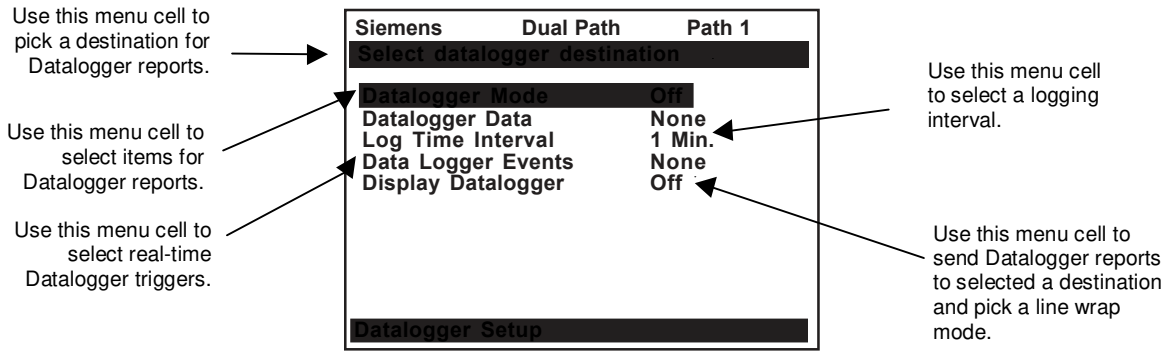
This menu becomes available after picking Meter Type and Measurement Channel. The integral Datalogger records data for eventual display on a Graphics Screen, or for connection to an RS-232 compatible external device (printer, computer, network, etc.). Use Datalogger Setup to select data items and real-time 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.

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

THE DATALOGGER SETUP MENU STRUCTURE

⇒ Datalogger Setup ⇕	⇒ Datalogger Mode ⇕	⇒ ⇕ Off Memory RS-232 Output
	⇒ Datalogger Data ⇕	⇒ ⇕ Site Id Date Time Flow Average Flow Raw Flow Total Vs Valc Aeration Alarms Delta T (usecs) Temperature Analog Inputs
	⇒ Log Time Interval ⇕	⇒ ⇕ 5 Sec. 10 Sec. 15 Sec. 30 Sec. 1 Min. 5 Min. 15 Min. 30 Min. 1 Hr. 2 Hr. 4 Hr. 6 Hr. 12 Hr. 24 Hr. Demand
	⇒ Datalogger Events ⇕	⇒ ⇕ Relay 2 Relay 1 Fault Alarm Memory Makeup Spacing Empty Aeration Interface Flow Alarm
	⇒ Display Datalogger ⇕	⇒ ⇕ Off No Line Wrap Line Wrap



2.9.1 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:

To access the [Datalogger Mode] option list press

Move the cursor to the desired mode by pressing

To store the selection press

2.9.2 DATALOGGER DATA

Set the Datalogger to record any or all of the data offered on the [Datalogger Data] option list shown on next page. However, recording unneeded data wastes valuable system RAM. We recommend that you always select [Site ID] (name) and [Time] to identify each line of data.

None	Default – Datalogging is disabled.
Site ID	You entered this site name when you created the site.
Date	The report date according to the meter’s real time clock. (Format: MM.DD.YYYY)
Time	The report time according to the meter’s real time clock. (Format: HH.MM)*
Flow	The instantaneous flow measured at the time of the report.
Average Flow	The average flow rate measured since the last report.
Raw Flow	The uncompensated flow rate in in 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.
Aeration	The aeration percentage recorded at the time of the report.
Alarms	The letter codes of any alarms active at the time of the report (see below).
Delta T (uSecs)	The Up to Down transit-time difference measured at the time of the report.
Temperature	The instantaneous supply and return temperatures at the time for the report.
Analog Inputs	Any data appearing on an auxiliary input at the time of the report.

*The Time field expands to HH.MM.SS when you select a logging interval of more than once per minute.


If you select Alarms, the Datalogger logs the state of each alarm function upon generating a report. A dash [-] represents an inactive alarm. A letter code represents an active alarm:




Alarm Letter Codes and Descriptions

S	Spacing	Transducer spacing may need re-adjustment
E	Empty	Pipe is empty
R	Rate	Flow above High setting or below Low setting
F	Fault	Three continuous seconds without new data update
A	Aeration	Current aeration percentage exceeds the alarm setpoint
M	Memory	Last valid reading for a selected interval during Fault condition
K	Makeup	In-Process Makeup occurred
I	Interface	Liquid Vs exceeds interface alarm setpoint
P	Pig	Pig passage detected (optional)
Z	ZeroMatic	ZeroMatic signal fault

NOTE: The time interval-based Datalogger records the state of all the alarms at the selected report time only. Therefore, if an alarm condition resets before the report time, it would not appear on the report. Use Datalogger Events to log transient alarms. This mode generates a report upon the detection of an alarm event.

To select Datalogger Data items:

To access the Datalogger Data option list press 

Move the cursor to a desired data item by pressing   then  to select it. Note that a plus sign (+) appears before the item.

To de-select Datalogger Data:

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

After selecting/deselecting all desired items press  to leave the Datalogger Data option list.



2.9.3 LOG TIME INTERVAL

The Datalogger records a “snapshot” of conditions at each log time interval. Datalogging uses a considerable amount of RAM, so only select short log intervals if it is fully justified.

NOTE: The meter maps the first Datalogger report time to an even division of its clock. Subsequent reports will conform to the selected interval.

To set the Log Time Interval:

To access the [Log Interval] option list press 

Move the cursor to desired interval by pressing  


To store your selection press 

2.9.4 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 liquid interface, or a short aeration alert). *Note: An Alarm Event report will be generated immediately after the transition from a non-alarm to an alarm event. The reverse situation (alarm state to non-alarm state) does not trigger the event-based Datalogger.*

Event-based Datalogger messages conserve memory. However, if you use this feature to monitor a level such as Flow Alarm, set the alarm threshold high enough to avoid repetitive triggering. You must select Site ID (Name) and Time to “time-stamp” the alarm events. Note that on the Datalogger report, a [-] represents a reserved letter code space (inactive alarm) and a letter code represents an active alarm.

To select Datalogger Event items:

To access the [Datalogger Events] option list press 

Move the cursor to the desired item by pressing   then  to select it. Note that a plus sign(+) appears before the item.

To de-select Datalogger Events:

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

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


2.9.5 DISPLAY DATALOGGER

Use this menu cell to enable and format the on-screen datalogger. You can allow the report to scroll on the screen with or without line wrapping. Selecting line wrap, forces a line feed after approximately 40 characters. This command is effective only after you select data items and the Datalogger has accumulated some data.


To enable the on-screen datalogger display:


To access the [Display Datalogger] option list press 


Move the cursor to the desired function.

To invoke the function press 



To scroll the on-screen datalogger display:


To display one line at a time press 


Use  key to scroll down one screen (12 lines) at a time.

Use  key to jump to the 12 lines of the last screen.

In No Line Wrap mode:

Use  or  to scroll one column to the left or right.

Press  +  simultaneously or press  +  simultaneously to scroll eight columns to the left or the right.

To get out of the display, press 

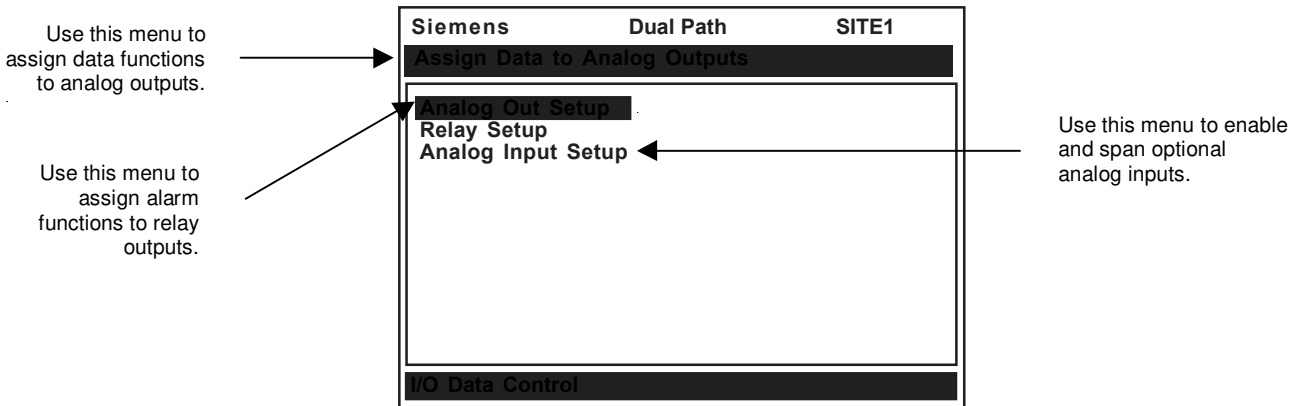
NOTE: In single channel FUS1010 units the Datalogger uses a compression scheme that precludes backward scrolling.

Important point about Datalogger resources and dual-channel systems

When logging data on both measurement channels 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 channel generated the report.

2.10 THE I/O DATA CONTROL MENU

This menu becomes available after picking a Meter Type and Channel. Use 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 Output Setup	⇒ Io1		⇒ ⇅ Vfo
				⇒ ⇅ Vfab
				⇒ Vs
			⇒ Valc	
			⇒ Vaer	
			⇒ T1	
			⇒ Vo1	⇒ *See Io1 option list
			⇒ Pgen1	⇒ *See Io1 option list
	⇒ Relay Setup	⇒ Relay 1	⇒ ⇅ Off	
			⇒ Power On	
⇒ Hi Temperature				
⇒ Low Temperature				
⇒ High Flow				
⇒ Low Flow				
		⇒ Flow Alarm		
		⇒ Fault Alarm		
		⇒ Soft Fault		
		⇒ Spacing		
		⇒ Empty		
		⇒ Aeration		
		⇒ Interface		
		⇒ Reverse Flow		
		⇒ Batch Tot		
		⇒ Pos Total		
		⇒ Neg Total		
		⇒ Relay 2	⇒ *See Relay 1 list	
⇒ Analog Input Setup	⇒ Iin1	Input	⇒ ⇅ Off	
			⇒ Aux	
		4 mA	⇒ *numeric entry	
	20 mA	⇒ *numeric entry		
	⇒ Vin1	Input	⇒ ⇅ Off	
			⇒ Aux	
0 Volts		⇒ *numeric entry		
	10 Volts	⇒ *numeric entry		

2.10.1 ANALOG OUT SETUP

System 1010 provides current, voltage and pulse-rate analog outputs. Analog Out Setup allows you to assign data functions for these signals. The flow 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.
Vo (DC voltage)	0 to 10 Vdc varies in proportion to an assigned data function.
Pgen (TTL logic)	0 to 5000 Hz varies in proportion to an assigned data function.

Analog Out Setup Data Categories



Vfo	Spanned volumetric/mass flow rate
Vfab	Spanned unsigned flow magnitude
Vs	Spanned liquid sonic velocity
Valc	Receive signal amplitude
Vaer	Relative degree of liquid aeration/cavitation
T1	Current liquid temperature

Assigning Io Output Functions

The Io analog output is a loop-powered (or externally powered), isolated 4-20 mA DC signal that varies linearly in relation to a selected data function.

To assign a function for the current output:

From [Analog Out Setup], press  twice to access the [Io] option list.


Move the cursor to the desired data function by pressing  

To store selection press 

Assigning Vo Output Functions

The Vo analog output is a 0-10 VDC signal that varies linearly in relation to a selected function.

To assign a function to the voltage output:

To access the [Vo] option list press 


Move the cursor to the desired data function by pressing  



To store selection press 

Assigning Pgen Output Functions

The Pgen analog output is a buffered TTL-compliant pulse rate signal. It varies linearly from 0-5000 Hz in relation to a selected data function.

To assign a function to the Pgen output:

To access the [Pgen] option list press 

Move the cursor to the desired data function by pressing  

To store selection press 

PULSE OUTPUT (Pgen Wiring)

Models 1010P & 1010DP

Installation Drawings 1010P-7 (Sht 2 of 2) and 1010DP-7 (Sht 2 of 2)

PIN#	SIGNAL	FUNCTION	NOTES
10	PGEN1	FREQUENCY OUTPUT 1	Pulse Freq Output (0-5kHz) 5V TTL CMOS Logic. Use any available signal gnd for return (Terminal 1, 17 or 26)
11	PGEN2	FREQUENCY OUTPUT 2	

Models 1010WP & 1010WDP

Installation Drawings 1010WP-7 (Sht 2 of 2) and 1010WDP-7 (Sht 2 of 2)

PIN#	SIGNAL	FUNCTION	NOTES
K	PGEN1	FREQUENCY OUTPUT 1	Pulse Freq Output (0-5kHz) 5V TTL CMOS Logic. Use any available signal gnd for return (Terminal A, T or c)
L	PGEN2	FREQUENCY OUTPUT 2	

2.10.2 RELAY SETUP

Use this menu to assign a function to channel relays. The system offers 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. Pulse Relay output supports totalizer and batch relay functions. The output pulse width is approximately 200 ms. The 1010 family of portable instruments use solid state logic levels rather than relays

to conserve its power. The 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 <F1> key Totalizer clear command also clears all channel totalizers plus the overflow register described in the last paragraph.


Assigning Relay 1 and 2 Functions

System 1010P, 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
Hi Temperature	High Temperature value relay trip point.
Low Temperature	Low Temperature value relay trip point.
High Flow	Flow rate exceeds high flow setpoint
Low Flow	Flow rate falls below low flow setpoint
Flow Alarm	Flow rate exceeds or falls below flow setpoints
Fault Alarm	System loses receive signal
Spacing	Transducer spacing needs adjusting
Empty	Empty pipe alarm
Aeration	Aeration percentage exceeds alarm setpoint
Reverse Flow	Flow is in negative direction
BatchTot	Batch/Sample total advances
Interface	Liquid interface setpoint exceeded
Pos Total	Positive total volume advances by 1 digit
Neg Total	Negative total volume advances by 1 digit
Soft Fault	Fault condition - memory mode active

To assign functions to Relay 1:

To access the Relay option list press 

Move the cursor to the desired Relay assignment by pressing  

To store selection press 

Repeat procedure for Relay 2.

2.10.3 ANALOG INPUT SETUP (optional function)

NOTE: Some versions of the 1010 Portable System are able to datalog analog input signals. The [Analog Input Setup] menu cell is not seen if your model’s operating system does not include this facility.

The Analog Input Setup function allows the assignment of an active analog input to a measurement channel/path, which can then be reported to the datalogger. The meter provides two DC current (4-20mA) input ports and two voltage (0-10V) input ports for Single Channel,

Dual 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 Aux function, assigned numeric variables for temperature monitoring might be spanned as follows: 4mA=1 (32°F) and 20mA=100 (212°F). Temperature data sent to the Aux 1 input port will feed-through the flowmeter and report the scaling data to the datalogger.

Note that although the flow computer receives these signals, the standard operating system will not use them as a variable in any of its operations. The analog input ports only act as a convenient “feed-through” to add data to Datalogger reports. *Also note that there will be no units shown next to the output data. Therefore, be aware of the appropriate units when entering scaling data and when viewing the resultant output on a Datalogger report.*

NOTE: Refer to the Installation Drawings or I/O Module markings for the locations of these inputs and wiring procedures.



I/O Data Control ⇨ ⇩	⇨ Analog Inp Setup ⇨ ⇩	lin1 ⇨ ⇩	Input	⇩ Off Aux		
			4 mA	numeric entry		
			20 mA	numeric entry		
				lin2	Same as lin1	
		Vin1 ⇨ ⇩	⇨	Input	⇩ Off Aux	
				0 Volts	numeric entry	
				10 Volts	numeric entry	
				Vin2	Same as Vin1	

Setting up the Analog Current Input


The first step is to enable the input port.

From Analog Input Setup:


Access the [lin or Vin] option list by pressing  twice.


Move the cursor down to [Aux (n)] by pressing  and then .

This enables the port to receive an input current. The cursor moves to [4 mA or 0 V].


To enable numeric entry press .

Type the numeric value corresponding to 4 mA or 0 V input signal.

To store the data press . This moves the cursor to [20 mA or 10 V].

To enable numeric entry press .

Type the numeric value corresponding to a 20 mA or 10 V input signal.

To store the data press .

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

DIAGNOSTIC DATA MENU STRUCTURE

⇕	⇨ Diagnostic Data ⇨	⇨ Flow Data ⇨	⇕ Flow Velocity F/S Total Vs m/s Signal mV Valc % Vaer % Alarm Status Ancal HiFlow LoFlow
		⇕	
		⇨ Application Info ⇨	⇕ TN uSec TL uSec DeltaT nSec Burst/Sec % Accepted Last Makeup Makeup Status
		⇕	
		⇨ Liquid Data ⇨	⇕ Reynolds # Temp 1 Temp 2
	⇕		
	⇨ Site Setup Data ⇨	⇕ fx (drive) N (burst length Ltn in Vfmax Vs max m/s Vs min m/s Empty % Samples/Cycles HF	
	⇕		
	⇨ Test Facilities ⇨	⇕ Makeup Graph Tx Up Tx Dn Fixed ALC Tx Up Fixed ALC Tx Dn Fixed ALC Graph AutoZero	
	⇕		
	⇨ Print Site Setup		No/Yes
	⇨ Date Site Created		xx.xx.xx xx.xx.xx

2.11.1 MAIN DIAGNOSTICS SCREEN

This is the main Diagnostics Data screen. It provides menus that show Flow, Application, Liquid 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 six menus and two menu cells:

Siemens	Dual Path	ABC
Real-time flow-related data		
Path Select	All	
Path Enable	N/A	
Flow Data		
Application Info		
Liquid Data		
Site Setup Data		
Test Facilities		
Print Site Setup	No	
Date Site Created	04.18.01	13.24.01
Diagnostic Data		

MAIN DIAGNOSTIC MENU DESCRIPTION

Flow Data	This menu shows flow rate, total & alarm data; adjustable flow limits.
Application Info	This menu shows current meter operating status.
Liquid Data	This menu shows current Reynolds # and RTD temperature readings (if this system includes optional RTD Temperature measurement capability).
Site Setup Data	This menu shows current transducer setup data and signal status.
Test Facilities	This menu provides system test and recovery routines.
Print Site Setup	This Menu cell allows you to send an ASCII dump of the current Site Data to a RS-232 port device (e.g. a printer or laptop computer).
Date Site Created	This menu cell shows date and time when the current site was created.

2.11.2 FLOW DATA MENU

This menu provides a “live” display of all flow-related output data.

Siemens	Dual Path	SITE1
Current Flow Rate and Units		
Flow GAL/MIN		-2.26
Flow Vel F/S		-0.60
Total KGAL		0.0000
Vs m/s		1273.21
Signal mV		44
Valc %		57
Vaer %		0
Alarm Status		---R----
AnCal GAL/MIN		0.0000
HiFlow GAL/MIN		1576.8
LoFlow GAL/MIN		-1576.8
Flow Data		

NOTE: Menu shows English units (i.e., gallons).

FLOW DATA MENU ITEMS

Flow	This is a real-time (updated) flow rate display in current rate units (e.g., GAL/MIN).
Flow Vel F/S	Linear fluid flow velocity in f/s or m/s depending on preferred units.
Total Vs m/s	This is a real-time (updated) flow total display in current total units (e.g., KGAL). Current liquid sonic velocity (Vs) in m/s. The Vs value depends on the liquid and its temperature. This menu cell allows “fine-tuning” when highlighted. Press [+] or [1] key to increase, or [-] or [2] key to decrease the reading. CAUTION: Incorrect usage will result in reduced accuracy.
Signal (mV)	Xdcr signal strength (in mV). This is the amplitude of the transit-time receive signals. Improper coupling, attenuative liquid or pipe could cause a low value.
Valc %	Input Amplifier gain indication. Larger % indicates a stronger liquid signal.
Vaer %	This shows the current percent of aeration detected by the meter.
Alarm Status	This letter code field shows the status of the meter’s built-in alarms. A dash indicates an inactive alarm. Letter codes reflect the following alarm conditions: S = Transducer Spacing Warning E = Empty Alarm R = Flow Rate Alarm (High or Low rate threshold exceeded) F = Fault Alarm A = Aeration Alarm M = Memory Activated (Fault Suppressed) K = Makeup Flag (May be Latched) I = Interface Alarm P = Pig Alarm (option) Z = ZeroMatic signal fault
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.
HiFlow GAL/MIN	Most positive expected flow rate for application (adjustable).
LoFlow GAL/MIN	Most negative expected flow rate for application (adjustable).

Vs m/s

This menu cell shows the current sonic velocity in 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. Sonic velocity (Vs) adjustment is a diagnostic tool intended for our technicians or experienced users only. Improper use will affect the meter accuracy.

HiFlow and LoFlow

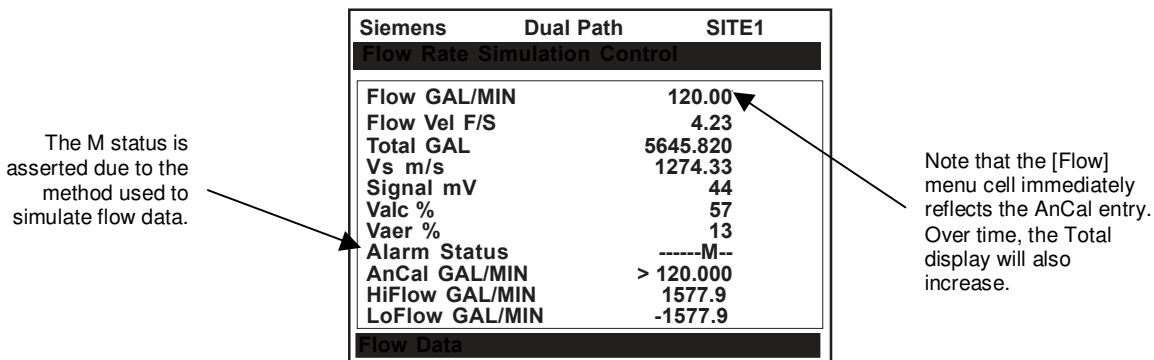
The HiFlow and LoFlow menu cells allow you to enter maximum and minimum expected flow rates based on current operating conditions. Under normal circumstances, you should never need to change these settings. It is possible however, that a Siemens customer service engineer may ask you to edit these settings during a support session. In such a case, pressing the <Right Arrow> the menu cell enables numeric entry.

Important Note: A caution on the use of upper and lower flow limits (used to prevent flow mis-registration) prior to using the Reversal Zero technique (Reversamatic): If the negative flow rate that the meter reads in the step during which the transducers are reversed is more negative than the over flow limit, the meter will re-register positive and the Reversal Zero cycle will thus be corrupted.



Therefore, postpone the installation of upper and lower flow limits until the reversal zero procedure is executed successfully. For pipes that combine large diameters with very high flow velocities, it may be necessary to move the upper and lower flow limits out of the way until the reversal zero is completed. Moreover, pipes of this size frequently have excellent intrinsic zero performance and may not even need zeroing.


AnCal

This menu cell allows you to enter an artificial flow rate in current rate units that will drive the meter's analog outputs, totalizer output and the screen shown below. You can use AnCal to check the analog outputs or as a reference source for calibrating external devices such as remote display screens or chart recorders and RTU's. To test the Totalizer function, leave AnCal active for enough time for an accumulation to appear on the screen below. Moving the cursor from the menu cell cancels the AnCal function.





To activate AnCal:

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

Press  to enable numeric entry. Note that an equal sign (=) appears before the number.

Type the desired flow rate using current rate units (e.g., 120.00 GPM). Note that the [Flow] menu cell now reflects the artificial rate.

Move the cursor away from the menu cell by pressing   to turn AnCal off.

2.11.3 THE APPLICATION INFO MENU

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

Siemens	2 Channel [1]	1
Time between transit and receive		
TN uSec		75.193
TL uSec		44.009
DeltaT uSec		126
Burst/Sec		256
% Accept		100
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.
% Accept	The % of accepted up/down transmit burst sets.
Last Makeup	Reason for last Makeup (signal reacquisition).
Makeup Status	Current stage of Makeup routine. [Measurement = normal operation]

2.11.4 THE LIQUID DATA MENU

This menu shows the current Reynolds number used by the meter to implement flow profile compensation.

NOTE: On some 1010 models, the Liquid Data Menu screen also displays current RTD temperature(s).

Siemens	2 Channel [1]	Channel 1
Current Reynolds number		
Reynolds #		318017
Liquid Data		

LIQUID DATA MENU ITEMS

Reynolds #	1010 corrects the current flow rate in accordance with this Reynolds number. This number is determined from pipe ID, current flow rate and liquid kinematic viscosity.
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2.11.5 THE SITE SETUP DATA MENU

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

Siemens	2 Channel [1]	Channel 1
Current transmit drive code		
fx (drive)		30
N (burst length)		5
Ltn in		-1.154
Vfmax GAL/MIN		1577.42
Vs max m/s		2165.41
Vs min m/s		936.62
Empty %		30
Samples/Cycle		16
Max Damping		
Min Damping		
HF		0.120
Site Setup Data		

SITE SETUP MENU ITEMS

fx (drive)	Current Transmit drive code selected during Initial Makeup. The drive code controls the sonic transmit signal.
N (burst length)	Transmit burst duration selected during Initial Makeup. To change N count press <Right Arrow>. At equal sign enter numeric value (1 to 9 only).
Ltn (in)	Spacing distance between the transducers. It will be in inches or millimeters, depending on default units.
Vfmax	The flow velocity (in selected units) corresponding to one whole cycle offset between upstream and downstream receive signals.
Vs max m/s	Maximum correctly calibrated Vs for current transducer spacing.
Vs min m/s	Minimum correctly calibrated Vs for current transducer spacing.
Empty %	Value of Empty Alarm Setting. The meter will declare an empty status if signal strength drops below this value.
Samples/Cycle	Digital sampling rate.
Max Damping	Maximum damping. Use to average digital data when an unstable condition occurs.
Min Damping	Minimum damping. Use to average digital data when an unstable condition occurs.
HF	Flow registration correction parameter.

Introduction to [HF] Menu Item

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

Using the [HF] Menu Item

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

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

- This menu is only accessible for the transducer channels, not the virtual (average flow) channel of the flowmeter. (i.e., Diagnostics Path 1 or Path 2, but not Path 1 & 2).
- The 1010 flowmeter will inhibit the “Automatic” installation of the [HF] parameter if the flow rate is insufficient (too low) to accurately measure the required correction. If the maximum flow rate for the application is relatively low then this correction should not be required.
- If the flow rate is very high and the flowmeter is reporting erroneous or unstable flow, then the flowmeter may already be having trouble resolving the upstream and downstream signals. In this event, it may be necessary to first lower the flow rate to a moderate level before performing the “Automatic” HF adjustment. Once this is done the flowmeter should be able to properly measure the highest flow rates without problems.
- The limits of the “HF” parameter are +/- 0.7 and 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.

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

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

- In the [Diagnostic Data] Menu, highlight [Path Select] and select the desired transducer path. Press <ENT> to select path.
- Press the <Down Arrow> and scroll to the [Site Setup Data] menu cell. Press the <Right Arrow> to select it.

“Manual” Adjustment Procedure

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

Siemens	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		
		1000.00
Samples/Cycle		
		29
Max Damping		
Min Damping		
HF		
		>-0.000
Site Setup Data		

Siemens	Dual Path	4SS10G
fx (drive)		
		29
N (burst length)		
		5
Ltn in		
		5 316
Vf max CU		
		>Manual
Vs max m/s		
		= -0.120
Vs min m/s		
		1000.00
Samples/Cycle		
		29
Max Damping		
Min Damping		
HF		
		>-0.000
Site Setup Data		

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

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

“Automatic” Adjustment Procedure

- In the [Site Setup Data] Menu, press the <Down Arrow> and scroll to the [HF] menu cell. Press the <Right Arrow> and a pop-up [Manual] prompt will appear.
- Press the <Up or Down Arrow> to select [Automatic] then press <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.

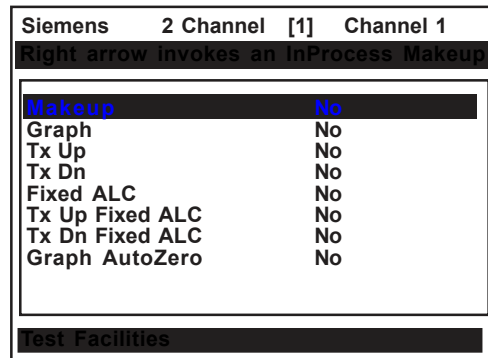
Siemens	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU	Adjustment	
Vs max m/s	>Automatic	
Vs min m/s	1355.00	
Samples/Cycle	29	
Max Damping		
Min Damping		
HF	>-0.000	
Site Setup Data		

Siemens	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU	>Automatic	
Vs max m/s	= 0.026	
Vs min m/s	1355.00	
Samples/Cycle	29	
Max Damping		
Min Damping		
HF	>-0.026	
Site Setup Data		



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

2.11.6 THE TEST FACILITIES MENU


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




To start a Test Routine:

To scroll the cursor to the test routine press  

To access the test option list press . Press   to move the asterisk to [Yes].

To start the routine press 

To end the routine press 

TEST FACILITIES COMMANDS



Makeup	Commands the meter to re-acquire the receive signal.
Graph	Enables an on-screen marker display. - Cor Q should be greater than 1.5. Larger number is better. Above 3 is desirable. SIG Q should be less than 10. A value of 8 or less is desirable.
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.*
Graph AutoZero	Use to establish a standard zero flow setting.




* For technical service diagnostics.


Makeup

The Test Facility Makeup routine allows you to command the meter to re-acquire the operating parameters established during the Initial Makeup routine invoked by the [Install Completed?] command (see paragraph 2.4 Pick/Install Xdcr Menu).

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.

Detection Modes

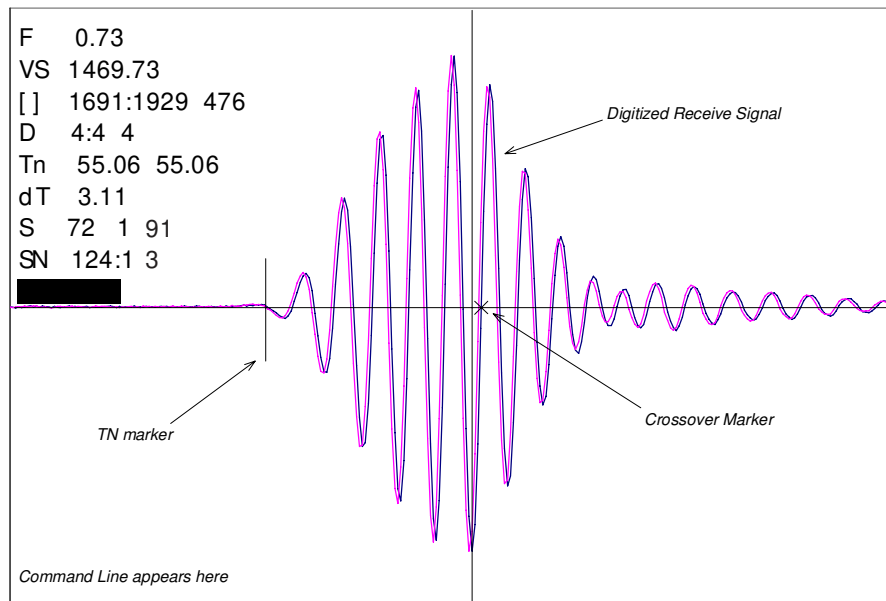
System 1010 flowmeters, Version 3 or higher, are equipped with a Test Facilities Graph Screen. The following paragraphs explain how the Test Facilities Graph Screen is used for troubleshooting System 1010 flowmeters.

The Test Facilities Graph Screen

NOTE: The following is intended for 1010 VFMT systems with Graphic Displays only. For VFMT capable 1010X systems (with or without digital displays) or 1010N blind systems, the digital receive signal can only be viewed as a text dump over the RS-232 output (i.e., by pressing the [F1] key and then the period key [.]). Access to the digital damping parameters can be found in the [Site Setup] menu cell of the Diagnostic Data menu. Refer to the appropriate System 1010 field manual for details.

When operating in the transit time mode the Test Facilities Graph Screen is an exceptional diagnostic tool for troubleshooting problem applications or simply determining receive signal quality. The primary function of this screen is the display of the digitized receive signal waveform with similar appearance and function of a digital oscilloscope. This screen also allows the user to override some of the 1010 default settings by permitting adjustment to the measured transit time, the digital averaging and the zero crossover used in the measurement of the up/down transit time difference. The figure shown on the next page is a representation of the 1010 diagnostic graph.

NOTE: The Test Facilities Graphic Screen requires significant CPU overhead. The 1010 meter should not be left in this mode during normal operation, where the Datalogger is the primary output, or during calibration work.



Entering the Diagnostic Graph Screen

Before you can view the Diagnostic Graph Screen the 1010 flow channel must first be properly installed and operating in a non-empty condition (refer to the appropriate 1010 Field manual). If a previously installed channel is in a “Fault” condition, but not reporting “Empty”, you can still access the Graph Screen to aid in troubleshooting the cause of the failure to measure flow.

To view the Graph Screen first enter the [Test Facilities] menu, which is a submenu of the main [Diagnostic Data] menu.

- Pressing the <Up/Down Arrows>, scroll to the [Graph] menu item.
- Press the <Right Arrow> to enter the [Graph] menu and scroll to highlight the [Yes] item in the option list.
- Now press the <ENT> key to access the Graph Screen.
- To exit the Graph Screen and return to the main menu, press the <MENU> key once.

Diagnostic Text Display

The text to the upper left-hand corner of the screen represents diagnostic items which can be individually turned on or off to reduce unnecessary clutter on the screen. This text display can be modified by pressing the <ENT> key and scrolling up or down through the various parameters that appear in the Graph Display menu. Pressing the <ENT> key will select the highlighted parameter (a “+” sign appears next to selected items) and pressing <CLR> will deselect the item. Pressing the <Left Arrow> will return you to the graph screen with the selected parameters appearing at the top left corner of the screen. (The figure above is shown with all diagnostics items selected).

Time Base Control

The digitized receive signal can be moved either to the left or right on the screen by pressing the <Left> or <Right> keypad arrows. The direction of the arrow actually represents the direction in which the receive “window” will move, thereby causing the receive signal to shift in the opposite direction on the screen (e.g., Pressing the <Left Arrow> moves the signal to the right).

The digitized receive signal can be expanded or contracted in the time domain by pressing the <+> or <-> keys on the keypad. This allows you to see the entire contents of the receive window, or zoom in to see greater detail. Pressing the <CLR> key once will automatically center the receive signal on the screen. When zooming in on the receive signal small vertical “tick” marks may appear. These marks represent the time at which the receive signal is digitally sampled.

Correlated Plot

During conditions of flow, the actual transit time delta (difference) can be observed in the displayed receive signal waveform when the [Correlated Plot] menu parameter is not selected. To observe this time difference simply depress the <+> key (to see greater signal detail) until the individual up and down receive signals are clearly discernible.

To verify that the 1010 signal processing algorithms are properly correlating the up and down stream receive signals, select the [Correlated Plot] option from the display menu list. Return to the graph screen and observe the relative position of the up and down waveforms. In a properly correlated receive signal the two images should be nearly superimposed on top of each other, even during high flow

conditions. In the unlikely situation where the two images appear to be offset by one or more receive cycles then the flow readings should be considered questionable.

Command Modes

Although the 1010 signal processing algorithms are capable of accommodating a very wide range of signal conditions, it may be desirable to override these default settings under extremely difficult operating conditions. The following functions are available for this purpose:

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. In this situation the meter will use the MaxDamp value when sound velocity is stable, but then switch to a faster damping value (limited by MinDamp) when a significant change in sound velocity is perceived. To exit this mode, press the <0> key on the keypad.

Transit Time Adjustment: (Hot Key 3)

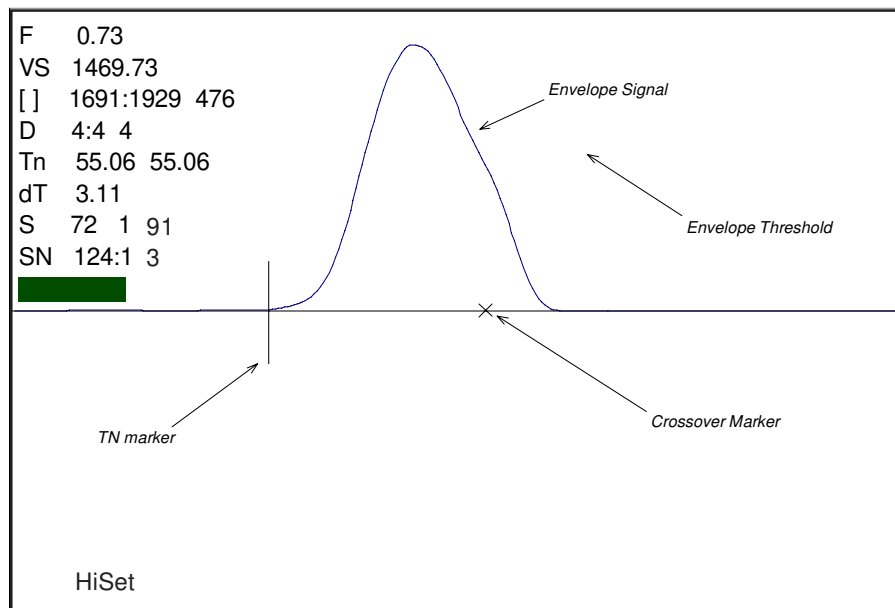
Observe the short vertical marker at the beginning of the receive signal in the Graph Screen above. This line represents the position in time (T_n) where the 1010 flowmeter perceives the arrival of the ultrasonic signal. There are actually two T_n markers, one for the upstream arrival time and one for the downstream arrival time. For proper liquid sound velocity measurement these T_n markers should be positioned near the beginning edge of the receive wave-form envelope (as shown), however, in cases of poor signal conditions it is possible for this measurement to be off by several receive waveform cycles. To adjust the T_n mark position press the <3> key on the keypad to bring up the [TnSet] command. Pressing the <+> or <-> keys will cause the T_n marker to move later or earlier, respectively. As you adjust the T_n marker, both T_n and V_s (liquid sound velocity) will change accordingly. To exit this mode, press the <0> key on the keypad.

Zero Crossover Adjustment: (Hot Key 4)

Observe the small “X” mark located on the zero crossing line near the middle of the receive signal in the Graph Screen above. This “X” indicates the central crossover which the 1010 is using to measure the transit-time delta. This crossover will generally be close to the peak of the receive signal with at least one well formed (non-aberrated) receive cycle on each side of the crossover. If it appears that the placement of this crossover is unsatisfactory then it can be adjusted by pressing the <4> key on the keypad, which will invoke the [ZCOSet] command. The crossover point can then be moved in either direction on the waveform using the <+> or <-> keys. The change from the default value (in receive cycles) will appear in the number to the right of the command. To exit this mode, press the <0> key.

Envelope Threshold Adjustment: (Hot Key 5 & 6)

Pressing the <=> key causes the graph to toggle between the default signal waveform screen and the signal envelope screen (see example below). This envelope screen can aid in the diagnosis of Tn errors caused by unusual receive waveform distortion. Signal distortion is sometimes caused by poor transducer selection or poor pipe wall conditions, which may result in an incorrectly measured fluid sound velocity. To improve the automatic measurement of Tn, the envelope threshold limit can be adjusted to exclude portions of the envelope, which may be causing the Tn detection problem.



If it appears that the default placement of the Tn marker is incorrect or unstable, it can be adjusted by pressing the <5> key on the keypad to invoke the [EnvSet] command (while viewing the envelope screen). A horizontal line representing the envelope threshold level will appear along with a number indicating the percentage level. The High and Low thresholds can then be moved either up or down on the envelope using the <+> or <-> keys. While viewing the Tn marker position, adjust the thresholds so that they are well above the baseline “noise” level but below the first major peak. To exit this mode, press the <0> key.

Signal Masking Function: (Hot Key 7)

Under conditions of extremely low signal amplitude, a noise spike associated with 1010's receive signal window may be present on the extreme left side of the graph display. If this spike is large enough it may interfere with the signal detection routines. To eliminate this noise from the signal processing routines, press the <7> key to invoke the [MaskSet] command, then press the <+> key until the noise is no longer present in the receive waveform. Press <0> to exit this command.

DESCRIPTION OF GRAPH SCREEN TEXT DISPLAY PARAMETERS

Screen Text Parameters	Menu List item	Description
F	Flow	Measured flow rate in selected flow units.
VS	Vs (m/s)	Sound Velocity in meters per second.
[]	Display Metrics	Represents the digital sample position of the receive window.
	Correlated Plot	Displays the receive waveform in its proper superposition or registration. The true delta time will be displayed by NOT selecting "Correlated Plot".
	Centroid Mark	Indicates with a large vertical marker the peak energy of the receive waveform.
D	Damping	Displays the minimum and maximum digital damping exponent along with the active damping exponent.
Tn	Tn (usec)	Receive signal transit time in microseconds.
dT	Delta T (nsec)	Transit time delta (difference) in nanoseconds.
S	Signal Strength	Displays %Valc (amplitude), %Vaer (aeration factor) and numeric ALC.
SN	Signal to Noise Ratio	Indicates the signal to noise ratio of the receive signal. Increased damping will increase the S/N ratio as the asynchronous noise reduces.
	Envelope Signature	Percentage change of the signal from Initial Makeup conditions.

HOT KEY SUMMARY

Key	Command Line	Description
<+>		Expands (magnifies) waveform to view more detail.
<->		Contracts waveform to view more or the waveform.
<Left Arrow>		Shifts receive window to the left (waveform to the right).
<Right Arrow>		Shifts receive window to the right (waveform to the left).
<CLR>		Brings waveform to the center of the screen.
<ENTER>		Calls up Text Display menu items. <Left Arrow> to return to graph.
<MENU>		Exits the Graph Screen and returns to the main menu.
<1>	MinDamp	Minimum damping exponent control (+ or - to increase or decrease).
<2>	MaxDamp	Maximum damping exponent control (+ or - to increase or decrease).
<3>	TnSet	Transit time adjustment (use + or - to move Tn marker).
<4>	ZCOSet	Zero Crossover adjustment (use + or - to move crossover marker).
<5>	HiSet	Signal envelope threshold level (use + or - to move threshold).
<6>	LoSet	Signal envelope threshold level (use + or - to move threshold).
<7>	MaskSet	Leading edge masking functions (use + or - to alter number of samples masked).
<8>	Hold Set	Set this number higher if intermittent mis-registration occurs.
<0>		Exits the command line.
<=>		Toggle graph between receive waveform and envelope waveform.
<F1> and <. >		Dumps the digitized waveform data over the RS232 port. You must first leave the Graph Screen mode before invoking this command.

2.11.7 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 Siemens Ultrasonic Flow Representative for expert help.

Flow Computer Messages

Certain actions or conditions invoke messages that may appear as a pop-up window, in the right-hand column of a given menu cell, or the highlighted prompt line at the top of the display screen. The following is a list of messages that you may encounter along with explanations, and in some cases, a recommended action.

MESSAGE	DESCRIPTION
Memory Full!	Response to an attempt to save site data, when data memory is full. Delete an obsolete site or clear Datalogger memory to make room for the new data.
Memory Corrupted!	Memory read error occurred while accessing the active site data.
Chan Not Setup	Response to an attempt to invoke an operation that requires a channel to be enabled. Enable the channel [<i>Channel Setup</i> → <i>Channel Enable</i> → <i>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 Saved Memory?
<EOT>	Response to a request to output datalogger data to the printer or the Graphics screen when no datalogger data exists. Set up the Datalogger.
Empty Pipe-Press [ENT]	Prompt to empty the pipe during the Actual MTY procedure. After emptying pipe, press <ENT>.
Fill Pipe-Press [ENT]	Prompt to fill the pipe during the Actual MTY procedure. After filling the pipe, press [ENT] (see paragraph 3.1.3).
No Sites	Response while trying to recall/delete a site setup when no Sites are stored.
Not Installed	Response to an attempt to access a menu function that is not included.
Re-space Index	Upon measuring the liquid sonic velocity (Vs), the meter recommends re-spacing the transducers to improve performance.
Invalid Setup (use Direct Mount)	<p>During the Initial Makeup, the system detects invalid transducer spacing, erroneous liquid/pipe parameters, or some other factor that prevents it from completing the Initial Makeup. This may be due to one of the following:</p> <ul style="list-style-type: none"> • An out-of-range data entry. • An invalid condition; (e.g., overlapping transducers in Reflect Mode). <p>If selecting Direct Mode does not resolve, review all site setup and transducer installation choices; particularly data entered for the pipe and liquid.</p> <ul style="list-style-type: none"> • In Reflect Mode, the flow computer detects that the pipe wall signal may infringe upon the liquid signal. Use Direct Mode instead <p>Press <ENT>, <UP Arrow>, <DOWN Arrow>, or <LEFT Arrow> to abort install routine. Continue programming other site data in anticipation of resolving the difficulty later. Call technical support for help if necessary.</p>

(continued)

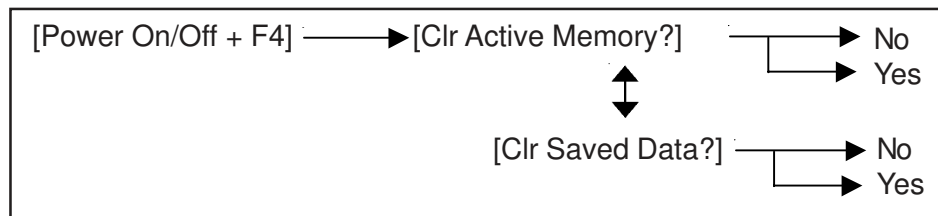
MESSAGE	DESCRIPTION
Low Signal - Press [ENT]	During the Initial Makeup, the meter decides that the level of the receive signal is insufficient for proper operation. Some reasons for low signal are: <ul style="list-style-type: none"> • Invoking [Install Completed?] on an empty pipe. • Coupling compound insufficient, not applied, or evaporated. • A disconnected or broken transducer cable. • You need to condition the pipe at the mounting location. • Flush out Large air bubbles. • The Xdcr cables are defective or not connected to the correct channel. • The Set Empty routine performed when pipe was NOT actually empty.
Detection Fault	If you locate and correct the improper condition immediately, press <ENT> to resume the installation procedure. Otherwise, press the <LEFT Arrow> to abort the installation and conduct a thorough investigation. <p>Appears if the meter cannot complete an Initial Makeup. It means that the pipe and/or liquid conditions do not permit a receive signal that meets the flow detection standards. The system will not be able to operate. Attempt to improve operating conditions by reinstalling the transducers at a different spacing offset, or even at a different location on the pipe. In addition, switching from Reflect to Direct Mount may solve the problem. However, operation may not be possible if there is poor liquid or pipe wall sonic conductivity or extreme liquid aeration.</p>

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

Using the “F4” Reset Sequence

You may encounter an operating problem that blocks access to the Diagnostics Menu, or the meter may operate erratically after exposure to a power transient or some other traumatic event. These cases may require use of the F4-Reset sequence to restore operation.

The F4-Reset sequence operates on two levels. The first F4-reset 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 all you have to do to restore operation is reload a saved Site Setup. If this fails then you have to resort to the second level of the F4 sequence, which allows you to clear ALL Dynamic Memory. Be aware that this erases all saved Site Setups (*including flow calibrated sites*). Datalogger Data and user-defined pipe and transducer tables. This will require you to completely re-install the system and repeat all desired default settings, custom pipe tables, etc. The chart below shows the sequence of the [F4] routine:



Procedure to clear Active Memory only:

Turn off power (if it is currently on).

Press <F4> and keep it pressed while you turn on power.

The prompt: **[Clr Active Memory? No]** appears at the top of the screen

To access the [F4 Reset] option list press <Right Arrow>. Press <Down Arrow> to switch option list to **[Clr Active Memory? Yes]**. To clear all Active Site Data (but not saved Site Setups). Press <ENT>.

To restore operation, press <MENU> to access the installation menu. Create a new site setup or recall a stored site setup.

Re-select any Meter Facilities items (e.g., RS-232 setup parameters).

Procedure to clear ALL Dynamic Memory:

Turn off power (if it is currently on).

Press <F4> and keep it pressed while you turn on power. The prompt: **[Clr Active Memory? No]** appears at the top of the screen. Press <Down Arrow>. Note that the prompt switches to **[Clr Saved Data? No]**.

To access the F4 Reset option list press <Right Arrow>. Press <Down Arrow> to switch the option list to **[Clr Saved Data? Yes]**.

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 technical service before continuing with this procedure. 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.

To clear all Dynamic Memory press <ENT>.

Create a Site Setup before attempting to access other menu items.

To restore operation, press <MENU> to access the Installation Menu. Create a new site setup and complete the installation procedure.

Re-select desired Meter Facilities items (e.g., RS-232 setup parameters).

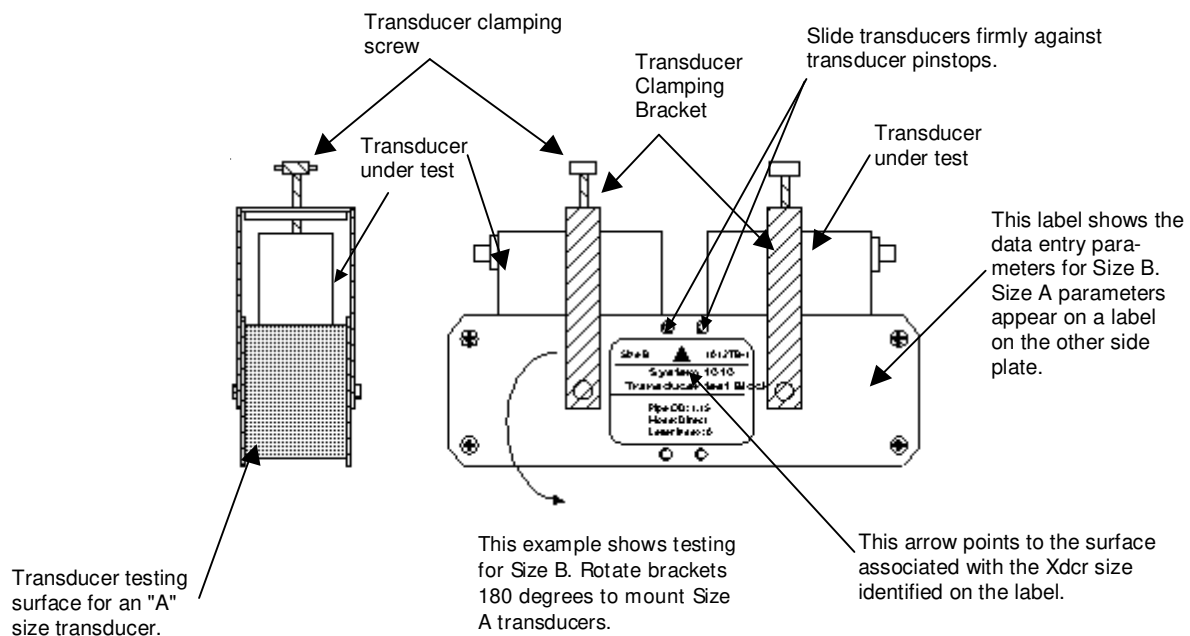
Troubleshooting With Transducer Test Blocks

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

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

2.11.8 USING THE 1012TB-1 AND -2 TEST BLOCKS

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



MOUNTING TRANSDUCERS ON A 1012 TRANSDUCER TEST BLOCK

- Identify the side of the simulator that applies to the transducers under test. Rotate the clamping bracket as required to mount transducers on the test surface.
- Using a coupling compound (preferably CC-102), mount the transducers on the pipe simulator as shown above. Slide each transducer until it presses against the pin-stop. Use the clamping screws to hold the transducers in place.
- Connect transducer cables between each transducer and the meter connectors for the channel under test. The Up and Down orientation is not important.

- Access the Installation Menu. Select [Meter Type] [Single, Dual, or Quad Channel] depending on meter type. Select the meter channel (1,2,3, or 4) depending on which measurement channel you intend to test. Select [Clamp-On] and then [Channel Setup].
- Access the [Channel/Path Setup] menu. Move the highlight to [Create/Name Site]. Create a new Site Setup (e.g., TEST1). You can now enter data without altering an existing Site Setup.
- Select the [Pipe Data] Menu. Referencing either the English or metric pipe simulator chart below, enter the pipe data corresponding to the transducer size under test.

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

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

*System Defaults

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

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

* System Defaults

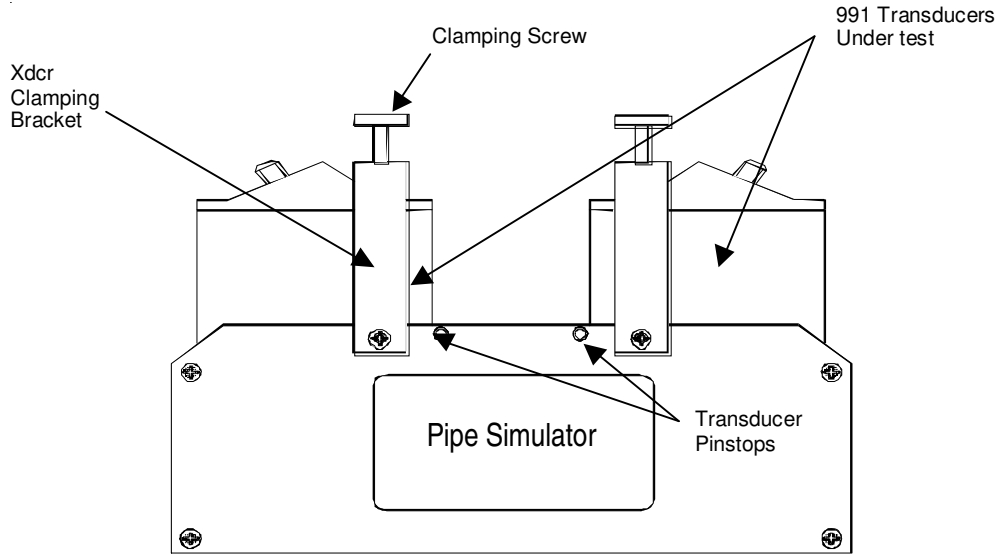
- Access the [Pick/Install Xdcr] menu. Check the [Transducer Size] menu cell. If necessary, enter the [Xdcr Size] option list and pick the transducer under test.
- Check the [Xdcr Mount Mode] menu cell. Adjust to match the simulator chart above.
- Press the <Down Arrow> to move the highlight down to [Install Completed?]. Access the option list. Press the Up or Down Arrows> and move the cursor to [Install]. Press <ENT> to start the transducer install routine.

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

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

2.11.9 USING THE 996PSP PIPE SIMULATOR

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



To mount Transducers on a 996PSP Pipe Simulator:

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

996PSP PIPE SIMULATOR CHART (English)

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

* The computer generates the Number Index.

** See note below.

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

996PSP PIPE SIMULATOR CHART (Metric)

Part Number	Xdcr Size	Pipe OD (mm)	Pipe Mat'l	Wall Thk (mm)	Mount Mode	Letter Index	Number Index*
996PSP-0	0	61.47	PVC	1.93	Direct	A	6
996PSP-1	1	63.02	PVC	1.96	Direct	A	9
996PSP-2	2	69.67	PVC	3.45	Direct	A	6
996PSP-3	3	95.45	PVC	8.74	Direct	A	1
996PSP-4	4	165.1	PVC	25.4	Direct**	A	0

* The computer generates the Number Index.

** See note below.

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

- Access the [Pick/Install Xdcr] menu. Access the [Transducer Model] menu cell. Enter the Transducer Model option list. Select [991 Universal].
- Check the [Transducer Size] menu cell. If necessary, enter the Transducer Size option list and pick the actual transducer under test.
- Check the [Xdcr Mount Mode] menu cell. Adjust as necessary to match the simulator chart above.
- Move the highlight down to [Install Completed?]. Access the option list. Move the cursor to [Install]. Press <ENT> to start the transducer install routine.
- Check to make sure that the computer returns the Number Index listed in the chart above. Next, review and verify the Diagnostics data items as described previously. If the computer, cables and transducers are operating properly, then review all site conditions to locate the operating problem.

If a Pipe Simulator/Test-Block Test Fails:

- Replace the transducer cables. If this allows you to complete the test as described above, then the cables were defective.
- If the cables are proven to be good, replace the transducers on the pipe simulator with a “known good” set. If the system functions properly, then the original transducers under test are defective. Please return any defective transducers to Controlotron for repair.
- If you replace the transducers and cables, and the system still fails to function correctly, then it is likely that the computer has a malfunctioning circuit module. If you have spare modules you may try module substitution to identify the defective module. Otherwise, please call our Technical Service Department for further instructions and assistance.

2.12 GUIDE TO A SMOOTH INSTALLATION

NOTE: The following should be used in conjunction with the System 1010 Field Manual Diagnostic and Troubleshooting procedures.

2.12.1 CHECKLIST FOR 1010 STARTUP & PERFORMANCE

PROGRAMMING

- Select appropriate meter type: Clamp-On, Reflexor, Dual Beam, Flow Tube, etc.
- Select proper channel (Dual or Multi-Channel Systems Only).
- Use "Full Site Setup"
- Create Site (or Recall Site).
- Program accurate Pipe Diameter, Material & Wall Thickness (or choose from tables).
- Program accurate Liner Material and Thickness (if applicable); Ensure Liner is well bonded.
- Program correct Liquid Type (Estimated Vs), Consult Vs Database for liquids not on meter menu.
- Select Recommended Transducer, HP for Steel Only; Use first choice for Universals, if possible.
- Ensure Transducer Type & Size match programming.
- Ensure transducer serial numbers match each other.

INSTALLATION/TRANSDUCER MOUNT GUIDELINES

- Install Transducers (Reflect/Direct) as recommended by meter; Use assigned spacing positions!
- Use Reflect Mount whenever possible (Not permitted on plastic pipes).
- Avoid placing transducers downstream of flow obstructions, pressure drops, elbows.
- Mount upstream of Orifice Plates, Turbines, Valves, "T's"
- Allow a minimum of 10 diameters of straight pipe upstream of Transducers; More following multi elbows.
- If <10 diameters is available, mount Reflect within 2 diameters, in Plane-of-Elbow (on outside of bend).
- DO NOT mount Transducers on top and/or bottom of horizontal pipe!
- Ensure pipe is clean and smooth; remove external scale, loose or flaking paint.
- Use appropriate Coupling Compound for application (see charts below).

- Avoid mounting on pipe seams.
- Connect “UP” Cable to “Upstream Transducer” (closest to source of flow) and vice versa.

START-UP

- Ensure pipe is FULL (flowing or not).
- Select “Install Complete?”INSTALL to Invoke “Initial Makeup” routine.
- Verify “Measured Vs” is accurate for liquid type & temperature (Consult Vs Database)
- Set Zero appropriately (AutoZero or ZeroMatic for Reflect, Actual Zero or ReversaMatic for Direct).
- After completion of Zeroing, access Flow Display by pressing <MENU> key.
- Use <UP/Down Arrows> to scroll through available displays.

DIAGNOSTIC/PERFORMANCE VERIFICATION

- Verify Vs is correct for Liquid and Temperature.
- Verify Valc is Greater Than 30.
- Verify Vaer is Less Than 10 when flowing.
- Check Signal Graph Trace to be acceptable. See reference graphs below.
- For 1011 Universal Transducers verify “VfMax” is significantly higher than maximum Flow Rate of application.
- Set “Hi Flow” at 90% VfMax; Ensure it is higher than Max Application Flow Rate.
- Set “Lo Flow” at –10% VfMax. (For unidirectional flow applications only!)
- Set “Lo Flow” at 10% Greater Than Maximum Negative Flow (Bi-Directional Applications).

2.12.2 OPTIMIZATION/CORRECTION OF PROBLEMS

Incorrect “Measured Vs”

- Verify actual pipe (outside) diameter matches meter programming.
- Verify actual Wall Thickness matches meter programming.
- Verify transducer Type and Size matches meter programming.
- Verify transducer mount method, and spacing positions (indices) match meter programming.

- Check actual transducer spacing matches “Ltn” dimension.
- Verify that Signal Graph is acceptable (see below).
- Use recommended High Precision or first recommended Universal Transducer.
- Verify Liquid Vs in database (take into account actual temperature & pressure).
- Verify Liquid chemistry is as expected. (Ask about additives, Pressure, Temp.)
- Try “1-Cycle” Vs Correction in Diagnostics if error remains for a liquid with well defined Vs data.

Low Valc

- Clean and condition pipe surface.
- Use High Precision or first recommended Universal Transducer.
- Use Direct Mount (be sure of transducer 180° alignment!).
- Use larger size transducer (Universal Only!).
- Use wider spacing (Maximum or Letter D).
- Stop flow to check for Aeration/Cavitation.
- Try another location.
- Perform an Initial Makeup after ANY of the above changes!!

Detection Fault/Low Signal

- Perform all checks for “Low Valc”
- Ensure pipe is full.
- Ensure cables are terminated at both ends; Check continuity with Ohmmeter.
- Check operation on Pipe Simulator.
- Switch off any radiating electrical equipment in area (Transmitters, Variable Freq. Drives, etc.).

High Vaer

- Avoid transducer mounting near flow obstructions.
- Check for possible pressure drop sources (Pipe Expansion, Orifice, Check Valve, etc.).
- Check liquid “Flash Point” against application conditions.
- Pinch downstream valve (of Transducer) to raise pressure.

- Mount on suction side of pump.
- Raise tank levels; adjust Float switches.
- Switch off any radiating electrical equipment in area (Transmitters, Variable Freq. Drives, etc.).

Poor Signal

- Check that actual pipe dimensions and material match programmed data.
- Consult X-Select; Choose first recommended transducer.
- Relocate transducers.

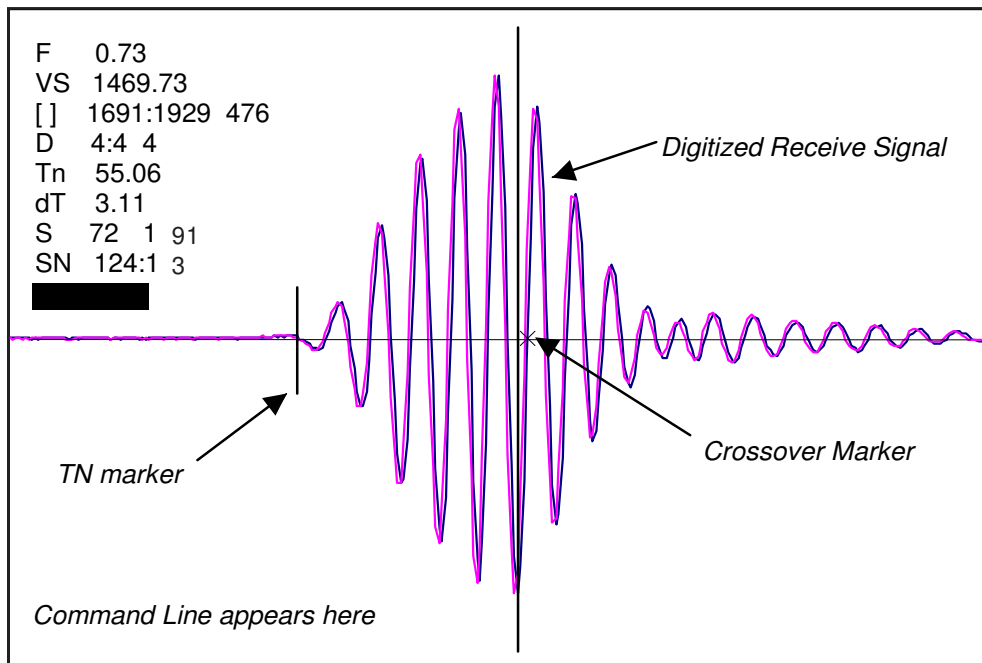
“Official” COUPLING COMPOUNDS

Part#	Name	Application	Max Temp.	Remarks
CC-102	Ultragel	Portable, Short Term (< 24 Hours)	110°F, 43°C	Water Soluble
CC-110	RTV-734	Permanent (Plastic Xducers Only)	150°F, 65°C	Avoid Humidity
CC-114	Magnalube	Long Term Teflon Grease	300°F, 159°C	Temp. affects life
CC-117	Dow-340	Temperature Sensors Only	400°F, 205°C	Heat Sync Comp.
CC-120	Denso	Submersible Applications	150°F, 65°C	Good Noise Damp
CC-122	Krytox	Long Term High Temperature	450°F, 232°C	Use for all HT
CC-124	Barco Bond	Permanent Epoxy for Metal Xdcrs	150°F, 65°C	Cure at Ambient
CC-128	SuperLube	Long Term Grease	375°F, 190°C	Avail. In Stores

“Alternative” COUPLING COMPOUNDS

Trade Name	Application	Max Temp.	Remarks
Motor Oil, Gear Oil, STP	Portable, Short Term	250°F, 121°C	Messy
Auto Wheel Bearing Grease	Moderate to Long Term	250°F, 121°C	Good Gen'l Compound
Silicone Rubber (RTV)	Permanent	As Rated	Cure at Ambient
2-Part Epoxy	Permanent	As Rated	Cure at Ambient
Gasket Cement	Permanent	375°F, 190°C	Cure at Ambient

Ideal Vsig Display



3. HARDWARE INSTALLATION GUIDE

3.1 PREPARING TO MOUNT THE TRANSDUCERS

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

- Selecting a mounting option for your application
- Selecting a location on the pipe
- Preparing the pipe to accept the transducers

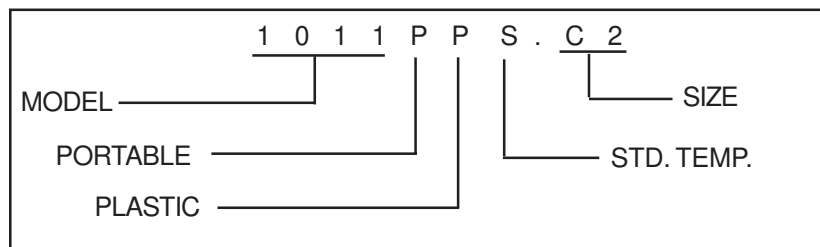
NOTE: When installing transducers, do not key in the V/M (Version/Modification) label number as the Transducer Size.

3.1.1 HOW TO IDENTIFY 1011 TRANSDUCERS AND MOUNTING HARDWARE

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

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

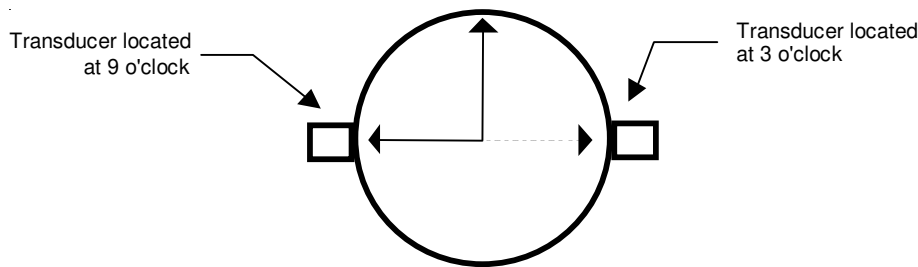
The transducer part number located on the front face provides a more detailed identification. *For example, the Part Number: 1011PPS-C2 means:*



3.1.2 SELECTING A LOCATION FOR CLAMP- ON TRANSDUCERS

- Locate the transducers downstream from the center of the longest available straight run. A location ten pipe diameters or greater downstream from the nearest bend will provide the best flow profile conditions.
- Do not (if possible) install the transducers downstream from a throttling valve, a mixing tank, the discharge of a positive displacement pump or any other equipment that could possibly aerate the liquid. The best location will be as free as possible from flow disturbances, vibration, sources of heat, noise, or radiated energy.

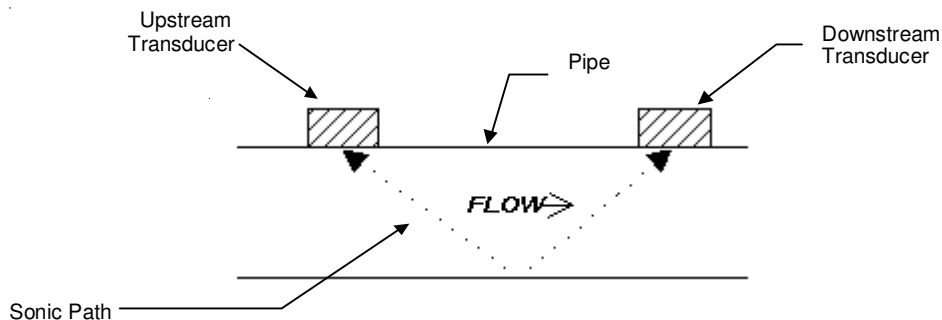
- Avoid mounting the transducers on a section of pipe with any external scale. Remove all scale, rust, loose paint, etc., from the location.
- Do not mount the transducers on a surface aberration (pipe seam, etc.).
- Do not mount transducers from different ultrasonic flowmeters on the same pipe. Also, do not run the transducer cables in common bundles with cables from communication equipment, other Controlotron systems, or any type of ultrasonic equipment. You can run these cables through a common conduit ONLY if they originate at the same flowmeter.
- Never mount transducers under water, unless you order submersible units and you install them in accordance with factory instructions.
- Never mount transducers on the top or bottom of a horizontal pipe. The best placement on a horizontal pipe is either the nine o'clock or three o'clock position for Reflect Mode, or one transducer at nine o'clock and one transducer at three o'clock for Direct Mode. Mounting on a vertical pipe is recommended only if flow is in the upward direction. When mounting on a vertical pipe flowing in a downward direction make sure there is sufficient back pressure in the system to maintain a full pipe.



END VIEW OF PIPE
(Horizontal Plane)

3.1.3 CLAMP-ON TRANSDUCER MOUNTING MODES

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

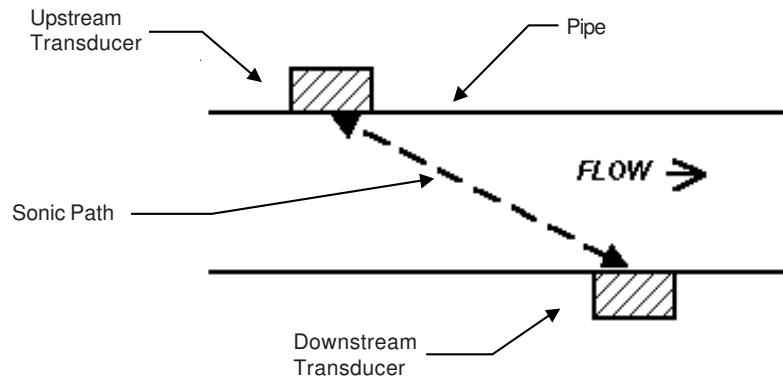


REFLECT MOUNT

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

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

Direct mount provides a shorter sonic beam path. This usually improves performance with sonically attenuative liquids or pipe materials. We recommend using Direct mount for plastic pipes. Compared to Direct mounting, Reflect mount requires almost double the amount of a straight pipe run. Therefore, Direct mount may be the only option if the availability of mounting space is limited.



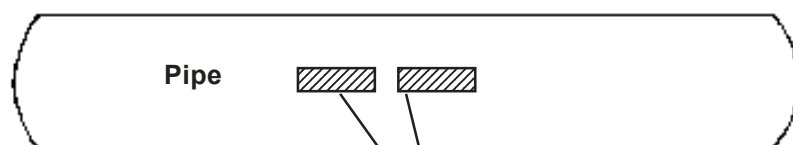
DIRECT MOUNT

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

3.1.4 PREPARING THE PIPE

- Pick a mounting location with the longest straight run. You must have easy access to at least one side of your pipe. The mounting location must remain full, even at zero flow.
- Decide on your mounting mode (Direct or Reflect). Always use Reflect Mode whenever possible. You may only need to use Direct Mode if your pipe is plastic.
- After receiving the spacing dimensions from the Installation Menu, prepare the pipe surface. Degrease the surface, if necessary, and remove any grit, corrosion, rust, loose paint, etc. Use abrasive material provided to provide a clean contact surface for the transducers.
- Refer to the next sections for illustrated instructions on how to locate each area to be cleaned and how to use each mounting option.

Please note that the instructions show vertical mounting for clarity purposes only. Do not install transducers on the top of a pipe.

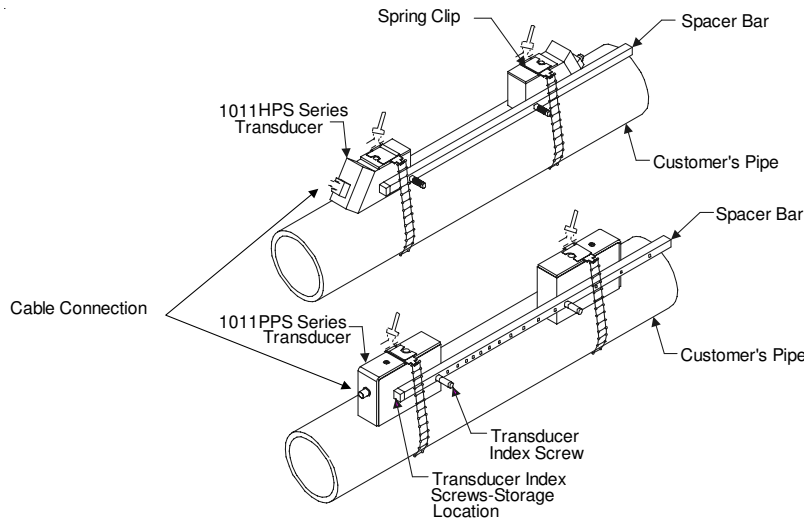


PREPARING THE PIPE SURFACE

Cleaned areas. Clean an area 1/2" on either side of transducer and an additional 1/2" along the length of the transducer.

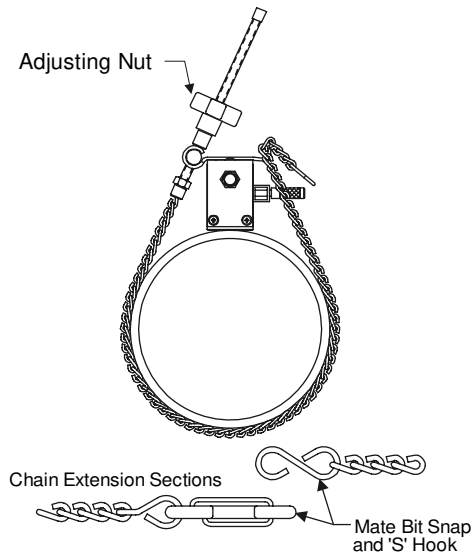
3.1.5 REFLECT MODE WITH EZ CLAMP AND SPACER BAR ONLY

The EZ Clamp is a quick and easy way to securely mount transducers on any pipe. The spacer bar eliminates manual spacing measurements and provides rigidity for mounting the transducers while maintaining axial alignment.



INSTALLATION - REFLECT MOUNT WITH EZ CLAMP AND SPACING BAR

1. Perform all required menu steps until the flow computer issues the number index and prompts you to press [ENT] to finish the transducer install routine. Stop at this point. Note the number index value displayed in the Pick/Install menu. You will use this number to properly space the transducers. Check to ensure that you have a matched set of transducers. They both should have the same SN number but marked with either an "A" or "B" (e.g., 100A and 100B).
2. Assemble the transducers to the spacer bar, with the cable connectors facing away from each other as shown above. The spacer bar is attached to a transducer using a transducer index screw. One transducer is attached using the "REF" hole on the spacer bar. The second transducer is attached to the spacer at the index hole specified in Step 1. Note that in some cases, the transducers may have two sets of holes for securing the transducers. When using the EZ Clamp assembly, use the lower set of holes when attaching the spacer bar.
3. Temporarily position the assembly (in the 9 o'clock position) at the location where you have determined it would be mounted. Ensure that this is a smooth area without any raised spots (seams, etc.). Mark a generous area around the transducers (with a pencil or chalk) where they contact the pipe. Remove the assembly.
4. Prepare the two areas you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided.
5. Remove the transducer from the spacer bar that was attached through the REF hole. Attach the EZ clamp to the transducer under the spring clip. The adjusting nut knob should be pointing up and on the side opposite of the spacer bar. Unscrew the knob until it's at the stop.

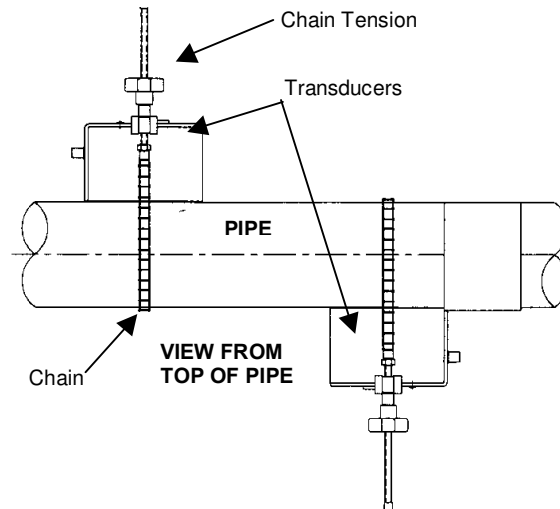


EZ CLAMPING TRANSDUCER TO PIPE

6. Apply a 1/8-inch continuous bead of couplant compound along the center (the long way) of the contact surface of the transducer. Place transducer on the pipe center in the middle of one of the areas you have cleaned with the cable connector facing away from where the other transducer will be placed.
7. While holding this transducer in-place, bring the chain around the pipe and attach the closest cross-link onto the hook of the EZ clamp. Tighten the adjusting nut until the chain is just snug around the pipe. Ensure that the chain is straight around the pipe and the transducer contacts the pipe at the white dot just under the front label. Ensure that there is equal space between the edges of the transducer and pipe.
8. Repeat Steps 5 and 6 with the second transducer leaving it still attached to the spacer bar. Apply a 1/8-inch bead of couplant compound to the transducer. At the same time that you place it in the middle of the second area prepared, secure the spacing bar to the already mounted transducer by inserting the transducer index screw through the REF hole on the Bar and into lowest hole on transducer (for those transducers that have two holes). Sight along spacer bar to ensure axial alignment to the pipe. Adjust if necessary. Tighten both chains. Do not overtighten. Ensure that transducers did not move while tightening.
9. Connect the transducer cable, ensuring that you have observed the upstream/downstream orientation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit, make sure you are connecting the cables to the correct channel's input jacks. Repeat this procedure for the number index transducer.

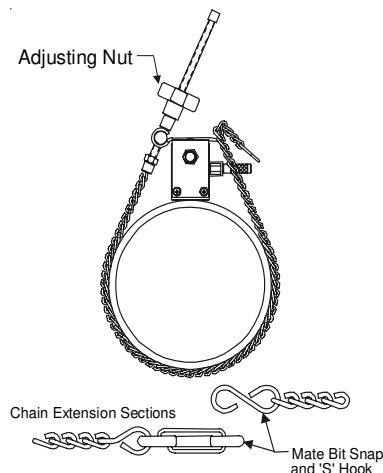
3.1.6 DIRECT MODE WITH EZ CLAMP AND SPACER BAR ONLY

This section will present an easy, uncomplicated method of mounting transducers in Direct Mode and ensuring that they will line up exactly 180° from each other (9 o'clock - 3 o'clock positions) and spaced the proper distance apart.



INSTALLATION - DIRECT MOUNT WITH EZ CLAMP AND SPACER BAR

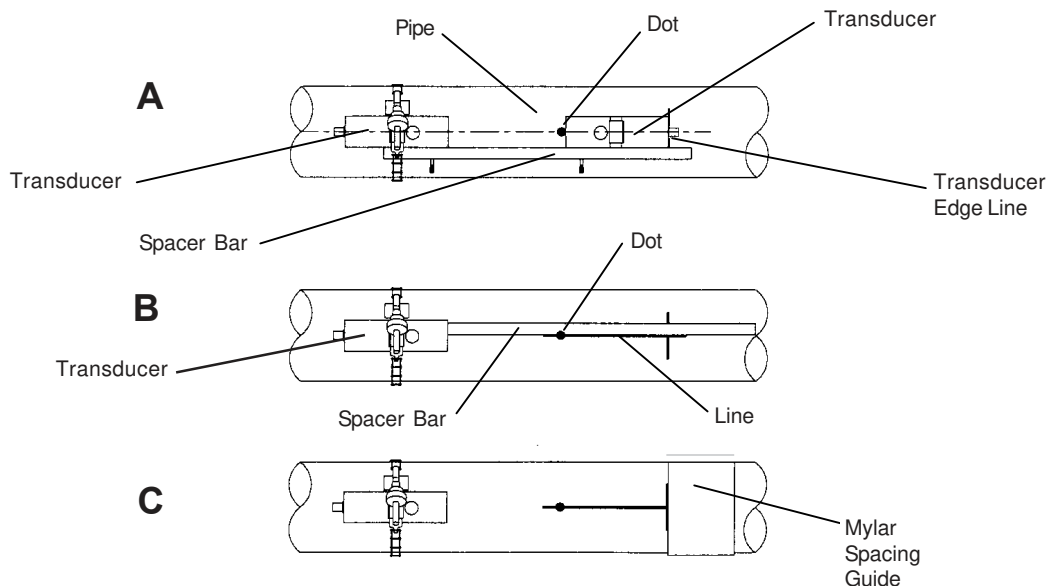
1. Perform all required menu steps until the flow computer issues the number index and prompts you to press [ENT] to finish the transducer install routine. Stop at this point. Note the number index value displayed in the Pick/Install menu. You will use this number to properly space the transducers. Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).
2. Temporarily position one transducer (in the 9 o'clock position) at the location where you have determined it would be mounted. Ensure that this is a smooth area without any raised spots (seams, etc.). Mark a generous area around the transducer where it contacts the pipe (with a pencil or chalk). Remove the transducer.
3. Prepare the area you marked by de-greasing the surface if needed and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided.
4. Attach the EZ clamp to the transducer under the spring clip. The adjusting nut knob should be pointing up and on the side opposite of the spacer bar. Unscrew the knob until it's at the stop.



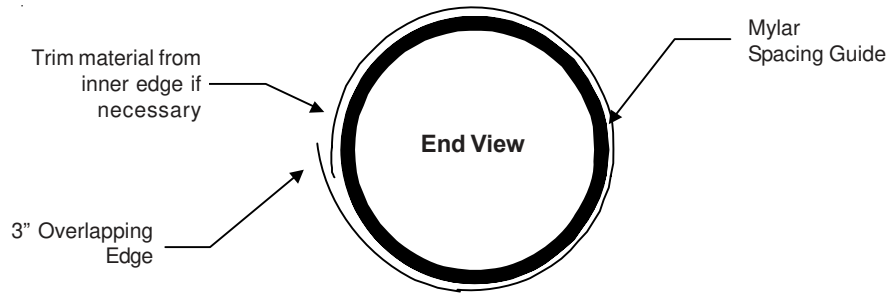
EZ CLAMPING TRANSDUCER TO PIPE

5. Apply a 1/8-inch continuous bead of couplant compound along the center (the long way) of the contact surface of the transducer. Position this transducer on the center of the pipe in the middle of area you have cleaned; the cable connector facing away from where the other transducer will go.
6. While holding the transducer in-place, bring the chain around the pipe and attach the closest cross-link onto the hook of the EZ clamp. Tighten the adjusting nut until the chain is just snug around the pipe. Check to ensure that the chain is straight around the pipe and that the transducer is contacting the pipe at the white dot just under the front label. Ensure also that there is equal space on either side of the dot between the edges of the transducer and the pipe. Adjust if necessary. Tighten the chain but do not overtighten. Ensure the transducer did not move while tightening.
7. Attach the second transducer to the spacer bar at the index hole specified in paragraph #1. Note that in some cases, the transducers may have two sets of holes for securing the spacer bar. When using the EZ clamp assembly, use the lower set of holes when attaching the spacer bar.
8. Unlike the first transducer, do not apply any couplant at this point. Attach the spacer bar (with the second transducer attached to it) to the mounted transducer by inserting an index screw through the REF hole in the bar and into the lowest hole on the transducer. Tighten. Visually ensure that the spacer bar is axially aligned with the pipe. While holding in this position, pencil a line (or a fine line with chalk) along the back edge of the transducer and a dot below where the white dot is below the front label (see "A" below).

Disassemble the spacer bar and second transducer from the mounted transducer and remove the transducer from the bar. Use the bar as a straight edge and, with one edge against the mounted transducer's white dot and the other crossing the dot you drew, draw a line crossing the dot (see "B" below). Set the bar aside.



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

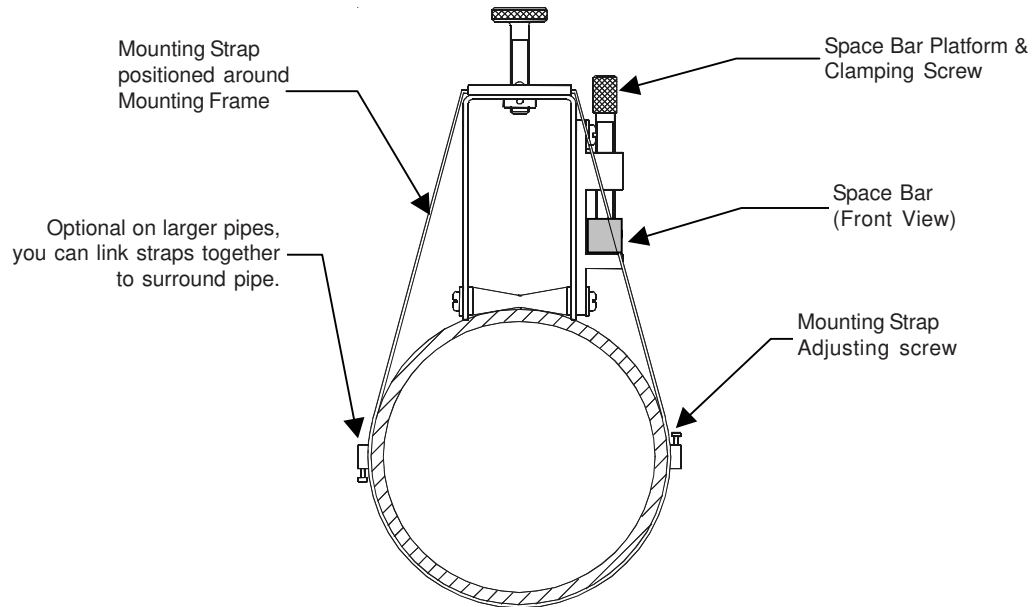


WRAPPING THE MYLAR SPACING GUIDE AROUND THE PIPE

10. Realign the left edge of the guide with the transducer edge mark. Line up both vertical edges of the guide and ensuring that it is snug around the pipe, mark along the overlapping edge.
11. Remove the Mylar spacing guide and lay it out on a flat surface. Either, measure the exact distance halfway between the overlap edge and the mark at the overlap or fold the guide from the overlap edge to the overlap mark and draw a line at the fold or half way point.
12. Reinstall the spacing guide; its left edge abutting the transducers edge mark on the pipe and the overlapping edge in line with the dot (now a line) on the pipe (see "C" on previous page). Tape it in this position on the pipe. Take the second transducer and place it against the edge of the guide with its white dot centered on the center mark on the guide. Temporarily position the transducer (in the 3 o'clock position opposite the mounted transducer) where it will be mounted. Ensure that this is a smooth area without any raised spots (seams, etc.). While holding, mark a generous area around the transducer (with a pencil or chalk) where it contacts the pipe. Remove the transducer and the mylar guide.
13. Prepare the area you marked by de-greasing the surface if needed and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided.
14. Replace the mylar guide back in the same position it was in and retape it to the pipe. Attach the EZ clamp to the transducer under the spring clip. Unscrew the knob until it's at the stop.
15. Apply a 1/8-inch continuous bead of couplant compound along the center (the long way) of the contact surface of the transducer. Position this transducer on the center of the pipe and aligned with the edge and center marks on the guide; with the cable connector facing away from the other transducer.
16. While holding this transducer in-place, bring the chain around the pipe and attach the closest cross-link onto the hook of the EZ clamp. Tighten the adjusting nut until the chain is just snug around the pipe. Check to ensure that the chain is straight around the pipe and that the transducer is contacting the pipe at the white dot which is just under the front label. Ensure that there is equal space on either side of the dot between the edges of the transducer and the pipe. Adjust if necessary. Tighten the chain but do not overtighten. Ensure that the transducer did not move while tightening.
17. Connect the transducer cable, ensuring that you have observed the upstream/downstream orientation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit, make sure you are connecting the cables to the correct channel's input jacks. Repeat this procedure for the number index transducer.

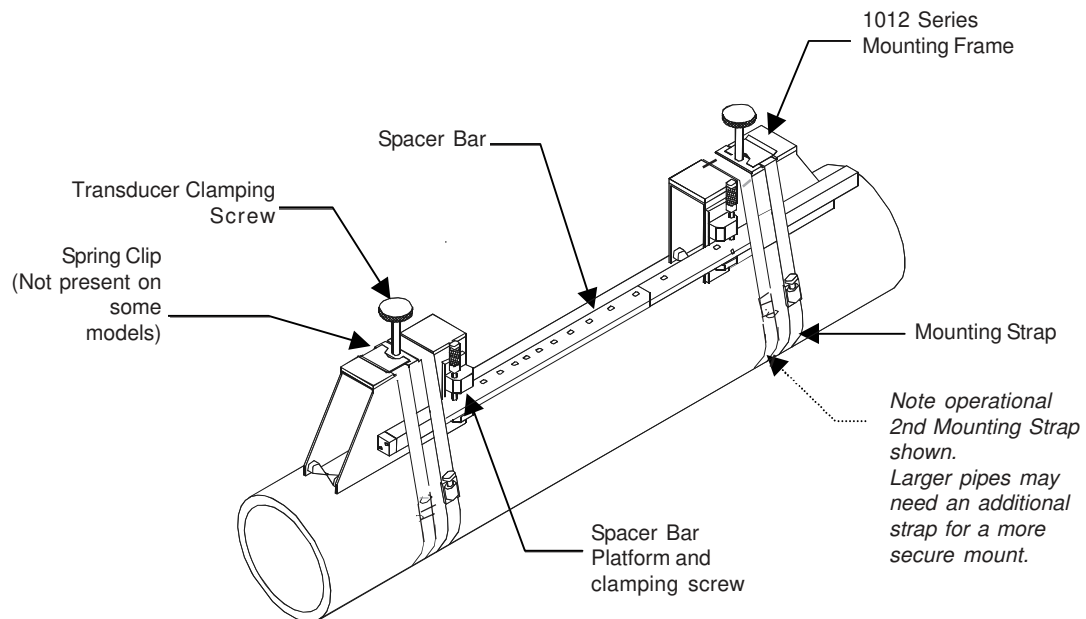
3.1.7 REFLECT MODE - MOUNTING FRAMES AND SPACER BAR

The combination of a spacer bar with mounting frames is the easiest way to mount in Reflect Mode. The result is a rigid structure that eliminates spacing measurements, and maintains the transducer-to-transducer geometry. In addition, reflect mounting allows you to move the entire assembly while maintaining the original transducer spacing.




INSTALLATION - REFLECT MOUNT WITH FRAMES AND SPACER BAR

NOTE: Minimum Ltn 0.75 in. (18 mm)



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

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

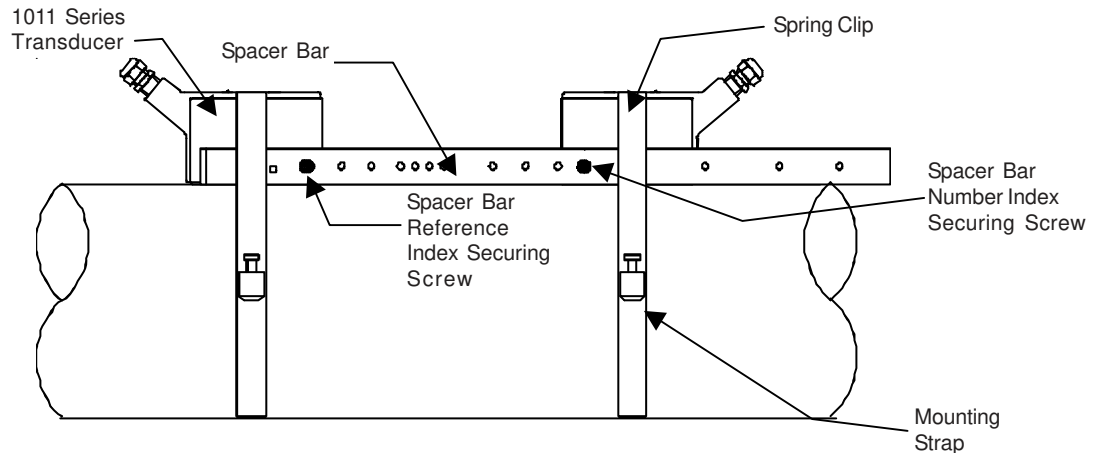
2. On a flat surface, attach the spacer bar to a mounting frame so that the reference hole on the spacer bar fits over the post on the platform of the frame; tighten the securing screw. Slide the second mounting frame onto the other end of the spacer bar, align the number index hole with the post on the platform; then tighten the securing screw. Ensure that the angled sides of both frames face away from each other. At the mounting location, place the mounting frame/spacer bar assembly on the pipe so that it rests on the top of the pipe. Wrap a mounting strap around the pipe. Engage the end of the mounting strap with the mounting strap adjusting screw. Slide it under the spring clip (if so equipped) of one of the mounting frames. Make sure to position it for easy access to the mounting strap adjusting screw. Do the same to the other mounting frame.
3. Tighten the mounting strap screw enough to take up all of the slack, but not enough to prevent rotation of the assembly. Rotate the assembly on the pipe to the 9 o'clock position ensuring that it is a smooth area without any raised spots or seams. Mark a generous area around the mounting frames (1/2" on either side and half again the length front and back) with a pencil or chalk. Move or revolve the assembly away from the area marked (loosen straps if necessary to do this).
4. Prepare the two areas you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.
5. Reposition the assembly over the center of the prepared surfaces. Tighten the mounting straps to seat the assembly firmly on the pipe. Do not overtighten. Apply a continuous 1/8-inch bead of coupling compound to the center of the face of a transducer, then slide it into the mounting frame but holding it away from making contact with the pipe until it butts up against the stop (to keep from smearing couplant where it's not needed); then push down onto the pipe. Tighten the transducer clamping screw to hold the transducer firmly in place. Repeat for the other transducer.
6. Observing the upstream to downstream orientation, attach the UP and DN cables to the transducers. Attach the other ends to the flowmeter's UP and DN terminals. See Engineering Drawing 1010P-7, Single Channel or 1010DP-7 Dual-Channel.
7. You can now press  to finish the transducer install routine.

The available Mounting Strap kits are listed below. Each kit comes with up to two band sizes to cover its designated pipe diameter range and a spacing guide for Direct Mount.

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

3.1.8 REFLECT MODE WITH SPACER BAR ONLY

The spacer bar eliminates manual spacing measurements and provides rigidity for mounting the transducers while maintaining axial alignment.



INSTALLATION - REFLECT MOUNT WITH TRANSDUCERS AND SPACING BAR

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

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

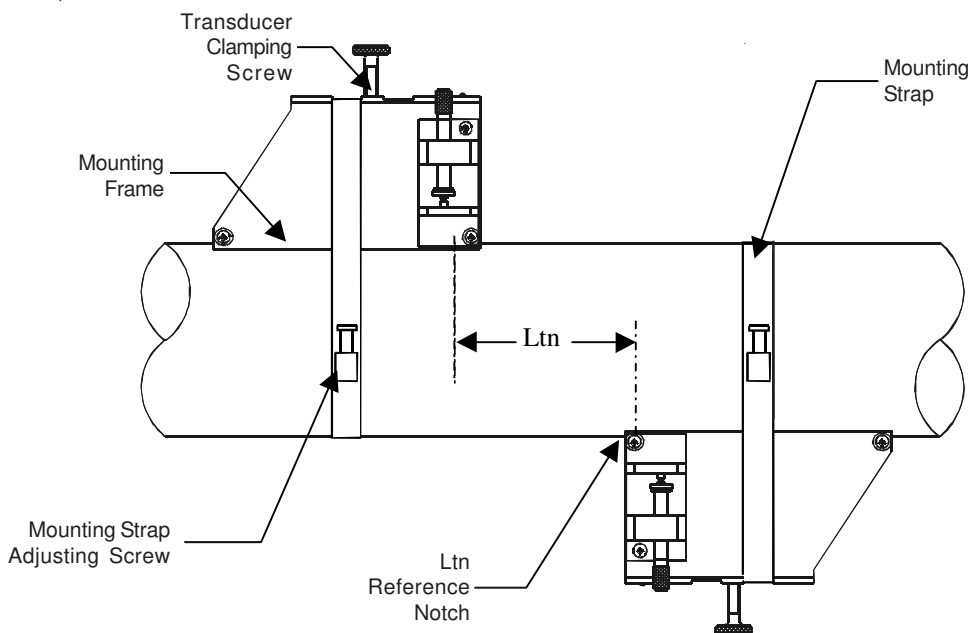
2. Assemble the transducers to the spacer bar, with the cable connectors facing away from each other as shown above. The spacer bar is attached to a transducer using a transducer index screw. One transducer is attached using the "REF" hole on the spacer bar. The second transducer is attached to the spacer at the index hole specified in Step 1.
3. Temporarily position the assembly (in the 9 o'clock position) at the location where you have determined it would be mounted. Ensure that it is a smooth area without any raised spots or seams. Mark a generous area around the transducers (1/2-inch on either side and half again the length front and back) with a pencil or chalk. Remove the assembly.
4. Prepare the two areas you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.
5. Remove transducer from the spacer bar that was attached through the REF hole. Put a mounting strap around the pipe and engage an end into the adjusting screw (adjusting screw should be pointing up). Apply a 1/8-inch continuous bead of couplant compound down the center (the long way) of the contact surface of one of the transducers (see Recommended Sonic Coupling Compounds Section 5, page 5-9). Place the transducer on the pipe center in the middle of one of the areas you have cleaned with its cable connector pointing away from the other cleaned area. Holding the transducer in place, slide the mounting strap over it (and under the clip if there is one) and tighten with a screwdriver. While tightening, check to ensure that the white dot under the front label is centered on the pipe and that there is equal space on both edges. Also, Make sure to position strap for easy access to the mounting strap adjusting screw.
6. Repeat Step 5 with the second transducer leaving it still attached to the spacer bar. Apply a 1/8-inch bead of couplant to the transducer. At the same time you place it in the middle of the second area

prepared, secure the spacing bar to the already mounted transducer by inserting the transducer index screw through the REF hole on the Bar. Put mounting strap around transducer and tighten as in Step 5. Sight along spacer bar to ensure axial alignment to the pipe. Adjust if necessary and do not overtighten. Ensure that the transducers do not move while tightening.

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

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

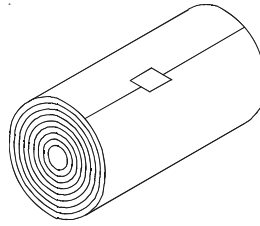
The combination of mounting frames, spacer bar and spacing guides is the recommended way to mount Direct Mode transducers. The mounting frame establishes the axial alignment of the transducers, and allows you to remove and replace either transducer while preserving their exact mounting location.



INSTALLATION - DIRECT MODE WITH TRANSDUCERS, MOUNTING FRAMES SPACER BAR (Not Shown) AND SPACING GUIDE

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

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

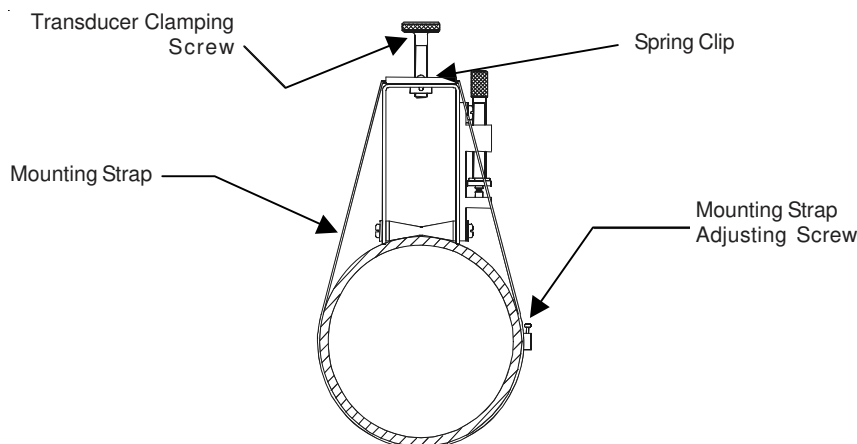


MYLAR SPACING GUIDE

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

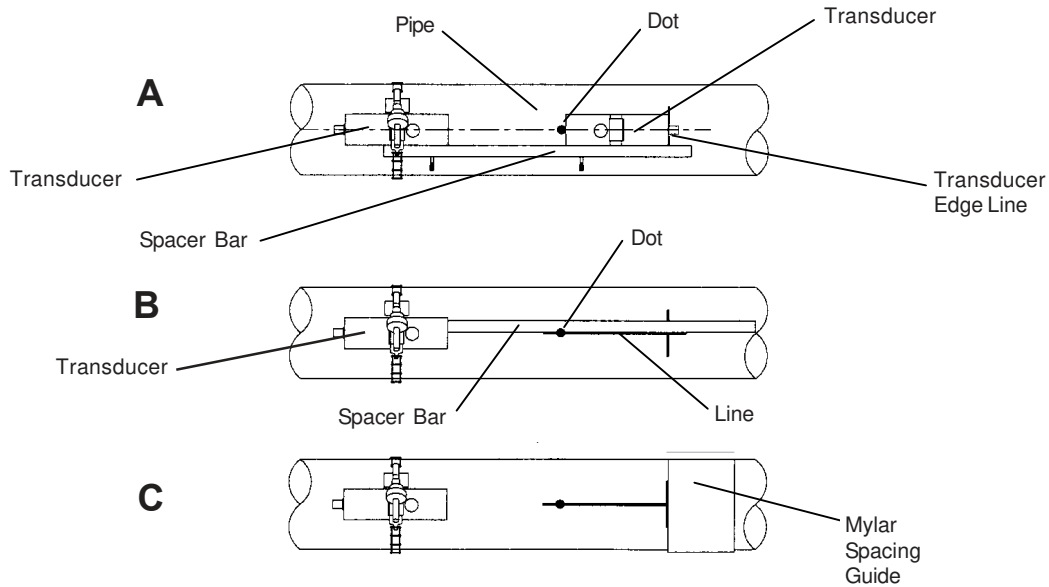
Make a note of the number index displayed in the Pick/Install menu. Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).

2. Temporarily position one of the frames on the pipe where you will be mounting it. Ensure that this is a smooth area without any raised areas (seams, etc.) With a pencil or chalk, mark a generous area around the frame (1/2" on either side and half again the length front and back). Remove the assembly.
3. Prepare the area you marked by de-greasing surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive material provided.
4. Put a mounting strap around the pipe and engage an end into adjusting screw (screw should be pointing up). Position frame in the middle of area you have cleaned and centered on the pipe with its angled end facing away from where the other frame will sit.

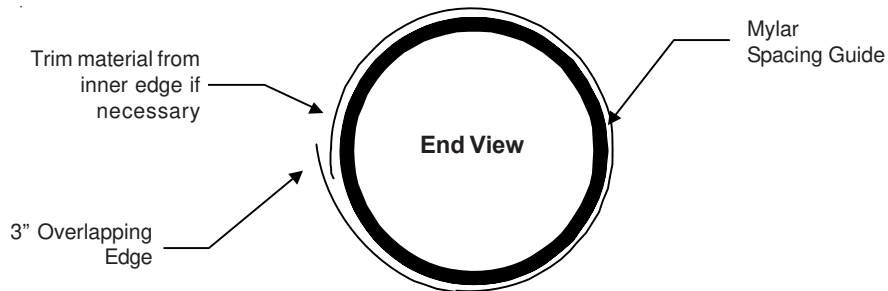


WRAPPING STRAP UNDER PIPE AND ATTACHING TO ADJUSTING SCREW

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

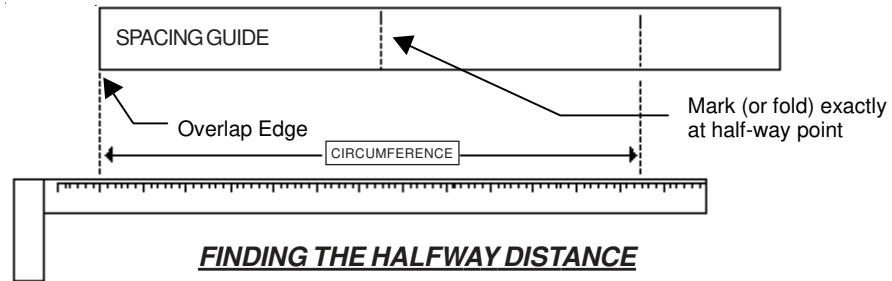


7. Disassemble the spacer bar and the unmounted frame. Use the bar as a straight edge and, with one edge against the mounted frames tapered roller center and the other crossing the dot you drew, draw a line crossing the dot (see "B" above). Set the bar aside.

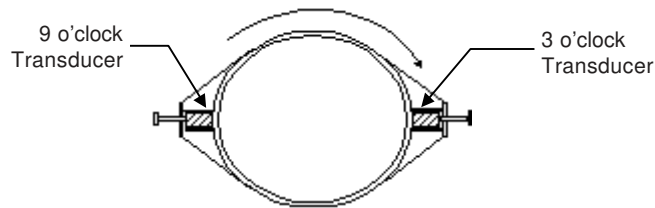


WRAPPING THE MYLAR SPACING GUIDE AROUND THE PIPE

8. Wrap the mylar spacing guide around the pipe so that the left edge is against the transducer edge mark (see "C" above). Arrange so that one end overlaps the other by at least three inches. Trim to fit if necessary, **but in order to keep it square, be sure not to trim at the overlapping end.**
9. Realign left edge of the guide with the transducer edge mark. Line up both vertical edges of the guide and ensuring that it is snug around the pipe, mark along the overlapping edge.
10. Remove Mylar spacing guide and lay it out on a flat surface. Either, measure the exact distance halfway between the overlap edge and the mark at the overlap, or fold the guide from the overlap edge to overlap mark and draw a line at the fold or halfway point (see next page).



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



12. Prepare the area you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of any debris and abrasive particles.
13. Replace the mylar guide back in the same position it was in and retape it to the pipe.
14. Put a mounting strap around the pipe and engage an end into adjusting screw (screw should be pointing up). Position frame in the middle of area you have cleaned and centered on the pipe with its angled end facing away from where the other frame will sit; and aligned with the edge and center marks on the guide. Slide the mounting strap over it (and under the clip if there is one) and tighten with a screwdriver. While tightening, check to ensure that the center of the tapered roller is centered on the pipe.
15. Apply a 1/8-inch continuous bead of couplant compound down the center (the long way) of the contact surface of one of the transducers. Place the transducer into one of the frames so that the couplant compound does not smear until it contacts the pipe. Slide it in until it butts against the stop and, while holding in-place, tighten the transducer clamping screw tight enough to hold firmly in-place. Do the same with the other transducer.
16. Connect the transducer cable, ensuring that you have observed the upstream/downstream orientation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit, make sure you are connecting the cables to the correct channel's input jacks. Repeat this procedure for the number index transducer.
17. Return to the menu, and press <ENT> to finish the transducer install routine.

3.1.10 USING 1012T MOUNTING TRACKS

The 1012TP and 1012THP Mounting Tracks provide a rigid mounting platform for Series 1011 universal or high precision size A or B transducers. The mounting tracks service pipe sizes up to a maximum of 5.00" (140 mm) outer diameter. Operating temperatures are supported up to 250°F (121°C). The assembly consists of lightweight aluminum track rails with integral transducer clamping screws. Attached index pins enable positive locating of the transducers at fixed spacing locations. Roller-chains and tension screws secure the assembly to the pipe. The following instructions refer to 1011 universal transducers. Please refer to Engineering Drawing 1012THP-7A for reflect mounting of high precision transducers and 1012THP-7B for direct mounting of high precision transducers.

The 1012T mounting tracks support both Direct and Reflect mounting modes. The flow computer recommends the appropriate transducers, mounting track and mounting mode, based on the pipe data entries. Refer to the instructions in paragraph 2.4 for details on the Transducer Installation procedure. If necessary, review paragraphs 3.1.2 through 3.1.4 for details on how to select and prepare a mounting location on your pipe.

Installing a 1012T Mounting Track in Reflect Mode

Paragraph 2.4 describes the Transducer Installation procedures that lead up to the automatic selection of transducers, mounting mode and spacing method. Examine the figure below, which shows a typical Pick/Install Xdcr menu screen. Note the automatic assignment of model numbers for the transducer and mounting track, plus the designation of the number index.

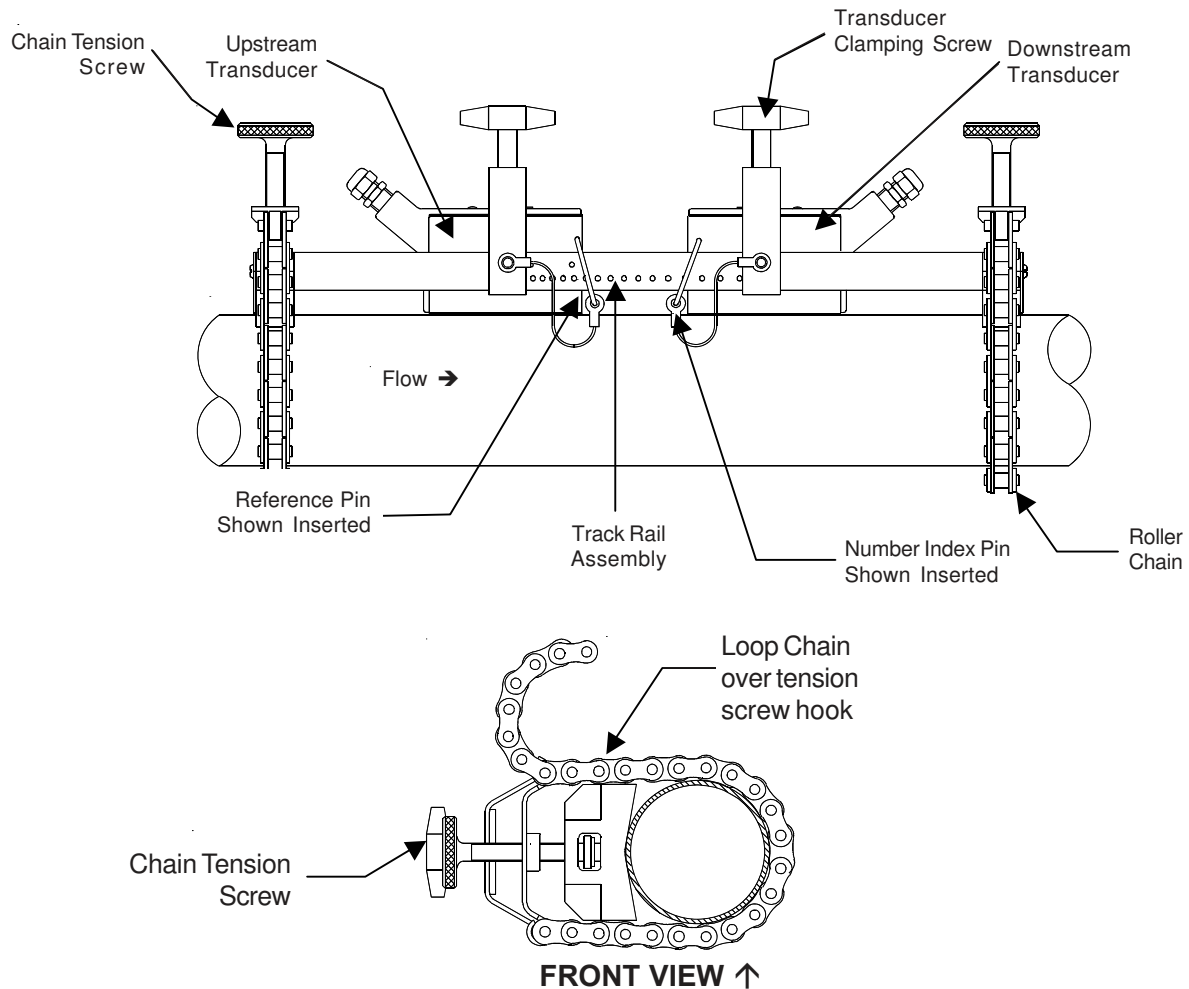
Siemens 2 Channel [1] SITE1	
Key [Install] after mounting transducers	
Transducer Model	1011 Universal
Transducer Size	B3
Xdcr Mount Mode	Reflect
Spacing Offset	Minimum
Number Index	6
Spacing Method	Track 1012TP
Ltn Value (in)	0.581
Install Completed? No	
Empty Pipe Set	Channel Not Setup
Zero Flow Adjust	Channel Not Setup
Pick/Install Xdcr	

Note selection of type, size and mounting mode.

Note selection of mounting track part number and number index.

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

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



INSTALLATION - REFLECT MOUNT WITH MOUNTING TRACK

2. Place the track rail assembly on the top surface of the pipe at the location where you have determined it would be mounted. Ensure that it is a smooth area without any raised spots or seams. Holding the assembly in place, loop one of the roller chains under the pipe, pull it around and maintain tension while slipping a link over the tension screw hook. Tighten the tension screw enough to hold the assembly on the pipe, but still allow rotation. Repeat for the other roller chain. Rotate the track rail assembly to the intended nine o'clock mounting position on the pipe, then tighten both tension screws just enough to prevent rotation. Do not overtighten.
3. Mark a generous area around the transducers (1/2-inch on either side and half again the length front and back) with a pencil or chalk. Loosen and move the assembly away from marked area. Prepare the two areas you marked by de-greasing the surface if needed and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.
4. Insert the index pin into the reference hole. Select a transducer, apply a thin band of couplant compound to the transducer's contact surface. Place the transducer between the track rails, slightly behind the pin and under the clamping screw assembly. Slide it forward until it butts up firmly against the reference pin.

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

Installing a 1012T Mounting Track in Direct Mode

Paragraph 2.4 describes the Installation procedures that lead up to the automatic selection of transducers, mounting mode and spacing method. Shown is a Model 1012T mounting track to accommodate size B3 universal transducers. Examine the figure below which shows a typical Pick/Install Xdcr menu screen. Note the automatic assignment of model numbers for the transducer and mounting track, plus the designation of number index.

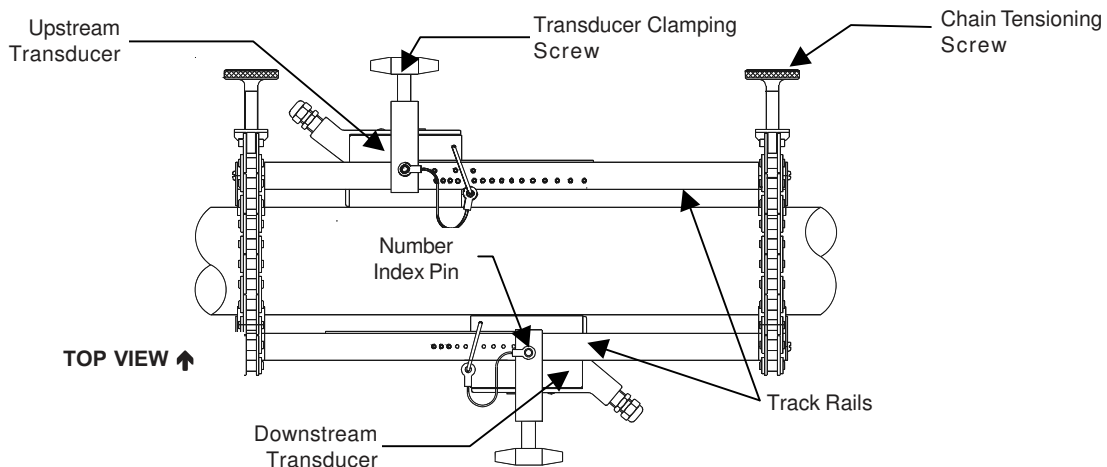
Siemens	2 Channel	[1]	SITE1
Key [Install] after mounting transducers			
Transducer Model	1011 Universal		
Transducer Size	B3		
Xdcr Mount Mode	Direct		
Spacing Offset	Minimum		
Number Index	4		
Spacing Method	Track 1012TP		
Ltn Value (in)	0.217		
Install Completed?	No		
Empty Pipe Set	Channel Not Setup		
Zero Flow Adjust	Channel Not Setup		
Pick/Install Xdcr			

Note selection of track P/N, Mount Mode and Number Index.

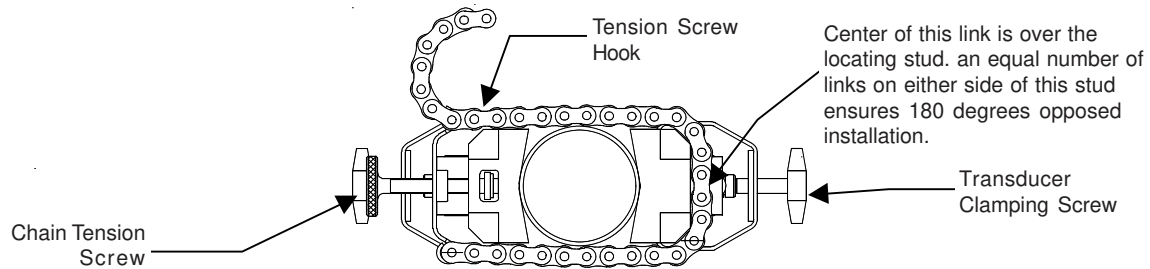
- Perform all required menu steps up until the point where the flow computer prompts you to press <ENT> to finish the transducer install routine. Note the reported number index.

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

- The direct mount configuration uses two track rails, one for each transducer, installed 180° apart on the pipe. One track rail includes the tension screw while the other has a locating stud to support the chain (see below and on next page).



INSTALLATION – DIRECT MOUNT 180° OPPOSED WITH MOUNTING TRACK



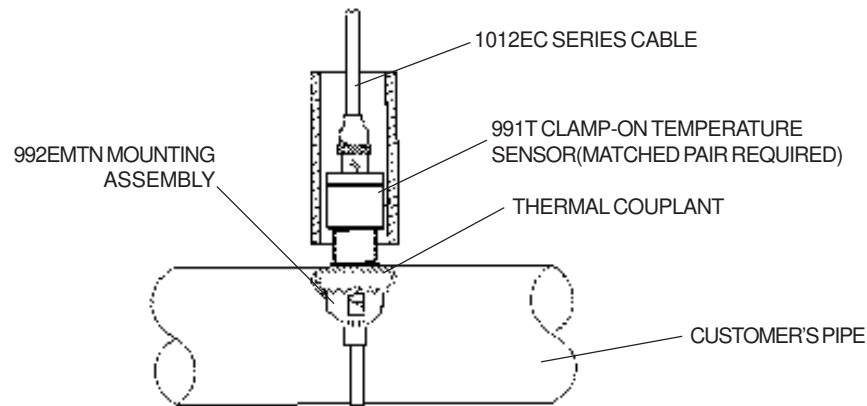
3. If this is a horizontal pipe, place the track with with the chain tension screws on top of the pipe (screws up, the chains hanging down and the numbered scale facing you) where you have determined it would be best to mount it.
4. Place the other track (with the centering stud on the bottom and the lettering on the scale toward the same side as the top track) directly underneath it (180°). Hold in place while you wrap the chain around the pipe; first onto the centering stud on the bottom track and then onto the hook under the Tensioning Screw. With the chain in-place, count the number of links between the beginning of the chain and the centering stud; and then between the centering stud and the hook. They both should have the same number of links. Arrange so they do and then loosely tighten. Do the same with the other chain. For a vertical pipe installation, it will probably be much easier to tie, tape or bungee cord the two tracks in place while chaining.
5. Wrap a length of the mylar spacing guide around the pipe and against the end of the track assembly. Ensure that the edges on both sides align and tape to the pipe. Loosen the chains enough to allow you to rotate the track assembly 90° until one track is in a 9 o'clock position and the other in a 3 o'clock position on the pipe (horizontal pipe). Tighten both chains but not too tight.
6. Insert an index pin into the REF hole of the track with the tensioning screws. Take one of the transducers and insert it between the track rails and to the left of the index pin with the cable connector pointing away from the pin. Move the transducer right until the pin stops it. Hold it in this position and move the transducer clamping screw over the transducer and tighten. Insert the other index pin into the index hole (see step #1) on the other track marked "Direct Mode Spacing." Insert the second transducer (with its cable connector pointing away from the pin) between the track rails on the right side of the pin and move the transducer left until it's stopped by the pin and then follow the same procedure as with the first transducer.
7. Mark a generous area around the transducers where they contact the pipe with a pencil or chalk. Make a mark showing the center between the tracks on the mylar guide. Release the tension on the transducers and remove them. Loosen the chains and rotate the track assembly on the pipe so you can gain access to the areas marked.
8. Prepare the area you marked by degreasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided.
9. Revolve the tracks on the pipe into the position they were originally in by using the edge of the mylar guide as a stop for both the upper and lower tracks and the mark on the guide to center that track. This time, before installing each transducer, apply a 1/8-inch continuous bead of couplant compound along the center (the long way) of the contact surface of the transducer. Also, keep the transducers lifted slightly from the pipe when installing until the transducer is against the pin; then push down against the pipe. Remember to install the transducers with the cable connectors facing away from each other. Once the transducer is in place, secure it with its clamping screw. Do not overtighten.

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

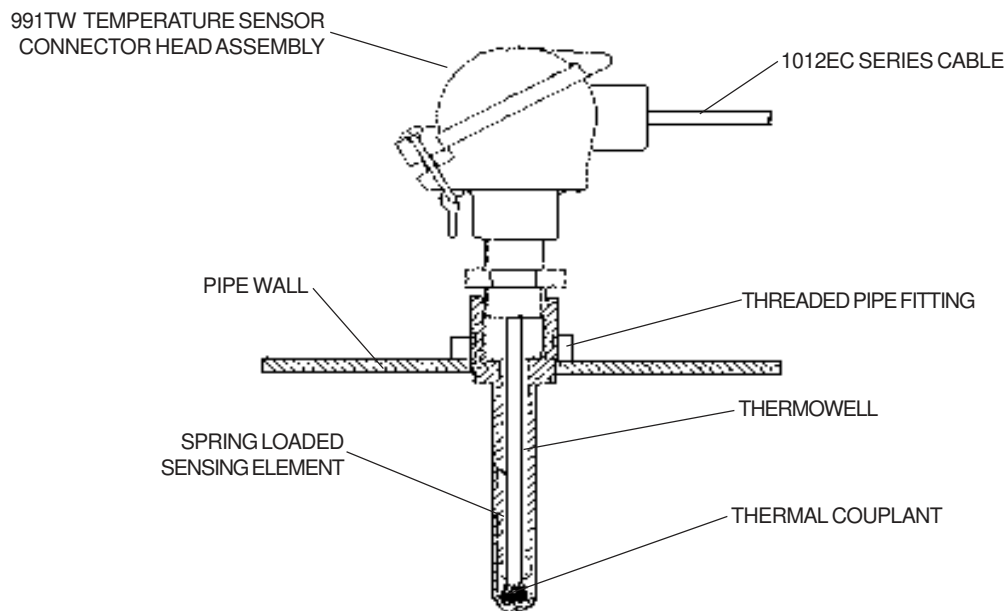
10. Connect the transducer cable, ensuring that you have observed the Upstream/Downstream orientation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit, make sure you are connecting the cables to the correct channel input jacks.

3.2 MOUNTING TEMPERATURE SENSORS (optional)

In order to accurately measure temperature differential in energy flow loops, Controlotron's Energy Flowmeters are designed to work with a pair of matched temperature sensors. These are available in clamp-on style 991T, or in insert (thermowell) style 991TW. Both styles incorporate 1000 ohm platinum RTD's for high precision.



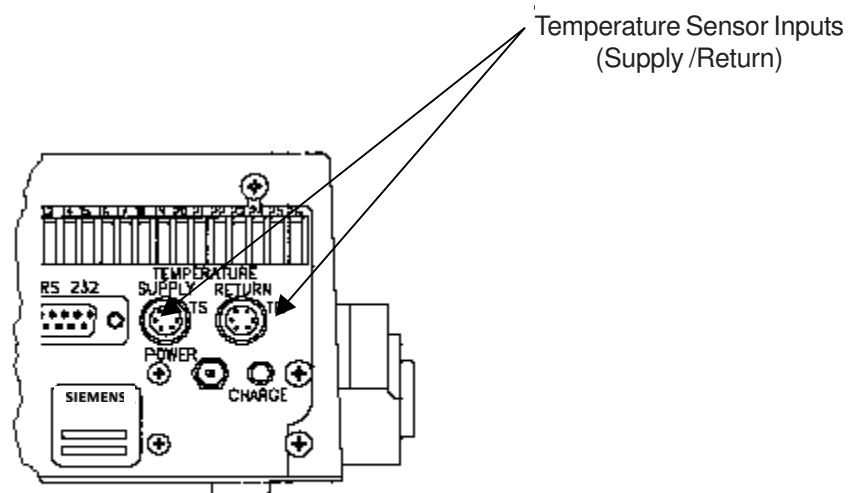
Clamp-on style sensors are mounted on the surface of the monitored pipe using 992EMT series mounting assemblies. Apply a generous quantity of the thermal couplant provided to the tip of the sensor and attach it securely to the cleaned pipe surface with the proper mounting assembly. Temperature measurement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



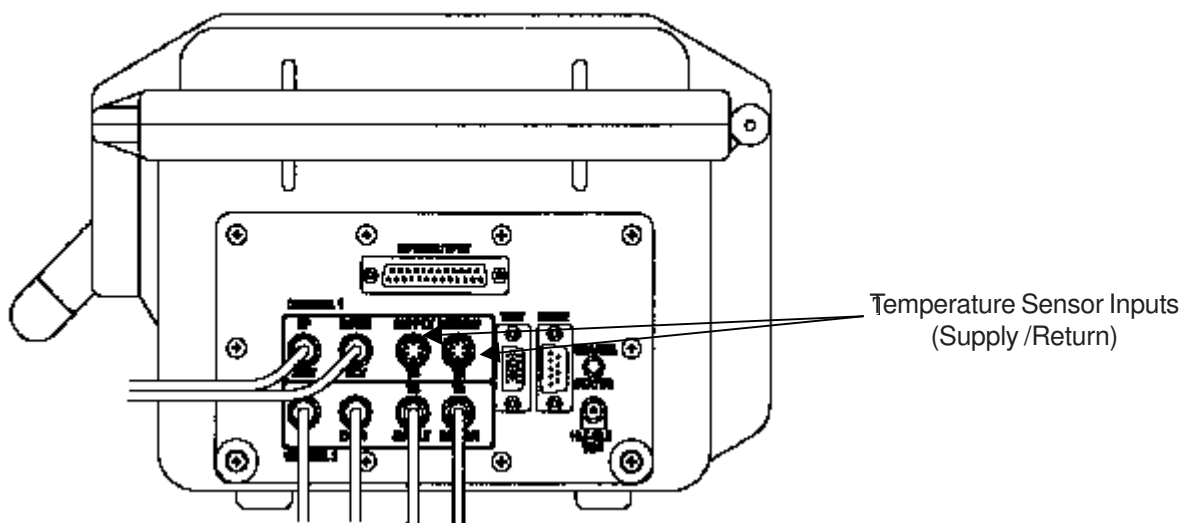
The 991TW insert sensors are designed to be used in pipes equipped with Thermowells. These are spring-loaded, 1/4" diameter sensors with 1/2" NPT integral connection heads, available in several lengths to accommodate a range of pipe sizes. Thermowells for new installations are available from Alloy Engineering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

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

WARNING: Turn meter power OFF before connecting cables to Temperature Sensor Supply/Return inputs.



1010EP Temperature Sensor Inputs



1010EWD Temperature Sensor Inputs

Notes on Clamp-On RTD Installation

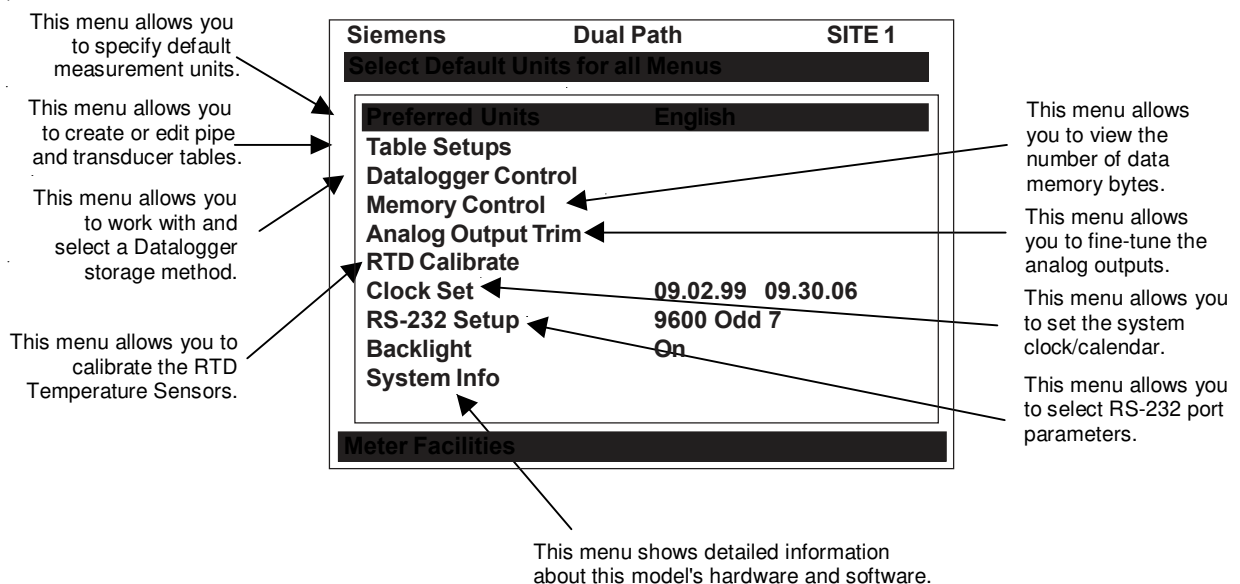
The Clamp-On RTD sensors with which your 1010 thermal energy meter is supplied are extremely sensitive and precise. Their contribution to the performance of your energy meter is every bit as important as that of the liquid flow sensors. Please consult the installation drawings at the back of this manual for details on physical installation and wiring of the RTDs. In order to produce the best possible tracking of the true liquid temperature difference, try to make your installation conform to the notes on the installation drawing and these tips:

- Prepare the pipe surface by removing paint to expose bare metal and smoothing out any remaining rough spots.
- Use the thermal couplant compound (CC117) between the face of the RTD element and the pipe surface to improve the conductivity of the metal-to-metal contact.
- Keep the RTDs out of direct sunlight or other non-pipe sources of heat or cold which may affect their temperature sensing. The foam insulator supplied helps in this regard, but consider using additional pipe insulation for all installations exposed to extreme ambient conditions. Consider mounting the RTDs under the pipes in order to keep them out of direct sunlight.
- In installations where the RTD elements are exposed to harsh conditions such as condensation, salt spray, etc., use couplant compound to coat the connection between the cable and the RTD sensor. Consult drawing # 991TN-7 for details.
- Be sure to install the supply RTD Sensors (see diagram on previous page) in the appropriate locations.
- Be sure to correctly indicate where the flow is being measured in the “Location” item of the 1010P menu; either the supply or return.

4. THE METER FACILITIES MENU AND GRAPHIC DISPLAY SCREENS

Meter Facilities functions are available immediately after pressing the <MENU> key. The Meter Facilities menu provides global control that enables you to identify and activate the following functions and features of the hardware supported by this model.

- 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.




4.1 PREFERRED UNITS

The selection you make in this menu cell becomes the default units for all menu items and data outputs. You can choose either English or metric units. The factory setting is English.

To specify metric default units for all meter functions:

To access the [Preferred Units] option list press 

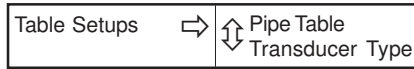
Move the cursor to [Metric] by pressing  

To register your selection press 

4.2 THE TABLE SETUPS MENU

The Table Setups menu allows you to precondition 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 preferentially be selected when the meter recommends transducers during the automatic Pick/Install Transducer routine.

To access the Table Setups menu press 



4.2.1 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 ASA	Carbon Steel	ASA Plastic
		⇅ 1SS10 2SS10 3SS10 4SS10 6SS10 8SS10	⇅ 1CS40 1CS80 2CS40 2CS80 3CS40 3CS80 4CS40 4CS80 6CS40 6CS80 8CS40 8CS80 10CS40	⇅ 1P40 1P80 2P40 2P80 3P40 3P80 4P40 4P80 6P40 6P80 8P40 8P80 10P40
		⇨ Metric DN Steel 15 DN 20 DN 25 DN 40 DN 50 DN 60 DN		

(continued)

*NOTE: The highlighted selection in the above table illustrates how to choose the **ASA Stainless Steel PipeClass** 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 *(continued)*


Create/Edit Pipe ⇨	Choose Pipe Name ⇨	⇕ 100 DN	⇕ 10CS XS	⇕ 10P XS		
		150 DN			12CS STD	12P STD
		200 DN			12CS XS	12P XS
		250 DN			16CS STD	16P STD
	⇨ ⇕ 300 DN	16CS XS	16P XS			
	⇨ ⇕ 350 DN	18CS STD	18P STD			
	400 DN	18CS XS	18P XS			
	500 DN	20CS STD	20P STD			
	600 DN	20CS XS	20P XS			
	800 DN	24CS STD	24P STD			
	Metric SGP Steel	24CS XS	24P XS			
	20A-SGP	30CS STD	30P STD			
	25A-SGP	30CS XS	30P XS			
	32A-SGP	36CS STD	36P STD			
	40A-SGP	36CS XS	36P XS			
	50A-SGP	1-1/25_40				
	65A-SGP	1-1/25_50				
	80A-SGP					
	90A-SGP	⇨ Cast Iron Table	⇨ Copper Tube Table			
	100A-SGP	⇕ 6" cls C	⇕ 1" type K			
	125A-SGP	⇕ 10" cls C	⇕ 1" type L			
	150A-SGP	12" cls C	1" type M			
	175A-SGP	16" cls C	2" type K			
	200A-SGP	20" cls C	2" type L			
	225A-SGP	⇨ Ductile Iron Table	2" type M			
	250A-SGP	⇕ 6" cls 52	4" type K			
	300A-SGP	8" cls 52	4" type L			
	350A-SGP	10" cls 52	4" type M			
	400A-SGP	12" cls 56"	6" type K			
	450A-SGP	16" cls 52	6" type L			
	500A-SGP	24" cls 52	6" type M			
	Outer Diameter (in.) ⇨	x.xxx <i>(numeric entry)</i>				
	Wall Thickness ⇨	x.xxx <i>(numeric entry)</i>				
	Liner Material ⇨	⇕ None				
		Cement				
		Coal Tar				
		Enamel				
		Glass				
		Plastic				
		HDPE				
		Teflon				
		Rubber				
	Liner Thickness ⇨	x.xxx <i>(numeric entry)</i>				
Delete Pipe ⇨	Choose Pipe Class ⇨	*See Create/Edit Pipe				
	Pick Pipe Name ⇨	*See Create/Edit Pipe				


4.2.2 CREATE/EDIT PIPE


The Pipe Table provides the primary data that the system uses to operate with different classes of pipes. This menu allows you to edit the pipe table by modifying any existing pipe or add an entirely new pipe.


An example of how to use the Create/Edit function:




To access the [Create/Edit] menu press 

To access the [Pipe Class] option list press 



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




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 by pressing   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 in actual wall thickness using the appropriate English or metric units. To store the wall thickness, press . 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 characters Max.). Press . This adds the new pipe to the pipe class.



4.2.3 DELETE PIPE


This menu allows you to remove any of the pre-loaded pipes within a class from pipe table. We recommend that you use this function only to delete pipes you've added; 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 press 

Scroll option list to the class that contains the pipe to be deleted by pressing  

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 the pipe to be deleted by pressing  

To remove it from the pipe table press 

4.3 TRANSDUCER TYPE MENU

During the Transducer Install procedure, the meter analyzes entered pipe and liquid data, then automatically generates a list of the transducer sizes most suited for the application.




The Transducer Type menu allows you to place “marks” next to any transducers that you may want the meter to consider preferentially during its recommendation routine. These will be included on the recommended list, which appear highlighted at the top of the display screen. Left-most transducer on list is most applicable; right-most, least applicable.

TRANSDUCER TYPE MENU STRUCTURE


⇕	⇐ Transducer Type ⇐	⇐ 1011 Universal ⇐	⇕	A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 E1 E2 E3
		⇕		
	⇐	⇐ 1011H High Precision ⇐	⇕	A1H A2H A3H B1H B2H C1H C2H D1H D2H D3H D4H
	⇐	⇐ 991 Universal ⇐	⇕	0A 0 1 2 2A 3 3A 4 4A 5 5A

To mark Transducers:

Access the Transducer Type menu by pressing 

Scroll the highlight by pressing   to a transducer type (e.g., 1011H Hi Precision) then press  to access the size option list.

Scroll the option list by pressing   then press  to “mark” desired transducers. Note that a plus sign (+) appears before each “marked” transducer.


If you want to clear a “marked” transducer, move the highlight to the transducer then press the  key. Note that this removes the plus sign.

To leave an option list press 

4.4 THE DATALOGGER CONTROL MENU

The Datalogger Setup menu in the Channel Setup menu provides the Datalogger controls for the meter's measurement channels. It allows you to enable usage, select data items, alarm events, a logging interval, and a destination for your Datalogger reports. While the Datalogger 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. Note that due to the data compression scheme employed, 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, 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.*

To access the Datalogger Control Menu press 

DATALOGGER CONTROL MENU STRUCTURE



Datalogger Control ⇨	Display Datalogger ⇨ ⇕	Off ⇕ Line Wrap No Line Wrap
	Output Datalogger ⇨ ⇕	⇕ No Yes
	Circular Memory ⇨ ⇕	⇕ No Yes
	Est. Log Time Left ⇨ ⇕	⇕ —:—
	Clear Datalogger ⇨ ⇕	⇕ No Yes


4.4.1 DISPLAY DATALOGGER


This menu cell allows you to send the Datalogger contents to the display screen. This command is effective only after a successful install. You can set the report to scroll on the screen with or without line-wrap. Selecting line wrap, forces a line feed after approximately 40 characters. In addition, you have to enable datalogging and then select items in the Datalogger Setup menu. Note that this command transmits the data from both channels.

To send Datalogger contents to the display screen:

To access the Display Datalogger option list press 

Scroll cursor to either [Line Wrap] or [No Line Wrap] press  

To view Datalogger contents press 

To return to [Datalogger Control] press 

4.4.2 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] (i.e., 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:

Check the flow computer-to-external device connections and your RS-232 Setup parameters (see RS-232 Setup).

To access the [Output Datalogger] option list press 

Scroll the cursor to [Yes] press  

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

To stop printout press 

4.4.3 CIRCULAR MEMORY

In its default mode, the Datalogger collects data until its memory becomes full. At that time the flowmeter suspends data logging and cannot resume until the datalogger memory is cleared (see Clear Datalogger command). Multi-Channel systems include Circular Memory and Single Channel systems do not. Circular Memory allows the Datalogger to "write over" its oldest records when memory reaches full capacity. If you enable Circular Memory, you are assured of always collecting the most recent data. But, also remember that you will lose the oldest Datalogger reports. Note further that invoking Circular Memory deletes the current contents of the Datalogger.

NOTE: To avoid potential data loss, the 1010 flowmeter prevents you from altering the Circular Memory setting when a channel is active.


To setup and enable Circular Memory:



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

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

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

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

Press  to access the [Circular Memory] option list.

Move the cursor to [Yes] by pressing  

To store selection press 

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

4.4.4 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.



4.4.5 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 

4.5 THE MEMORY CONTROL MENU

Memory Control is a reference menu that shows the amount of bytes of data memory left. The data memory capacity depends on the number and complexity of the site setups stored in memory and the size of the current datalogger file. Capacity is also affected by the RAM option with which your 1010 is equipped with - either 900k expanded or 170k standard RAM.

Data Memory Left		XXXXX
Memory Map	 	 Yes No
Defragment	 	 Yes No

Data Memory Left: This view only menu cell shows the minimum remaining number of characters available for Datalogger and site storage. When the Datalogger is enabled for circular mode, the meter allocates all of memory except for two conventional empty sites worth for datalogger use.

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

Defragment: Selecting YES for this item consolidates memory data blocks into contiguous storage; collapsing the filler regions. You may be able to use an additional block for site or datalogger storage as a result. Use this command if you seem to be out of memory even though the Data Memory Left item indicates free capacity.

4.5.1 THE ANALOG OUTPUT TRIM MENU

Analog Output Trim allows you to fine-tune the meter's analog voltage and 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, voltage, and Pgen trimming will be limited by the 12-bit resolution of the meter's D/A Converter (DAC).

To access the [Analog Output Trim] menu press 

ANALOG OUTPUT TRIM MENU STRUCTURE

⇕	Analog Output Trim ⇨	Trim Io1 (Io2) ⇨	⇕ Operate Trim @ 4mA ⇨ <i>Indicated mA = x.xx</i>
		Trim Vo1 (Vo2) ⇨	⇕ Operate Trim @ 2V ⇨ <i>Indicated V = x.xx</i>
		Trim Pgen1(Pgen2) ⇨	⇕ Operate Trim @ 1kHz ⇨ <i>Indicated Hz = xxxx</i>


4.5.2 CURRENT OUTPUT TRIM (Io1 and Io2) *Caution: See drawing 1010P-7.*

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


To calibrate a current output (Io1 or Io2):

Set up the multimeter to read Amps, then connect it to the Io and Io return terminals of the current output under test. (Note: Power must be provided to activate Io output.)

Move the highlight to the port to be tested, press , then press  to move the cursor to Trim @ 4mA.

Press . This triggers a 4.00 mA pop-up window. The multimeter should now be reading 4.00 mA.

If the multimeter reading does not match, use the numeric keys to type in the multimeter reading.

Press  to register setting. This adjusts the meter's DAC (digital-to-analog converter) so that a 4mA output corresponds with 4mA on the multimeter.





Recheck the multimeter to make sure that it is now reading 4mA.


4.5.3 VOLTAGE OUTPUT TRIM (Vo1 and Vo2)

(Note: Can be trimmed to within .0025 V of nominal.)


To calibrate a voltage output (Vo1 or Vo2):

Set up the multimeter to read volts, then connect it to the output and reference terminals of the voltage output under test.

Move the highlight to the port to be tested  , press , then press  to move the cursor to Trim @ 2V.

Press . This triggers a 2.00 Volts pop-up window. The multimeter should now be reading 2.00 Volts.

If the multimeter reading does not match, use the numeric keys to type in the multimeter reading.

Press  to register setting. This adjusts the meter's DAC (digital-to-analog converter) so that a 2.00 Volts output corresponds with 2.00 Volts on the multimeter.





Recheck the multimeter to make sure that it is now reading 2.00 Volts.


4.5.4 PGEN OUTPUT TRIM (Pgen 1 and Pgen 2)

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


To calibrate a pulse rate output (Pgen1 or Pgen2):

Connect a frequency counter to the signal and reference terminals of the pulse rate output under test.

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

Press . This triggers a 1 kHz pop-up window. The frequency counter should now be reading 1 kHz.

If the frequency counter reading does not match, use the numeric keys to type in the frequency counter reading.


Press  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.

Recheck the frequency counter to make sure that it is now reading 1 kHz.

4.5.5 THE RTD CALIBRATE MENU *(optional)*

The RTD Calibrate Menu appears on some 1010P models. Use this menu to calibrate the 1011 Series RTD Temperature Sensors to an external standard. It is important to note that Controlotron RTD temperature sensors are factory-calibrated for high accuracy. We recommend that before deciding to perform the calibration, check the current RTD reading in [Diagnostics/Liquid Data]. You may find that you do not even need to calibrate the sensor. In any case, make sure that the temperature reading stabilizes before proceeding further. The RTD Calibrate menu allows you to perform an external calibration, which can be accomplished either by data entry of the current RTD temperature or by a 32°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 

RTD CALIBRATE MENU STRUCTURE (Single Channel 1010)

RTD Calibrate ⇐ ⇕	RTD 1 ⇐	⇕ Factory User Cal
	RTD 2 ⇐	⇕ Factory User Cal


4.5.6 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 a known 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 

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

Calib @ deg F
=32.0

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

Calib @ deg F
=72.0

To recalibrate the RTD sensor press . To verify the calibrated reading, go to [Diagnostics/Liquid Data] to check the current RTD output. Make sure 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.

4.5.7 ICE BATH RTD CALIBRATION



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


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

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

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

Move the highlight press   to the RTD you want to calibrate (RTD1 or RTD2).

To access the RTD option list press . Move the highlight to [User Cal] then press . This triggers the pop-up window.

When you are sure that the RTD Sensor is at 32°F (0°C), press  to recalibrate the RDT sensor. 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.

**Calib @ deg F
=32.0**

4.6 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 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. Although we limit the year to 2 digits in all our displays, 1010 datalogger reports are Y2K compliant using an industry standard algorithm to form a 4 digit year field.

4.6.1 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, 2007 by typing 12.07.07. You can use the  key to move the cursor back to a number if you need to retype it.

Press the  key to remove the current setting. (Note: The Datalogger provides a fully Y2K compliant 4-digit year field.)


To set the Date:


To enable numeric entry press .

Use the numeric keys to type the date (MM.DD.YY).

To store the date press . This moves the cursor to [Time].

4.6.2 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  to move the cursor back to a number if you need to retype it.

Press the  key to remove the current setting.

To set the Clock:

To enable numeric entry press 

Use the numeric keys to type the time (HH.MM).

To store the time press . This moves the cursor to RS-232 Setup.

4.7 RS-232 SETUP

Use RS-232 Setup menu to set operating parameters of the serial I/O port. Settings include baud rate, parity, data bits, line feed, network ID number and waiting period before a RTS time-out. Only activate RS-232 output if you intend to transmit serial data; to avoid burdening 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/NT/2000//XP HyperTerminal, that includes a field for stop bits; select 1 stop bit.

RS-232 SETUP MENU STRUCTURE

⇕	RS-232 Setup ⇨	Baud Rate ⇨	⇕	300 1200 2400 4800 9600 38400
		⇕		
		⇨ Parity ⇨	⇕	None Odd Space Even Mark
		⇕		
		⇨ Data Bits ⇨	⇕	7 8
		⇕		
	⇨ Line Feed ⇨	⇕	No Yes	
	⇕			
	⇨ Network ID ⇨			xx (numeric entry)
	⇨ RTS Key Time ⇨	⇕	0.0 Sec. 0.2 Sec. 0.4 Sec. 0.6 Sec. 0.8 Sec. 1.0 Sec. 2.0 Sec. 3.0 Sec. 4.0 Sec.	
		⇕		


4.7.1 BAUD RATE

The Baud Rate menu sets the asynchronous serial transmission data transfer rate of the RS-232 port providing a selection of baud rates up to 38,400 baud. The baud rate must match the baud rate setting of receiving external device. The factory-set baud rate is 9600.

To change the Baud Rate:

To access the [Baud Rate] option list press 

Move the cursor to the required baud rate press  


To store selection press . This moves the cursor to [Parity].



4.7.2 PARITY


Parity is a simple method to check the accuracy of an asynchronous serial data transfer. The parity setting tells the meter how to format the data words it sends to an external device. Parity is usually an additional bit added to each data word. For example, if you select [EVEN], the total sum of all the bits in a single data word (including the parity bit) will always be an even number.

The Parity option list includes all the standard parity settings for asynchronous serial transmission. The selected parity must match the parity setting of the receiving external device. Some devices ignore parity entirely; therefore, the option list includes [None]. The factory setting is [None].

To edit the Parity Setting:

To access the [Parity] option list press 

Move the cursor to the required parity setting press  


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


4.7.3 DATA BITS

You can specify how many data bits the meter uses to format data words for serial transmissions. The default setting is [7]. Note that the 996P portable printer requires a word length of [8].

To set the Data Word Length:

To access the [Data Bits] option list press 

To move the asterisk to the required bit setting press  


Press  to store data. This moves the cursor to [Line Feed].

4.7.4 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 Line Feed to [OFF]. This instructs flow computer to send a carriage return character without adding line feed (creating an additional blank line after each carriage return).

Setting the Line Feed to [ON] tells the flow computer to insert a line feed character after each carriage return that it transmits. This may be necessary to avoid the constant “wrapping” of transmitted data onto a single line. The factory setting is [NO] (line feed disabled). Note that the 996P portable printer requires [NO].

To enable (or disable) Line Feed:

To access the [Line Feed] option list press 

Press   to move the asterisk to [Yes] Line feed enabled, or to [No] Line feed disabled.


To store the data press . This moves the cursor to Network ID.

4.7.5 NETWORK ID


The Network ID menu cell stores an identification number to facilitate host computer polling when you use this system in a network environment. The Network ID number can be any value other than 0 (zero). The default setting, zero, disables the network function. Note that entering a non-zero Network ID number suspends all routine Datalogger activity regardless of any selected options.

NOTE: If you are using the flowmeter for a “stand-alone” application, you must keep the zero Network ID number.

To assign a Network ID number

To enable numeric entry press 

Use the numeric keys to type the Network ID number.


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


4.7.6 RTS KEY TIME


During a serial transmission session, you can select how long the flow computer holds its *request-to-send* line high while checking for a *clear-to-send* signal. If RTS key time expires, the 1010 will return its RTS line low and abort the transmission attempt. Data entry units are *seconds*. The default RTS key time is 0.2 seconds.

NOTE: The RTS Key Time function is only provided when the meter’s Network ID number is non-zero.

To set the RTS Key Time:


To access the [RTS Key Time] option list press 

To move the asterisk to the required RTS time press  

To store the data press 

4.8 BACKLIGHT

This menu allows you to specify how long you want the LCD Display backlighting to remain on. Select [On] for continuous illumination.

To access the option list press , and then scroll to desired time delay (before turn-off).

Press  to store setting.

4.9 SYSTEM INFO

This menu provides general information about the flowmeter.

SYSTEM INFO MENU STRUCTURE

Version	This is the meter's operating system version number. The Technical Services Group may request this number during a consultation.
Battery Capacity %	Defines remaining battery capacity. Battery alarm beeps when approximately 10 percent of the meter's operating time remains.
Reset Date/Time	Shows the date and time of this meter's last <F4> reset.
Op System P/N	Meter's operating system part number.
Checksum	Operating System verifying code. The Technical Services Group may request this number during a consultation.
Code	Software Compile Date/Time. Operating System identifier. The 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

4.10 THE 1010P GRAPHIC DISPLAY SCREENS

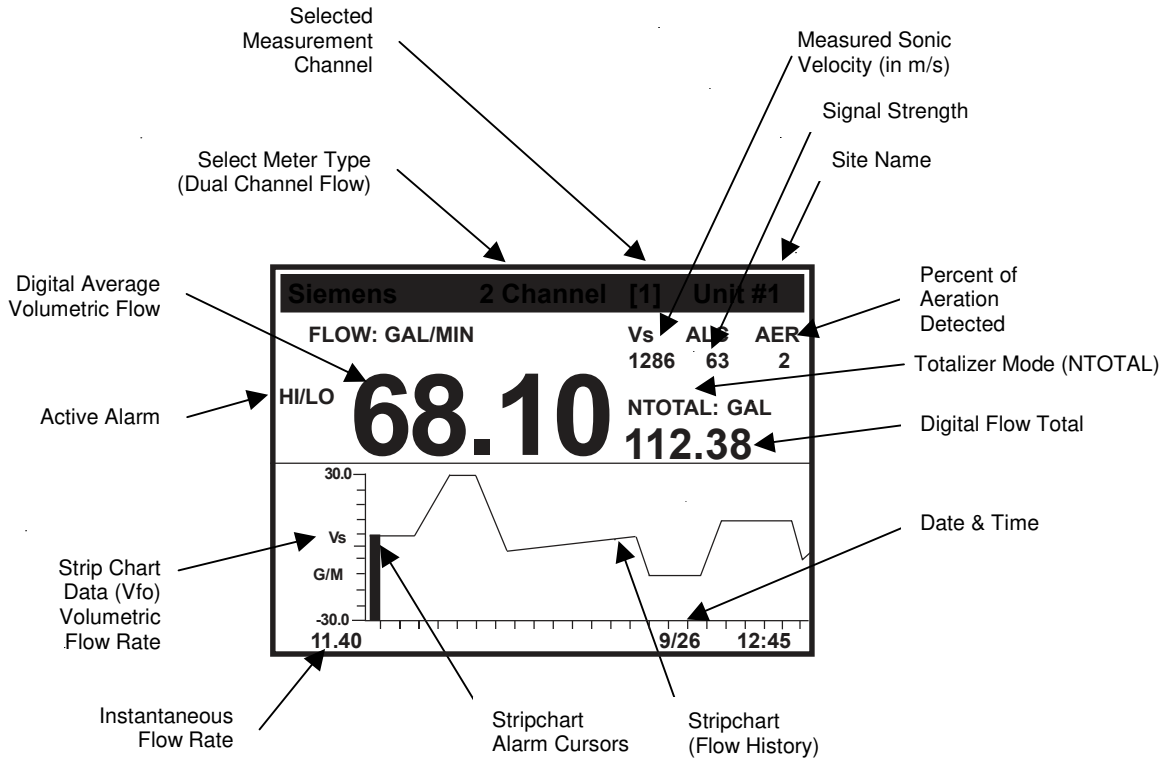
The 1010 Graphic Display is a versatile resource which provides visual access to all system variables and conditions. Dependent on your selection, details of the display may vary, but all elements are always clearly labeled with units and variable names. You're always able to move through the various displays by keying the up or down arrow keys. The meter will hold the last display selected indefinitely or until pressing the <MENU> key. When you again leave menu, the last selected display will greet your return.

After completing the Site Setup, you should check your local display screen to make sure that everything is operating properly. The meter begins to measure flow as soon as you complete the transducer installation. When you press the <MENU> key to leave the menu, you will see the hybrid digital display screen (see page 4-17).

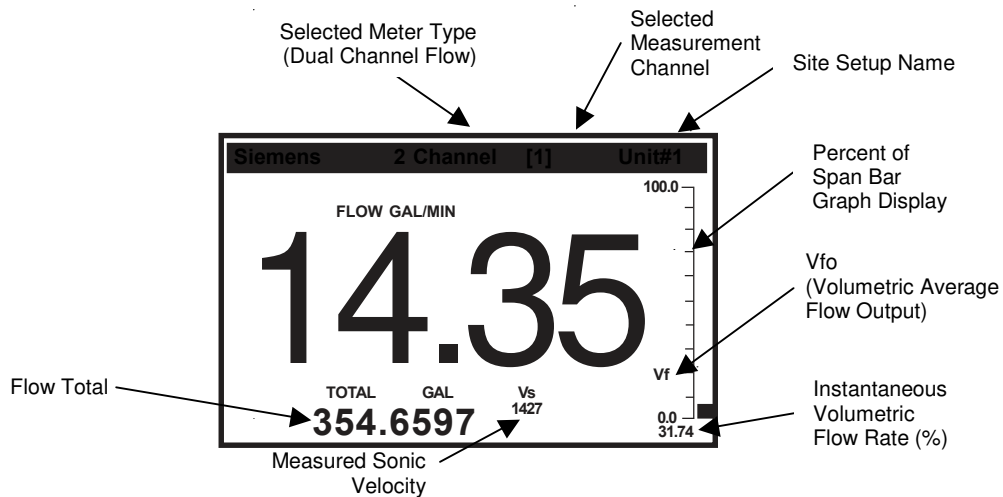
Note that the display screen includes a digital flow, total numeric display and a Stripchart.



The StripChart Contains a number of special elements that deserve mention:

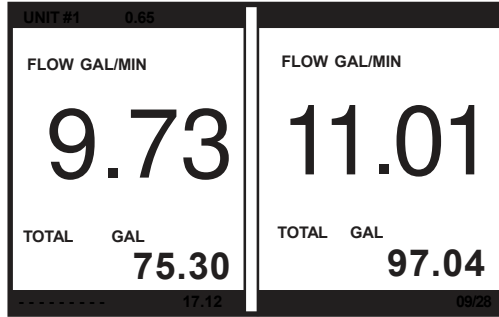
- *The spanning of the stripchart's vertical axis obeys the same user settings that define the span limits for the analog outputs. If the variable "pegs", the numerical expression of that variable will also peg.*
- *Alarm limits, or thresholds, are indicated by triangular cursors shown near the stripchart bar. These are also defined in the Data Span/Set/Cal area of the menu.*
- *Each time the stripchart is altered in a manner that can cause misinterpretation of already displayed data (re-spanned, new interval, etc.) a vertical bar is drawn on the stripchart. Only the data to the left of the vertical bar is correctly displayed.*
- *Due to limitations in display area, certain rate or total units may be displayed with fewer characters than are needed for unambiguous interpretation. Consult the 1010's Flow and Total Units menu cells for clarification in these cases.*



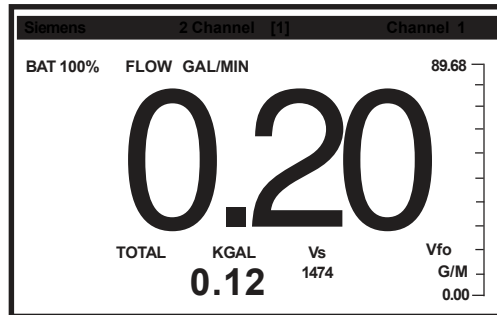
To switch the screen to the “big digits” display press  



You can press the   keys to scroll between the available display screens.



Dual Display Screen



The flow display uses the first (prompt) line display for the purpose of identifying the type of meter currently enabled (Dual Channel, Dual Path) and the channel from which the current display is derived (1 or 2 for the physical channels and 3 for the computed or average channel in a dual-path meter). The Site Name is displayed in the upper right-hand corner of the digital display.

5. SYSTEM 1010P APPLICATION NOTES

The 1010P is an extremely versatile transit-time flowmeter that operates with either non-intrusive clamp-on, or in-line (non-wetted) flow transducers. The following application guidelines will enable you to obtain the best service from this equipment.

System 1010P provides a simple menu-driven interface for site programming. During the installation procedure, you tell the system what you need it to do. It will then verify the pipe and liquid conditions, and, based on your selections, optimize its operation automatically. However, the system cannot protect itself from any critical data entry errors that you input. Its performance depends on the accuracy of the information that you provide it.

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

5.1 TO OBTAIN TECHNICAL ASSISTANCE

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

5.2 CONSIDERATIONS FOR CRITICAL APPLICATIONS

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

System 1010P flowmeters automatically compensate for adverse flow conditions to achieve their extremely high accuracy. Not closely following the instructions for proper equipment selection, use of the correct clamp-on transducer or flow tube configuration, and paying close attention to installation instructions could adversely affect this accuracy. Judicious use requires expert equipment knowledge and experience, plus a thorough understanding of flow conditions to achieve the high accuracy the meter is designed to deliver.

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

5.3 PIPE CONSIDERATIONS FOR CLAMP-ON TRANSDUCERS

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

5.3.1 PIPE DIMENSIONS

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

5.3.2 PICKING THE APPROPRIATE TRANSDUCER

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

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

NOTE: Transducer pairs must have matching serial numbers.

5.3.3 FLOW VELOCITY RANGE

System 1010P's flow velocity range with clamp-on transducers is at least ± 40 ft/sec regardless of the diameter of the pipe. Depending on application conditions, this range can extend to over 100 ft/sec. This measurement range is greater than needed for virtually any application. For optimum accuracy at very low flow rates and for small line sizes, consider using our 992DFT or 1011FT flow tubes.

5.3.4 OVERVIEW OF SYSTEM PERFORMANCE

Our system performance specifications are based on acceptable liquid sonic conductivity and other pertinent application conditions. The diversity that characterizes liquid flow, makes it impossible for us to cover all possible application conditions that have the potential to reduce performance. Performance within specifications depends primarily on the receive signal's signal-to-noise ratio and amplitude. The information below may point to application conditions that could reduce system performance below its normally high level.

5.3.5 ACCURACY

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

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

5.3.6 REPEATABILITY

Some applications require repeatability rather than absolute accuracy. System 1010 features excellent repeatability specifications since its digital "no moving parts" design avoids the adverse effects of hysteresis and other wear mechanisms typical of mechanical devices.

5.3.7 DATA STABILITY

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

Data Scatter

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

System 1010P does not exhibit inertia since it has no moving parts. It takes readings at ten times per second. 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 variation of liquid temperature or liquid sonic velocity. Drift is more noticeable when combined with a poor signal-to-noise ratio. System 1010P is carefully designed to minimize the effects of drift. There are no drift-prone analog phase-locked loop devices in the primary detection circuits. In addition, we use only the most stable plastics or steel to construct our transducers.

5.4 FLOW CONDITIONS

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

5.4.1 LOW FLOW RATES

Our 1010P Systems provide a flow resolution and measurement range that surpasses any other type of flowmeter. Therefore, it operates superbly for low or high flow rate applications. However, with our clamp-on systems, using the highest resolution when measuring a low flow rate may cause natural data scatter to become a high percentage of the reading. Since it is data scatter, it will not contribute any error to a totalizer reading accumulating for at least several minutes. However, if the flow rate is extremely low (e.g., under 0.25 ft/sec) the minute zero drift retained by the system may cause an observable performance decline. Therefore, if your application involves extremely low flow velocities, and your line size is 2" or under, our 992DFT or 1011FT Flow Tubes might serve you best.

5.4.2 FLOW DATA SCATTER AND DAMPING

The transit-time flowmeter's ability to respond to the extremely fast flow fluctuations that characterize "real" flow may surprise you. Most conventional flowmeters cannot detect these rapid flow fluctuations since they are subject to unavoidable mechanical inertia. The System 1010P's response speed is ideal for tracking fast flow transients. However, if this performance is unnecessary, it also includes controls to smooth its response time to suit any application.

System 1010P Damping and Slewing Controls

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

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

SmartSlew is a digital signal processing method that generates a variable time constant based on the real-time assessment of collected data. When the flow data exhibits a steady trend, SmartSlew extends the time constant - resulting in very smooth data output. SmartSlew instantaneously reduces the time constant whenever the trend of flow changes, even for a short duration. The flow output quickly

follows the slewing of actual flow. It thus provides excellent data without sacrificing the fast response required for precise flow control. Feel free to experiment with time average damping and slewing factors to discover which settings optimize the collected data. With SmartSlew enabled, you can create very smooth output graphs without losing the ability to respond to fast flow transients that may be undetectable with the fixed time average filter enabled.

5.4.3 NOTES ON LIQUID CONDITIONS

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

Most liquids are excellent sonic conductors, regardless of their electrical or optical properties. Although highly viscous liquids exhibit a greater degree of sonic attenuation, the 1010 operates perfectly with the vast majority of these liquids. The **Valc %** (signal strength) item on the Diagnostic Menu is a good indicator of this condition. A low value (under 30) indicates a possible low liquid sonic conductivity, or improper transducer installation.

5.4.4 ERRONEOUS LIQUID PARAMETER SPECIFICATION

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

5.4.5 LIQUID COMPATIBILITY

Since our clamp-on transducer systems never contact liquid, the issue of liquid compatibility only applies to entrained gases or mineral solid content that might impair sonic signals. Also, since System 1010P is designed to measure flow using both transit-time and Reflexor techniques, we can safely say that it will operate most successfully on virtually all liquids.

5.4.6 AERATION

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

System 1010P can operate successfully with a larger amount of aeration than any other transit-time flowmeter. It measures and reports the aeration level as the analog output, Vaer %. This represents the relative degree of aeration detected within the flow stream. Its computer reports the Vaer level until it impedes operation and forces a Fault Alarm. The Vaer output accommodates applications requiring an aeration indicator. The Vaer also appears on the display screen. The aeration percentage can be used as an alarm relay set-point. You can set the aeration alarm setpoint such that it trips before aeration reaches a level that impairs flow measurement.

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

5.4.7 SLURRIES

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

5.4.8 TWO-PHASE LIQUIDS

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

5.4.9 VISCOUS LIQUIDS

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

5.4.10 TEMPERATURE AND PRESSURE RATINGS

We rate our standard (universal) transducers for operation up to 250°F. We offer High (H) temperature flow transducers rated for operation up to 375°F. We also manufacture Very High (VH) temperature transducers for applications where the temperature exceeds 375°F, but is less than 450°F. Please refer to Section 6 for flow tube pressure and temperature ratings.

5.5 OVERVIEW OF SYSTEM 1010P MEMORY RESOURCES

System 1010P’s memory resources include Read-Only-Memory (ROM) and battery-backed Random Access Memory (RAM). The ROM memory contains the system operating instructions, on-line help text, default data, and the pipe, transducer and liquid tables. The flowmeter uses 256K bytes of RAM (standard) or 1 Meg (optional) to provide three discrete storage functions:

Active Memory - Site Storage Memory - Datalogger Memory.

Upon creating a site, the meter copies all ROM-based defaults into the meter’s operational database, the *Active Memory*. This provides two advantages. First, RAM-based operation increases performance. Second, this creates an immediate Site Setup, based on the meter’s defaults.

To make the meter operational, you just have to enter the *required* data (e.g., pipe and transducer data) and edit other default settings to suit your application. When you program the meter, all your entries are retained in the *Active Memory*. This enables you to use the meter immediately after finishing a Site Setup. You’re not limited to one set of site parameters. You can copy site data from *Active Memory* to *Site Storage Memory*.

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

The Datalogger logs data collected at preset intervals during operation. It uses the system RAM resources independently of *Active Memory* and *Site Storage Memory*. Therefore, data movement between Active Memory and Site Storage memory will not affect it directly. However, all stored data shares a common RAM pool. The meter allocates the actual amount of bytes available for each storage function dependent on the demands of each facility. Therefore, an unusually large Datalogger file may reduce the amount of site storage memory available. Storing several inactive site setups may reduce the available logging capacity.

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

The 1010P also offers a Memory Map and Defragmenting command in the Meter Facilities area of the menu as an aid in visualizing and maximizing the efficient utilization of your meter's memory resources.

5.6 REFERENCE TABLES

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

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

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

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

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

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

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

RECOMMENDED SONIC COUPLING COMPOUNDS

ITEM	CC#	USE	CHARACTERISTICS
1	101	Temporary and portable use on Clamp-on flow transducers. Temp. range: -40°F to 100°F.	Low in halogens and sulfur content.
2	102	Temporary and portable use for all Clamp-on flow transducers. Well suited for survey use. Temp. range: -30°F to 100°F.	Low in halogens and sulfur content. Water soluble.
3	109	Temporary and portable use for all Clamp-on flow transducers. Temp. range: -40°F to 300°F.	Low viscosity Petroleum product.
4	110	High temp. temporary couplant to be used when setting up high temp. plastic flow transducers. Temp. range: 255°F to 450°F.	Resists breakdown and thinning out at high temperatures.
5	111	Permanent high temp. couplant for plastic flow transducers. Temp. range: 255°F to 450°F.	Room temperature vulcanizing silicone rubber.
6	112	Permanent ambient temperature couplant for plastic flow transducers. Temp. range: -40°F to 250°F.	Room temperature vulcanizing silicone rubber.
7	113	Protective spray for providing corrosion resistance to exposed transducer and track parts.	Spray on liquid. Excellent resistance to salt water atmosphere.
8	114	Temporary and long term couplant for all flow transducer types. Temp. range: -40°F to 255°F.	Teflon filled grease. Water resistant.
9	117	Long term and permanent couplant for Clamp-On transducers. Temp. range: -40°F to 450°F.	Silicone grease loaded with metal oxides. Resists Breakdown and thinning at high temperatures.
10	120	Submersible couplant. To be used on all submerged transducer applications.	Extremely water resistant. Consult Controlotron before using.
11	122	Long term and permanent couplant for Clamp-on transducers. Temp. range: -40°F to 450°F.	Long chain polymer grease. Resists breakdown and thinning at high temperatures.
12	124	Long term and permanent couplant for Clamp-On transducers. Temp. range: -40°F to 250°F.	Two part room temperature cure adhesive.
13	128	Temporary and long term couplant for all flow transducer types. Temp. range: -40°F to 375°F.	High viscosity silicone grease. Water resistant.
14	129 129A	Adhesive backed Dry/Damping couplant for all flow transducer types.	Viscoelastic polymer sheet. Water resistant.

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

SYSTEM 1010 REYNOLDS COMPENSATION FACTORS

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

TERMINOLOGY CHART

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

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

(continued)

TERM	EXPLANATION
Local Display	Refers to the 1010P's integral display screen.
Menu	Sub-sections of the Installation Menu that you to define specific operational functions (e.g., RS-232 Setup).
Menu Cell	A location within a Menu where you define either a single numeric value or option list selection that supports the Sub-Menu's function. Certain view-only menu cells show reference data appropriate to the current application.
NEGFLOW	Totalizer mode for negative flow total only.
NETFLOW	Totalizer mode that combines positive and negative flow totals.
NOTOT	System function that disables the internal Totalizer.
Number Index	Computed transducer spacing index based on the estimated sonic velocity measurement. This Index cannot be overridden by installer.
Numeric Data	Refers to a value entered into a menu cell. An example would be the pipe outer diameter.
Numeric Entry	Refers to a number you type into menu cell that stores numeric data.
Numeric Keys	Use the Numeric keys to type a numeric value where appropriate.
OpSys ROM	The read only memory that stores its basic operating instructions and permanent defaults.
Option List	Lists of options presented at menu cells that allow you to select either a single item or multiple items (depending on the function that the menu cell controls).
Parameter	Refers to value (either numeric or list selection) stored in a menu cell.
POSFLOW	Totalizer mode for positive flow total only.
Register	Refers to a memory location used by the flow computer to store data such as the flow total, etc.
RTD	Temperature sensors used with energy flow of mass flow systems.
Site Name	A user-entered name that meter associates with a stored Site Setup. You 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.
Spacing Index	Refers to the Number Index, used by the flow computer to determine the space between the upstream and down stream transducers on clamp-on systems.
Spacing Offset	Fixed transducer offset assigned by the flow computer. This can be overridden by the installer.
TOTCNT	A totalizer pulse count function used for Batching or Sampling.
Transducer	Clamp-on flow sensors that the meter uses to measure the flow rate.
Vaer	The meter's aeration percent output.
Vps	The sonic propagation velocity of a pipe.
Vs	The sonic velocity of a liquid.

5.7 THE DUAL-CHANNEL MENU CHART

This section shows the 1010 Dual Channel Menu Chart. (Note: Single channel unit menus are different.) The Reflexor and Flow Tube menus repeat the Clamp-On menu, except for the exclusion of menu cells appropriate for clamp-on transducers.

THE METER TYPE MENU

Meter Type ⇄	Dual Channel Flow ⇄	⇄	Channel 1 ⇄	⇄	⇄	Clamp-On Flow Tube Reflexor	⇄	⇄	Faststart Setup Channel Setup Channel Setup
			Channel 2 ⇄			<i>same as Ch. 1</i>			
	Dual Path Flow ⇄		Channel/Path Setup ⇄						
	Ch 1+2 Flow ⇄	⇄	Channel 1 ⇄	⇄	⇄	Clamp-on Flow Tube	⇄	⇄	Channel Setup Channel Setup
			Channel 2 ⇄			<i>same as Ch. 1</i>			
			Channel 3 ⇄			Channel 3 Setup	⇄		Channel Setup
	Ch 1-2 Flow ⇄		<i>Same as Ch 1+2 Energy</i>						
	Thickness Gauge ⇄	⇄	Measure Thickness ⇄	⇄	⇄	Pick Pipe Material Measure?			Steel No
			Calibration ⇄	⇄	⇄	Automatic	⇄	⇄	Set Xdcr Zero Select material Calibrate material
				⇄	⇄	Manual	⇄	⇄	Zero Set (usecs) Select Material Modify Vpl (ips) Data Lock Level Reset Default

THE METER FACILITIES MENU

Meter Facilities ⇄	⇄	Preferred Units ⇄	⇄	⇄	English Metric			
		Table Setups ⇄	⇄	Pipe Table ⇄	⇄	Create/Edit Pipe ⇄	⇄	⇄
					Delete Pipe ⇄	⇄	⇄	Choose Pipe Class Pick Pipe Name
				⇄	Transducer Type ⇄	⇄	⇄	1011 Universal 1011H High Precision 991 Universal
		⇄	Datalogger Control ⇄	⇄	⇄	Display Datalogger Output Datalogger Circular Memory Est Log Time Left Clear Datalogger		
		⇄	Memory Control ⇄	⇄	⇄	Data Memory Left Memory Map Defragment		

(continued)

THE METER FACILITIES MENU *(continued)*

⇕	⇨	Analog Output Trim	⇨	⇕	Trim lo 1	⇨	⇕	Operate Trim @ 4mA	
					Trim lo 2	⇨		Operate Trim @ 4mA	
			⇕		Trim Vo 1	⇨		Operate Trim @ 2V	
					Trim Vo 2	⇨		Operate Trim @ 2V	
					Trim Pgen 1	⇨		Operate Trim @ 1Khz	
					Trim Pgen 2	⇨		Operate Trim @ 1Khz	
	⇨		RTD Calibrate	⇨	⇕	Ch 1 Ts - RTD-1	⇨	⇕	Factory User Cal
					⇕	Ch 1 Tr - RTD-2	⇨	⇕	Factory User Cal
						Ch 1 Ts - RTD-3	⇨	⇕	Factory User Cal
						Ch 1 Tr - RTD-4	⇨	⇕	Factory User Cal
	⇨		Clock Set	⇨	⇕	Date Time			xx.xx.xx xxx.xx
	⇨		RS-232 Setup	⇨		Baud Rate	⇨	⇕	38400 9600 4800 2400 1200 300
					⇕	Parity	⇨	⇕	None Odd Space Even Mark
						Data Bits	⇨	⇕	7 8
					⇕	Line Feed	⇨	⇕	No Yes
					Network ID	⇨		xx (numeric entry)	
					RTS Key Time	⇨		xx.x Sec	
⇨		Backlight On	⇨	⇕	30 Seconds 1 Minute 2 Minutes 3 Minutes 5 Minutes 10 Minutes On				
⇨		System Info	⇨	⇕	Version Battery Capacity % Reset Date/Time Op System P/N Checksum Code				

THE CLAMP-ON MENU

⇕	Clamp-On ⇨	Faststart Setup ⇕		
		⇨ Full Site Setup ⇨	⇨ Channel Setup ⇨	⇕ Recall Site Setup Channel Enable Create/Name Site Site Security Delete Site Setup Save/Rename Site
			⇕	
			⇨ Pipe Data ⇨	⇕ Select Pipe Class Select Pipe Size Pipe OD (in / mm) Pipe Material Wall Thickness Liner Material Liner Thickness
			⇕	
			⇨ Application Data ⇨	Liquid Class ⇨ ⇕ Select Liquid Estimated Vs m/s Viscosity cS Density S.G.
				⇕
				Temperature Range ⇨ ⇕ -40F to 450F -40F to 250F -40F to 375F
				⇕
				Pipe Configuration ⇨ ⇕ Fully Developed 1 Elbow Dbl Elbow + Dbl Elbow - Expander Reducer Norm Entry Header Inlet Intrusions
				Anomaly Diams ⇨ xxxx (numeric entry)
			⇨ Pick/Install Xdcr ⇨	⇕ Transducer Model Transducer Size Xdcr Mount Mode Spacing Offset Number Index Spacing Method Ltn Value Install Completed? Empty Pipe Set Zero Flow Adjust
		⇕		
		⇨ Operation Adjust ⇨	Damping Control ⇨ ⇕ Time Average SmartSlew	
			⇕	
			Damping Control ⇨ 0.00	
		⇕		
			Memory/Fault Set ⇨ ⇕ Fault Memory	
			⇕	
			Memory Delay (sec) ⇨ N/A	
			Zero/Fault Set ⇨ ⇕ Fault Zero	
		⇨ Flow/Total Units ⇨	⇕ Flow Volume Units Flow Time Units Flow Display Range Flow Display Scale Total Volume Units Totalizer Scale Total Resolution	
		⇕		

(continued)

THE CLAMP-ON MENU *(continued)*

⇕	⇐	⇐	⇐	Flow Total Units ⇐	⇕ Totalizer Mode Batch/Sample Total					
					⇐	Data Span/Set/Cal ⇐	⇐ Span Data ⇐	⇕ Max Flow (Units) Min Flow (Units) Max Temperature Min Temperature Max Vs m/s Min Vs m/s		
						⇕				
						⇕	⇐ Set Alarm Levels ⇐	⇕ High Flow (Units) Low Flow (Units) High Temperature Low Temperature Interface Vs m/s Aeration % Makeup Latch		
						⇕				
						⇐	⇐ Stripchart Setup ⇐	⇕ Calibrate Flow Rate		
						⇕		⇕ Select Data Data Display Time Base Stripchart Clear		
						⇐	⇐ Datalogger Setup ⇐	⇕ Datalogger Mode Datalogger Data Log Time Interval Datalogger Events Display Datalogger		
							⇐	⇐ I/O Data Control ⇐	⇐ Analog Out Setup ⇐	⇕ Io1 Vo1 Pgen1
							⇕			
							⇕	⇐ Relay Setup ⇐	⇕ Relay 1 Relay 2	
								⇐ Analog Input Setup ⇐	⇕ Iin1 Vin1	
			⇐	⇐ Diagnostic Data ⇐	⇐ Flow Data ⇐	⇕ Flow Velocity F/S Total Vs m/s Signal mV Valc % Vaer % Alarm Status AnCal HiFlow LoFlow				
			⇕							
					⇐ Application Info ⇐	⇕ TN uSec TL uSec DeltaT nSec Burst/Sec % Accepted Last Makeup Makeup Status				
					⇐ Liquid Data ⇐	⇕ Temp 1 Temp 2 Reynolds #				
					⇐ Site Setup Data ⇐	⇕ fx (drive) N (burst length) Ltn in Vfmax				

THE CLAMP-ON MENU *(continued)*

⇕	⇐	Diagnostic Data ⇐	⇐ Site Setup Data ⇐	⇕	Vs max m/s Vs min m/s Empty % Samples/Cycles HF
			⇕		
			⇐ Test Facilities ⇐	⇕	Makeup Graph Tx UP Tx Dn Fixed ALC Tx Up Fixed ALC Tx Dn Fixed ALC Graph AutoZero
			⇕		
		⇐ Print Site Setup ⇐	⇕	⇕	No Yes
		⇐ Date Site Created: ⇐	⇕		xx.xx.xx xx.xx.xx

6. OPERATING SYSTEM 1010 WITH FLOW TUBES

Models 1010P 1 & 3 and WDP 1 & 3 support the use of the 992DFT or 1011FT Flow Tubes. This extremely versatile in-line transit-time flowmeter system has proven to be a valuable tool for servicing the following applications listed below.

Typical Applications include:

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

Typical Industries Serviced include:

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

6.1 GENERAL INSTALLATION GUIDELINES

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

6.1.1 LIQUID APPLICABILITY AND COMPATABILITY

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

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

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

6.1.2 SELECTING THE RIGHT FLOW TUBE

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

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

Flow Tube Pressure and Temperature Ratings

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

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

Flow Tube Material, Size & Flow Range Ratings

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

6.1.3 FLOW TUBE MOUNTING LOCATION

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

1. The flow tube must be mounted horizontally, with its inlet and outlet facing upward. This minimizes the possibility of trapped air bubbles that could interfere with transducer signals.
2. For the best flow profile, locate the flow tube downstream from the center of the longest available straight run. Make sure to locate the inlet upstream relative to the outlet.
3. DO NOT select a location *immediately* downstream from:
 - A throttling valve or other source of cavitation.
 - A mixing tank or other device that could aerate the liquid.
 - The discharge of a positive displacement pump.

4. DO NOT mount the flow tube on a section of pipe that may be empty during zero flow. If this cannot be avoided, then be aware that the system will not be able to measure flow until the pipe refills and flow persists for long enough to drive all the air from the flow tube.
5. DO NOT run the transmit/receive cables in common bundles with cables from any other equipment.
6. DO NOT mount the flow tube under water, unless you order a submersible cable kit and install it according to factory instructions.

6.1.4 FLOW DATA SCATTER AND DAMPING

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

6.2 CONSIDERATIONS FOR CRITICAL APPLICATIONS

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

Our System 1010 Universal Nema Flowmeters include provisions to minimize adverse flow conditions to achieve extremely high accuracy. This requires closely following the instructions for proper equipment selection, use of the correct clamp-on transducer or flow tube configuration and paying close attention to installation instructions.

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

To Obtain Technical Assistance

The operating program provides comprehensive diagnostics data. Using this data, our engineers can analyze your system in relation to the application usage. A detailed analysis will provide solutions to virtually any adverse application problem. Call our Technical Service Group for any assistance you might require. Toll-free assistance is available every week day from 8:30 A.M. to 5:00 P.M. (EST) by calling 800-275-8480. You can also request help via e-mail by contacting the Technical Service Group at TSG.ultrasonicflow@siemens.com.

6.3 HOW TO SET UP SYSTEM 1010 FOR FLOW TUBE OPERATION

The example in this section shows how to set up channel 1 of a 1010 dual channel system for use with a 1011FT stainless steel Flow Tube. Note that Series 1010 dual-channel models allow flow tube operation with either measurement channel. In addition, all 1010 flow computers operate with both 1011FT and 992DFT series of flow tubes. This example begins at the Channel Setup Menu. If necessary, review paragraph 1.7.3 for instructions on how to select a Meter Type and a measurement channel.

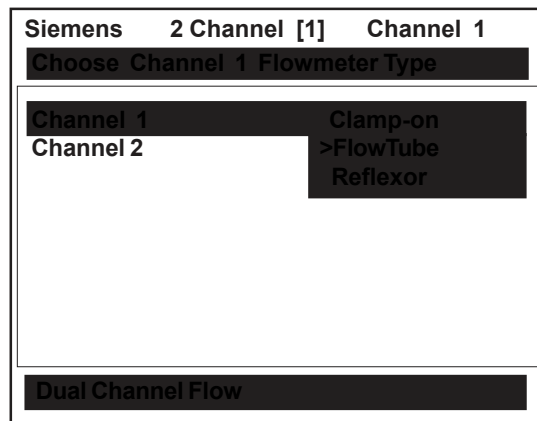
6.3.1 OVERVIEW



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

- Select a Meter Type (in this case Dual Channel Flow).
- Select a channel to install the flow tube (e.g., Channel 1).
- Set Kc calibration (slope correction) indicated on Flow Tube tag. (Note: Programmed Kc must match offset error on plastic Kc tag to get accurate flow tube readings. See paragraph 2.7.3 Calibrate Flow Rate.)
- Create a site setup to store the flow tube installation parameters.
- Enter liquid Parameters (optional, default = water@68°F).
- Complete the Flow Tube install procedure.




6.3.2 SETUP PROCEDURE

From the Channel Select screen, press  to access the option list, then press  to move the cursor to [FlowTube] (if required).



To select the [Flow Tube] menu cell press . This enables the Flow Tube menu. Press  to access the Channel Setup menu.

Siemens	2 Channel	[1]
Scroll saved Site Setup list and Enter		
Recall Site Setup	No Sites	
Channel Enable	No	
Create/Name Site		
Site SecurityF	Off	
Delete Site Setup	No Sites	
Save/Rename Site		
Channel Setup		

Move the highlight by pressing   to [Create/Name Site]. To access the site name field press . In this example, we will simultaneously create and name the site:

FLOW1. Use the character lists to select a site name as shown below.

Siemens	2 Channel	[1]
Right Arrow & Enter Create a new Site		
Recall Site Setup	No Sites	
Channel Enable	No	
Create/Name Site	?FLOW1	
Site SecurityF	Off	
Delete Site Setup	No Sites	
Save/Rename Site		
Channel Setup		

To create a new site and register the site name press .

FLOW1. Note that the name now appears in the site name field on the upper right of the display and in the Save/Rename Site menu cell.


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

Press  to leave the Channel Setup menu.

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

To move the highlight to [Install Flow Tube] press . Press  to access the Install Flow Tube menu.




Siemens	2 Channel	[1]	FLOW1
Pick Flow Tube size and Type			
Select FlowTube			
Install Completed?	No		
Empty FlowTube Set	Chan Not Setup		
Zero Flow Adjust	Chan Not Setup		
Install FlowTube			

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


Siemens	2 Channel	[1]	FLOW1
Pick Flow Tube size and Type			
Select FlowTube	>1S		
Install Completed?	1P		
Empty FlowTube Set	1K		
Zero Flow Adjust	1T		
	2S		
	2P		
	2K		
	2T		
Install FlowTube			

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


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

After filling the flow tube with liquid, press  to access the [Install Completed?] option list and then move the cursor to [Install] by pressing  .


Siemens	2 Channel	[1]	FLOW1
Key Install to start operation			
Select FlowTube	1S		
Install Completed?	>Yes		
Empty FlowTube Set	New Makeup		
Zero Flow Adjust	Chan Not Setup		
Install FlowTube			



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

Siemens	2 Channel	[1]	FLOW1
Drive 27 m 10 [6. :0]			
Select FlowTube	1S		
Install Completed?	Install		
Empty FlowTube Set	Chan Not Setup		
Zero Flow Adjust	Chan Not Setup		
Install FlowTube			

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



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

Pressing  accepts the displayed sonic velocity. This moves the highlight to [Empty Flow Tube Set].

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


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



Siemens	2 Channel	[1]	FLOW1
Conforms Indicated flow to Actual zero			
Select FlowTube	1S		
Install Completed?	Yes		
Empty Flow	Zero Flow GAL/MIN		
Zero Flow	= 0.000		
Install FlowTube			

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

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

Siemens	2 Channel	[1]	FLOW1
Integrating 9 Press [ENT]			
Select FlowTube	1S		
Install Completed?	Yes		
Empty FlowTube Set	MTYmatic		
Zero Flow Adjust	Actual Zero		
Install FlowTube			

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

A pop-up window prompts you to save the site. Do so by pressing , then . Provide a site name, if desired (see paragraph 2.1.3). This moves you to the flow rate display screen. The flowmeter is now operational.

6.4 SPECIFICATIONS – CPVC FLOW TUBE

**Typical values, subject to change without notice.*

	Size 1	Size 2
Liquid	Must be compatible with CPVC under operating conditions and free of suspended gasses or solids.	Must be compatible with CPVC under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.28 psi @ 1.5 GPM (5.7 LPM) flowing water at 68°F	0.24 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.0057 LPM)
Linearity	1% of flow for rates above 0.09 GPM (0.34 LPM)	1% of flow for rates above 0.27 GPM (1.0 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.0013 GPM (0.005 LPM)	±0.003 GPM (0.011 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.5 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Connection	3/8" FPT	3/4" FPT

6.5 SPECIFICATIONS – KYNAR® PVDF FLOW TUBE

**Subject to change without notice.*

	Size 1	Size 2
Liquid	Must be compatible with PVDF under operating conditions and free of suspended gasses or solids.	Must be compatible with PVDF under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.28 psi @ 1.5 GPM (5.7 LPM) flowing water at 68°F	0.24 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.006 LPM)
Linearity	1% of flow for rates above 0.09 GPM (0.34 LPM)	1% of flow for rates above 0.27 GPM (1.0 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.0013 GPM (0.005 LPM)	±0.003 GPM (0.011 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 5 GPM (95 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Connection	3/8" FPT	3/4" FPT

6.6 SPECIFICATIONS – TEFLON® PFA FLOW TUBE

**Typical values, subject to change without notice*

	Size 1	Size 2
Liquid	Must be compatible with PFA under operating conditions and free of suspended gasses or solids.	Must be compatible with PFA under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.23 psi @ 1.0 GPM (3.8 LPM) flowing water at 68°F	0.23 psi @ 3.0 GPM (11.4 LPM) flowing water at 68°F
Sensitivity	0.0004 GPM (0.0015 LPM)	0.001 GPM (0.004 LPM)
Linearity	1% of flow for rates above 0.07 GPM (0.26 LPM)	1% of flow for rates above 0.27 GPM (1.00 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.001 GPM (0.0038 LPM)	±0.003 GPM (0.012 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 16 GPM (60 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 16 GPM (60 LPM)
Connection	1/2" Flaretek Ultrapure PFA Tube Fitting	3/4" Flaretek Ultrapure PFA Tube Fitting

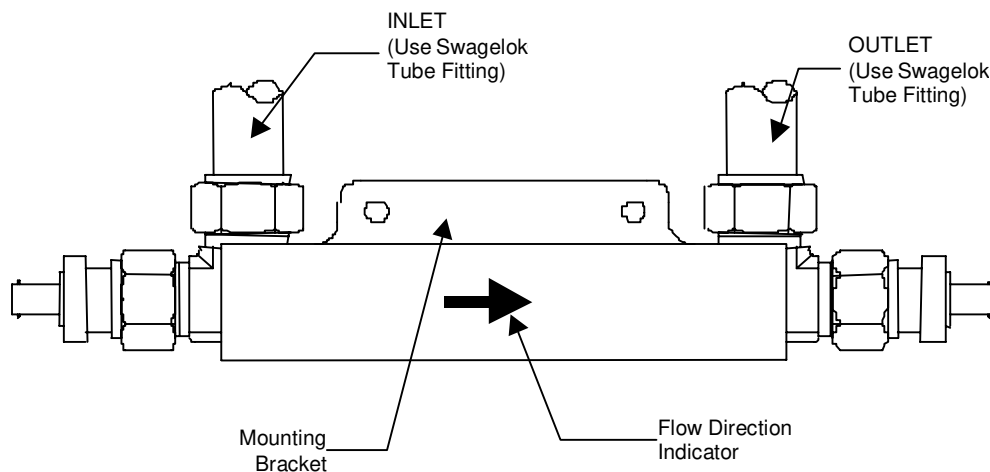
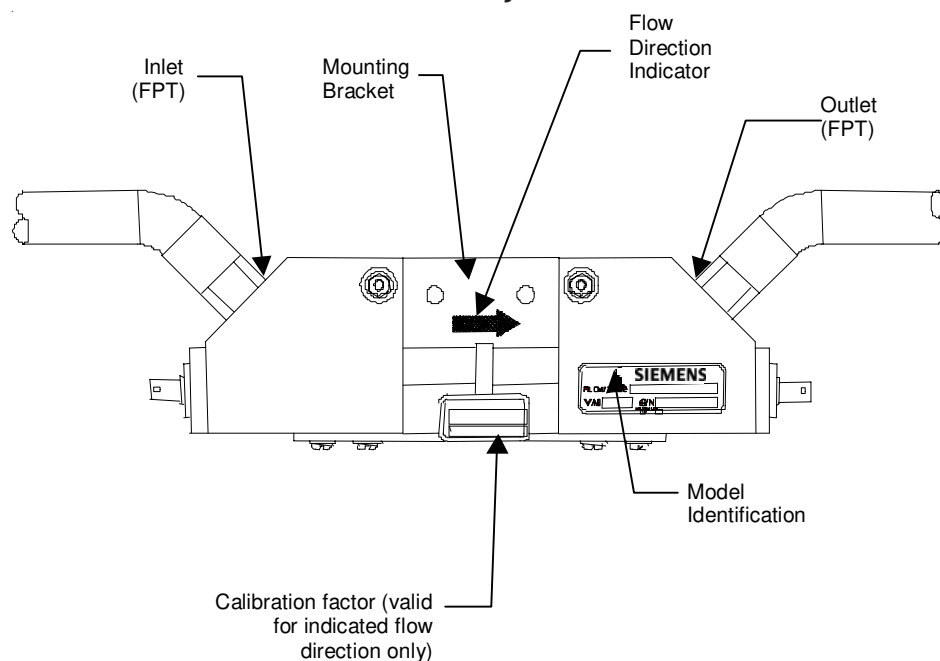
6.7 SPECIFICATIONS – 316 STAINLESS STEEL FLOW TUBE

**Subject to change without notice*

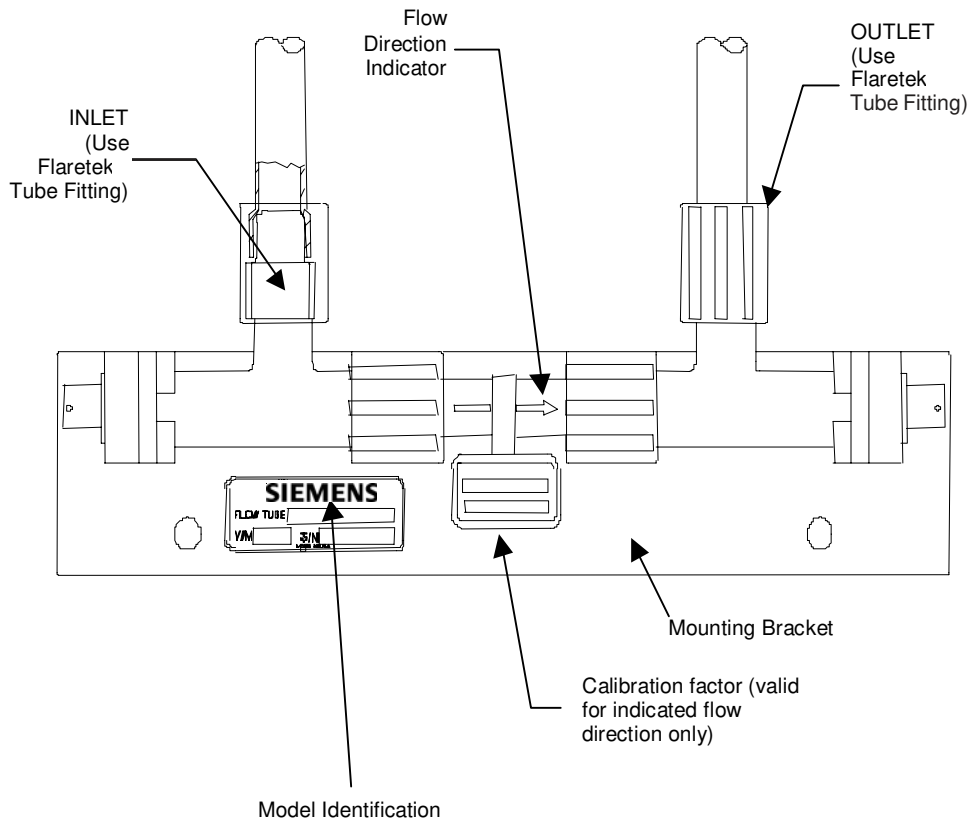
	Size 1	Size 2
Liquid	Must be compatible with 316SS under operating conditions and free of suspended gasses or solids.	Must be compatible with 316SS under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.21 psi @ 1.6 GPM (6.0 LPM) flowing water at 68°F	0.20 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.0057 LPM)
Linearity	1% of flow for rates above 0.1 GPM (0.38 LPM)	1% of flow for rates above 0.3 GPM (1.1 LPM)
Repeatability	±0.2% of flow for rates above 0.5 GPM (1.9 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.001 GPM (0.0038 LPM)	±0.004 GPM (0.015 LPM)
Accuracy, Intrinsic	±1% of flow over 0.13 GPM (0.57 LPM) to 10 GPM (40 LPM)	±1% of flow over 0.4 GPM (1.5 LPM) to 30 GPM (114 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.13 GPM (0.5 LPM) to 10 GPM (38 LPM)	±0.5% of flow over 0.4 GPM (1.5 LPM) to 30(114 LPM)
Connection	5/8" Swagelok Tube Fitting	1" Swagelok Tube Fitting

ADDITIONAL INSTALLATION NOTES

- All Flow Tubes are supplied with integral line connections. The end-user must supply any adapters, etc. required for line connection.
- When connecting a screwed fitting to a Kynar, Teflon (PFA) or CPVC Flow Tube, please start the thread carefully to avoid cross threading. Hand-tighten only. If necessary, use Teflon tape manufactured for plastic piping to effect a leak-proof seal (see Appendix A- Engineering Drawings for details).
- Whenever possible, use the mounting brackets to support the weight of the flow tube.
- Consult the supplied engineering drawing for important dimensional data.

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

992DFT Series Teflon PFA Flow Tube



7. THE SYSTEM 1010 REFLEXOR FLOWMETER

Reflexor is one of the operating modes available on certain 1010 models. The Reflexor operating mode utilizes Doppler flow detection along with digital signal processing techniques to successfully measure flow under conditions that may not be suitable for transit-time flow measurement. The Reflexor samples the flow stream as it detects Doppler shift. It converts the Doppler shift information by use of Fast Fourier Transform (FFT) and filters the FFT to determine the flow rate. The Reflexor mode will operate with many of the same transducers that are used with transit-time flow measurement along with those which are specifically designed for Doppler flow measurement. Use of any other transducer than shown in these instructions may result in failure to measure or give an incorrect flow rate indication.

7.1 REFLEXOR INSTALLATION STEPS

The typical steps to complete the installation procedure are as follows:

- Collect the site data (pipe and liquid data, part numbers, etc.).
- Choose a mounting location for the flow transducers.
- Prepare the pipe for transducer's mounting.
- Access the Installation Menu and create a site.
- Enter the pipe parameters.
- Mount flow transducers on pipe and connect to flow meter.
- Invoke the transducer installation procedure.
- Optimize installation through use of the Spectra Display and diagnostic data.

Please do not allow the size of the Installation Menu to intimidate you. Almost all menu cells will contain default parameters and will not require any additional action. To obtain operation you will only need to access the menu cells for required parameters, such as pipe data. Obtaining accurate flow rate data will take less than five minutes.

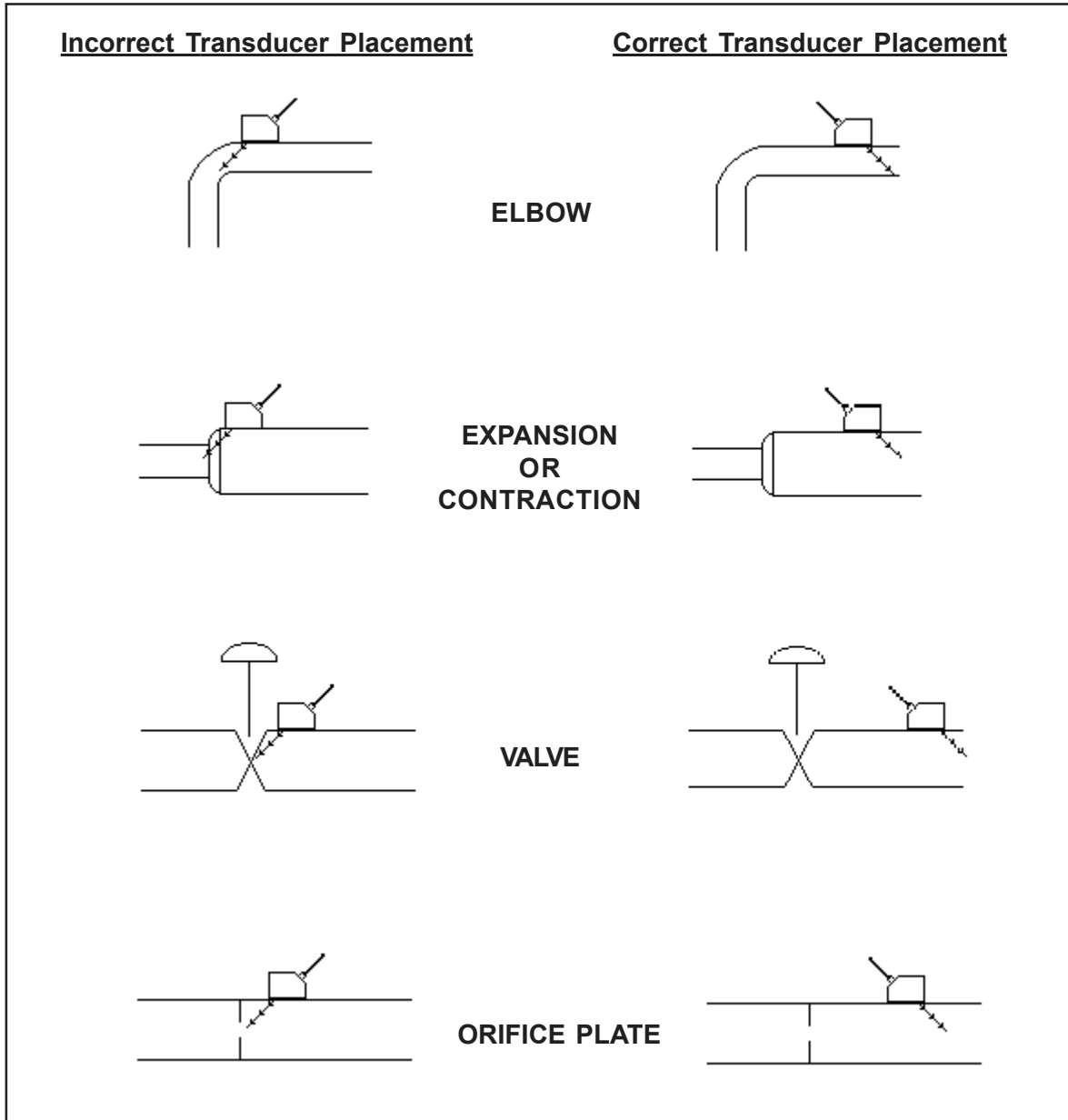
Application conditions may require you to mount the transducers using the adjacent mounting method as described and shown in paragraph 7.4.

7.2 SELECT A TRANSDUCER SET FOR USE BY REFLEXOR

The transducer recommended for use by Reflexor is any of the currently available Spectra transducers. For general purpose dedicated use, this is the 191N1S transducer set. Alternate transducers are any of the 1011 size C Universal, 991 size 2 and 3A including High and Very High Temperature versions along with the 1011 High Precision size A3 and B1. The maximum sensitivity will be obtained with use of the 191N1S transducers. Transducer models are available for submersible and extended temperature applications.

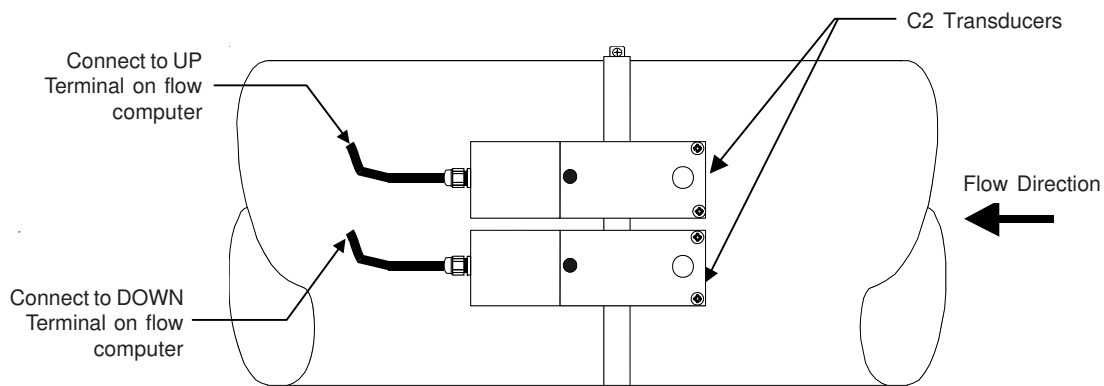
7.3 SELECT THE TRANSDUCER MOUNTING LOCATION

Select a mounting location that has a fully developed flow profile. Do not locate the transducer so that sonic energy enters a region that is not representative of the flow velocities at the measuring location. Use the figure below as a guide to select the proper mounting location.

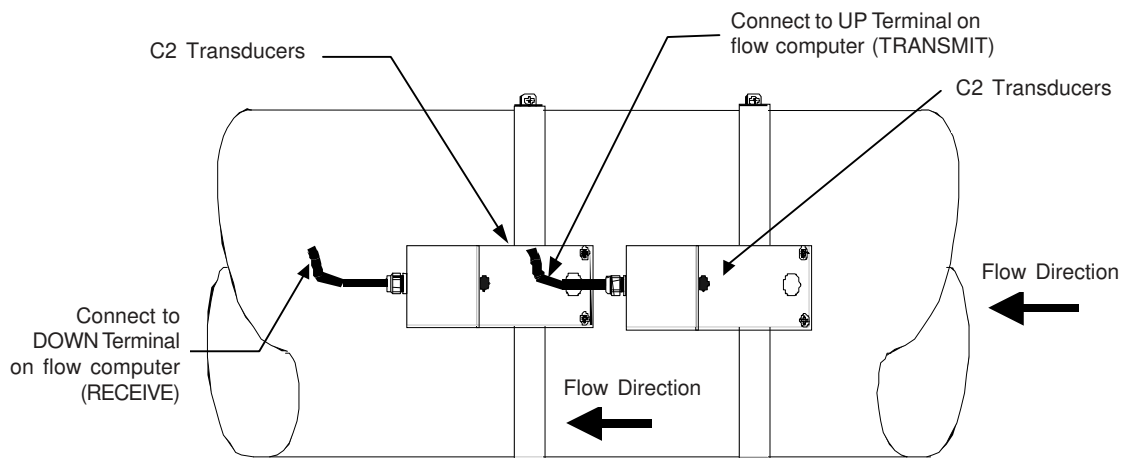


7.4 MOUNTING THE TRANSDUCERS

Two mounting configurations are available. Adjacent mounting locates the two transducers alongside each other using a single mounting chain or strap. In-Line mounting locates the two transducers axially along the pipe using two mounting chains or straps. On metal pipes the Receive Transducer is always located behind the Transmit Transducer. On plastic pipes the Transmit Transducer is always located behind the Receive Transducer. In both cases, the cable entry will be on the same end of both transducers unlike the transit-time configurations. Adjacent mounting will provide the maximum sensitivity to flow. Refer to the appropriate transducer installation drawing for the 191N1S (Installation Drawing 191N1S-7).



REFLEXOR MODE - ADJACENT TRANSDUCER MOUNTING



NOTE: Transducer position shown is for metal pipes.

REFLEXOR MODE - IN-LINE TRANSDUCER MOUNTING

7.5 CONNECTION OF TRANSDUCER CABLES

Connect transducer cables between the transducers and the flow computer. The XMIT (transmit) transducer is connected to the Up cable connection and RCV (receive) transducer is connected to the Down cable connection. The correct connection orientation is important for the in-line transducer configuration. It is not a factor for the adjacent configuration.

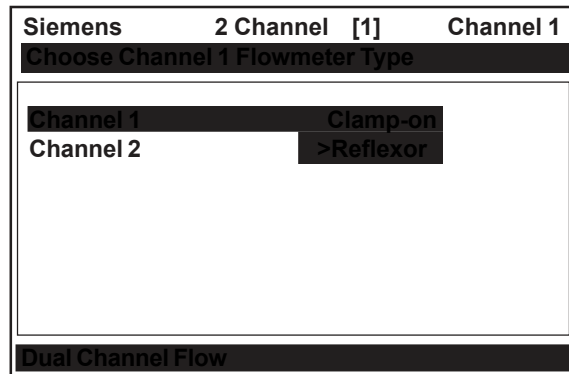
7.6 SELECT REFLEXOR OPERATING MODE

Select meter type as *Reflexor* for the channel that is to be used as Reflexor. Dual channel units may have either one or both channels used in the Reflexor mode.

7.7 INSTALLING REFLEXOR OPERATING MODE

Access [Channel Setup] and “Create or Recall” a previous Saved Site setup. If a previous Saved Site is recalled, and the same transducer and location is used, then no other installation steps are required.

Access [Pipe Data] and enter the required pipe data.



7.8 ACCESS THE INSTALL XDCR (TRANSDUCER) MENU

At [Transducer Model], press the <Right Arrow> and select the proper group of transducers that match the mounted transducer set. For all 191N, select 190.

At [Transducers Size], select the proper size of transducer mounted. For all 191N, select 191.

If the flow rate units are not the default units of Gallons per Minute, then it is recommended to change those units now by use of the Flow/Total Units menu.

At [Flow Range], press the <Right Arrow> and select the lowest flow range rate that is at least *two times higher* than the maximum flow expected at this application.

At [Install Complete], for new installations, press the <Right Arrow>, select [Install], and then select [Yes]. Press the <Enter> key.

The meter is now operational and the display will show flow by pressing the <MENU> key.

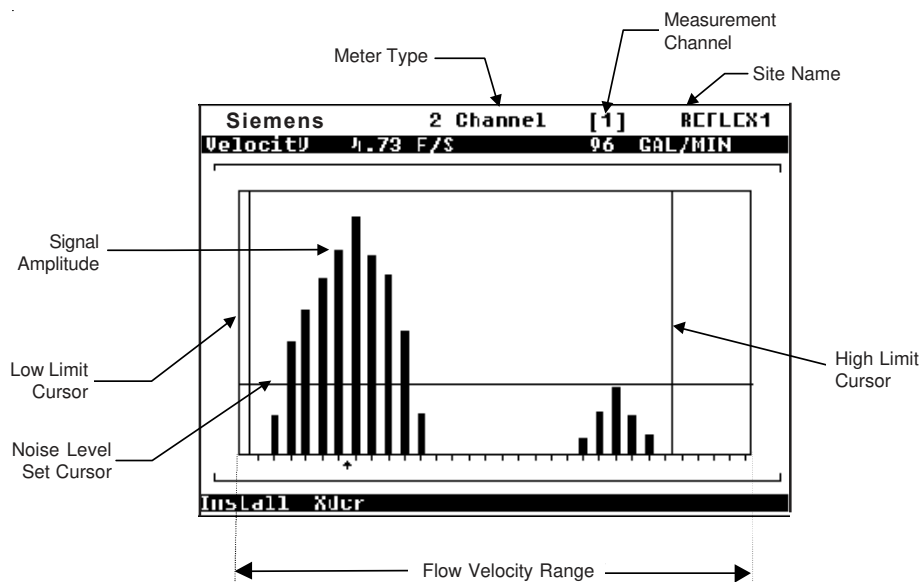
Siemens	2 Channel [1] Channel 1
Key Install to start flow measurement	
Transducer Model	190
Transducer Size	191
Flow Range GAL/MIN	6.71
Install Completed?	Yes
Spectra Graph	No
Install Xdcr	

7.9 THE SPECTRA DISPLAY SCREEN

The Spectra Graph provides a powerful tool to determine if the installation has achieved an adequate margin of operation. It also eliminates the possible effects of mechanical vibration and external RFI (Radio Frequency Interference). Mechanical vibration and external RFI can cause other types of Doppler flowmeters to be inaccurate. The Spectra Graph screen provides keypad control keys that allow adjustments of application dependent parameters, if required, while observing the results of these adjustments. Application dependent parameters are the Low and High Limit Cursors and the Noise Cursor. In most cases, only the Noise Cursor will be required to be adjusted.

To display the Spectra Graph, position the highlight over Spectra Graph and use the <Right and Down Arrows> to select [Yes].

The Spectra Graph display shows the results of the Fast Fourier Transform (FFT) performed by the flow computer. The horizontal scale represents flow velocity with the higher velocities on the right and lower velocities on the left. The vertical axis is relative amplitude or magnitude; each bar shows the relative amplitude for a velocity range. The reported flow rate is the mean value of the included Spectra Graph bars. It is computed by excluding signals that are lower (to the left of) than the Low Limit Cursor or higher (to the right of) than the High Flow Cursor or lower (under) than the Noise Cursor.



EXAMPLE OF A SPECTRA DISPLAY SCREEN

7.10 CURSOR USE ON THE SPECTRA GRAPH

CURSOR	USAGE TIPS
High Limit Cursor	This cursor appears as a vertical line on the right side of the Spectra Graph. All signals to the right of this line will be excluded from the flow calculation. Use this adjustment if the right side of the Spectra Graph has noise that is larger in amplitude than the signal that is produced by flow. The cursor may be arbitrarily placed at two times the maximum flow expected.
Low Limit Cursor	This cursor appears as a vertical line on the left side of the Spectra Graph. All signals to the left of this line will be excluded from the flow calculation. Use this adjustment if the left side of the Spectra Graph has noise that is larger in amplitude than the signal that is produced by flow. The cursor may be arbitrarily placed at one half the minimum flow expected.
Noise Level Set Cursor	This cursor appears as a horizontal line on the Spectra Graph. All signals below this line will be excluded from the flow calculation. Position the cursor approximately one quarter the height of the FFT peak.

7.11 HOW TO USE SPECTRA GRAPH DATA AND CONTROLS

When you first access the Spectra Graph, the data shown on the top highlighted line shows Velocity in feet-per-second (F/S) on the left side and the volumetric Flow Rate in the current rate units on the right side. You can scroll the data shown using the <Up and Down> Arrows.

Pressing the <Up Arrow> changes the data in the highlight to [Diagnostic Data] containing, from left to right: (Hz) Doppler shift frequency in Hertz, (mV) Signal Amplitude in millivolts, (FFT Pk) Peak FFT magnitude and (%D) FFT Percent Deviation. Carefully inspect the data for Signal Amplitude and Percent Deviation. Refer to the “Available Adjustments to Spectra Graph” table in paragraph 7.12 and the “Reflexor Diagnostic Data” table found in paragraph 7.13. Press the <Down Arrow> to return to Velocity.

Press the <Down Arrow> from Flow Velocity in feet per second (F/S) to advance to the Noise Level Set cursor control. A numeric indication of the Noise Level Cursor position is provided in the highlighted area. Refer to the “Available Adjustments To Spectra Graph” table found in paragraph 7.12.

Adjust the Noise Level cursor, if required, by pressing the <+> key to increase or <-> key to decrease.

NOTE: A delay in response to all keys will occur. This is due to the longer periodic sampling of the keyboard by the processor while performing FFT's.

Press the <Down Arrow> from Noise Level to advance to the High Limit cursor control. The <+> and <-> key are active in this position. Refer to the “Available Adjustments To Spectra Graph” table found in paragraph 7.12.

Press the <Down Arrow> from High Limit to advance to the Low Limit cursor control.

The <+> and <-> keys are active in this position. Refer to the “Available Adjustments To Spectra Graph” table found in paragraph 7.12.

Press the <Down Arrow> from Low Limit to advance to the Carrier FX control. The <+> and the <-> keys are active in this position.

Press the <Down Arrow> from Carrier FX to advance to the Diagnostic Data Display. The <+> and the <-> keys are active in this position.

To exit the Spectra Graph, press the <Menu> key.

To display the Digital Flow Display, press the <Menu> key from any Installation Menu location.

7.12 AVAILABLE ADJUSTMENTS TO SPECTRA GRAPH

The table below describes the available adjustments that can be made to the Spectra Graph.

ADJUSTMENT	FUNCTION	NOTE
Noise Level Set	Noise Filter	Set to approximately one quarter the Peak FFT value for typical flow conditions.
High Limit	Low Pass Filter Setting	Set to two times the maximum flow rate.
Low Limit	High Pass Filter	Set to one half minimum flow if noise is present. In most cases, leave at zero.
Carrier Fx	Transmit Frequency Code	Adjust only under guidance of technical support staff.

7.13 REFLEXOR DIAGNOSTIC DATA

The Diagnostic Data menu screen provides one location where all diagnostic data can be viewed. Please note, *adjustments can not be made on this screen*. Adjustments can only be made on the Spectra Graph.

DIAGNOSTIC DATA

APPLICATION INFORMATION	FUNCTION / EXPLANATION
Low Limit	High Pass Filter Setting
High Limit	Low Pass Filter Setting
Noise Level Set	Noise Filter Setting
Doppler Frequency (Hz)	Average FFT Frequency
% Deviation	<p>The width of Spectra is used to determine beam penetration and calibration. The selection of "Slurry" in Application Data is recommended for flow rate indication accuracy when the % Deviation is less than 25. For % Deviation above 35 the use of "Liquid" is recommended.</p> <p>For applications that continuously have % Deviation between 25 and 35 proper selection of either Liquid or Slurry can be confirmed by comparison to a known flow reference.</p>
Signal Peak-to-Peak mV	<p>Peak-to-Peak demodulation signal amplitude. The acceptable range is between 100 and 3200 mV during typical flow conditions. If less than 100 mV, check transducer type used and mounting configuration. If greater than 3200 mV, try in-line mounting and/or "detune" Carrier Fx.</p>
FFT s/sec	Number of FFTs per second
FFT Peak	Peak FFT Amplitude
Carrier Fx	Transmit Frequency code

Siemens	2 Channel	[1]	Channel 1
Shows range of flow rate detected			
Low Limit GAL/MIN			0.00
High Limit GAL/MIN			16.75
Noise Level Set			2
Doppler Freq <Hz>			8571
% Deviation	>		100.00
Signal Pk-Pk mV			27
FFTs/Sec			28
FFT Peak			0
Carrier fx <drive>			27
Application Info			

7.14 DISPLAY OF “F” AT NO FLOW CONDITIONS

It is normal for the digital display to show an “F” for the no flow condition since the lack of Spectra information during no flow is the same as a fault condition.

NOTE: Selecting the Operation Adjust menu cell [Zero/Fault Set] allows the option of indicating Zero Flow rather than a Fault (see paragraph 2.5.4 for details).

7.15 SELECTION OF LIQUID COMPOSITION

The width of the Spectra wave shape is an indication of the depth of penetration of sonic energy into the flow stream. The % Deviation is a measure of the width of the Spectra and is representative of the penetration of the sonic beam into the liquid. Select [Slurry] in the Application Data menu for better flow rate indication accuracy when the % Deviation is less than 25 with typical flow conditions. For % Deviations above 35, select [Liquid]. For applications that continuously have % Deviations between 25 and 35, proper selection of either [Liquid] or [Slurry] can be confirmed by comparison to a known flow reference.

Siemens	2 Channel	[1]	Channel 1
Choose Liquid or Slurry flow calibration			
Liquid Composition		Liquid	
Density SG			1.00
Application Data			

7.16 OTHER MENU ENTRIES

All other menu entries will operate and be used in the same manner as the transit time flow measurement mode.

8. THE THICKNESS GAUGE

This section describes the 1010P Portable Flowmeter Thickness Gauge function.

8.1 INTRODUCTION

System 1010P Portable Flowmeters include a Thickness Gauge for convenient pipe wall thickness measurement at the selected mounting location. To use, you will need the optional 1011TS Thickness Gauge Transducer. This highly recommended option ensures the accuracy of this important set-up parameter. It produces a numeric report and a graphic display of a pipe's wall thickness by timing the wall reflections (these reflections vary in proportion to the wall thickness). It produces accurate measurements of pipe walls from 0.1" (2.5 mm) to over 2.00" (50.8 mm).

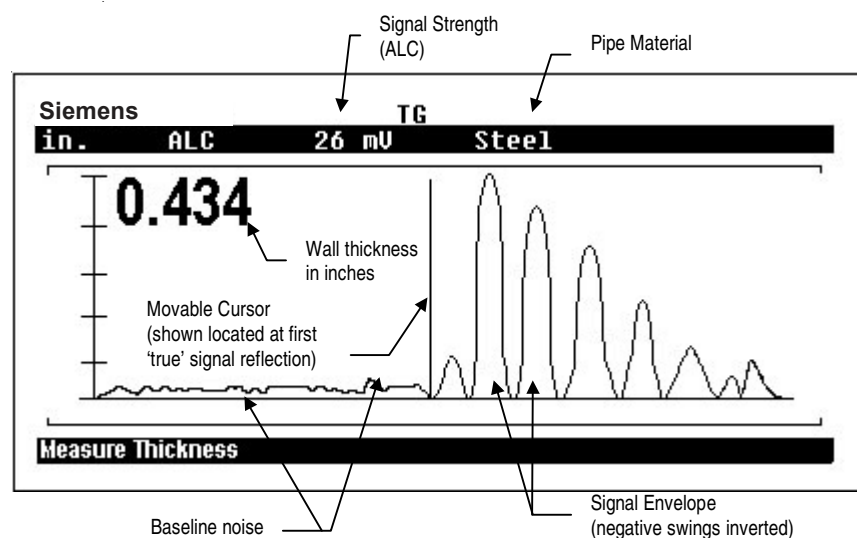
NOTE: When you select Thickness Gauge the meter disables all flow measurement.

If you order the 1011TS transducer when you purchase your 1010P/WDP system, the factory matches the transducer to the flow computer. This allows you to take measurements immediately. Should you purchase the 1011TS separately, you will need to perform a simple calibration procedure to contour the 1011TS to the transmit/receive profile of your flow computer. Also, consider re-calibrating if you suspect that a reading may not be accurate.

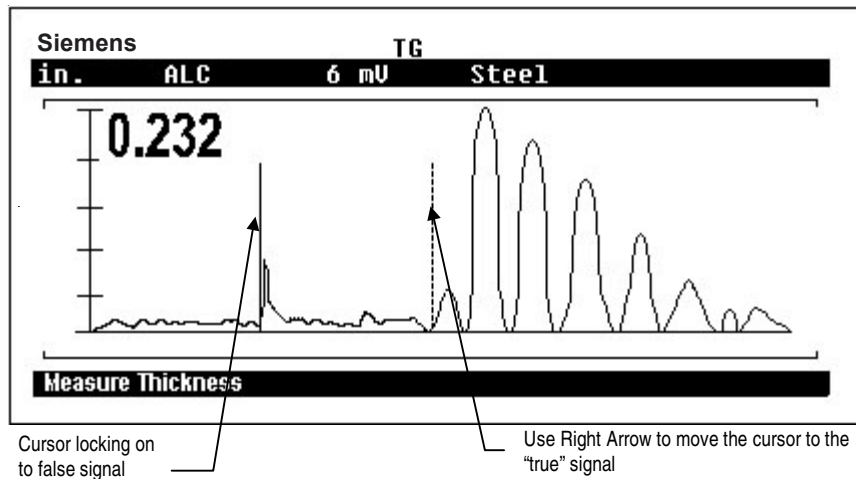
The Thickness Gauge may be applied to pipe surfaces ranging in temperatures from -40° F to 180° F (-40° C to 82° C) when used with the appropriate coupling compound. Note: Do not use CC102 couplant compound on pipes with a temperature greater than 100° F (38° C) or less than 32° F (0° C). For all pipe surface temperatures between -40° F (-40° C) and 180° F (82° C) use CC128 couplant compound.


8.2 THE WALL THICKNESS SCREEN

The figure below is an example of the graphic wall thickness screen.



The graphic screen can reveal pipe flaws that could affect the thickness readings. This may be evident if the cursor locks onto a signal envelope before the main cluster (see below).

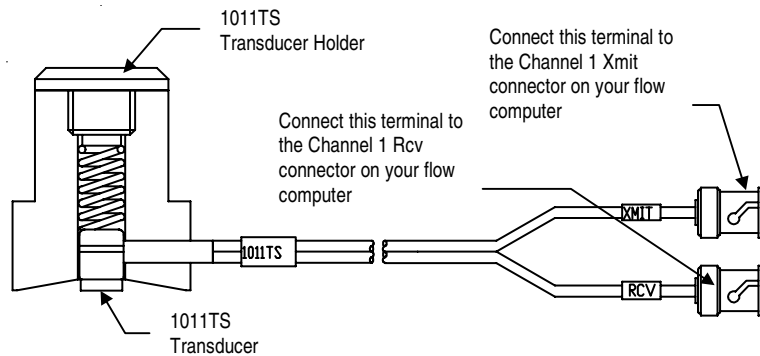


In the example above, you would use the  key to move the cursor to the first "true" signal peak (see dotted line) for a more accurate dimension. If the pipe exhibits significant interior wall deterioration (indicated by irregular amplitude patterns), consider taking preventative action to avoid a possible pipe wall fracture.

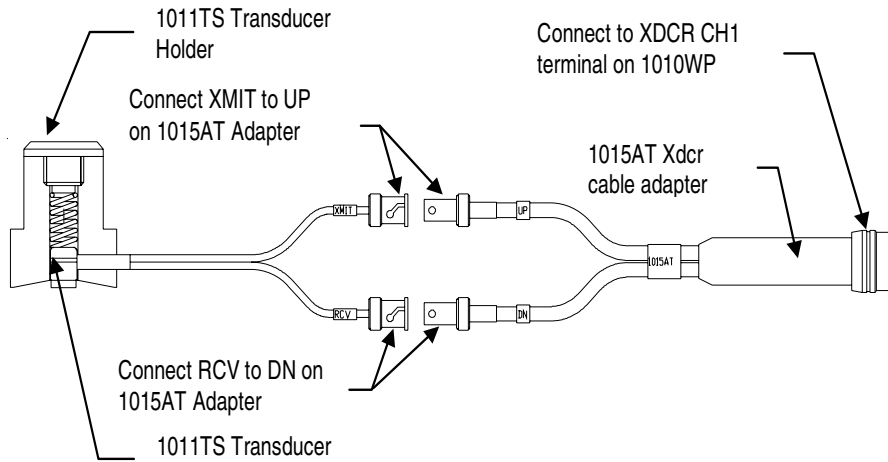
8.3 THE THICKNESS TRANSDUCER

Pipe wall thickness measurement requires the 1011TS thickness gauge transducer. If you have a 1010WDP you will need the 1015AT adapter (see the figures below and on the next page). The 1011TS transducer connects to the Channel 1 transducer inputs of both the 1010P and 1010WDP series flow computers. Connect the BNC cable labeled [UP] to the Channel 1 [XMIT] terminal. Connect the BNC cable labeled [RCV] to Channel 1 [DN] connector on the flow computer.

To connect the 1011TS to a 1010P flow computer:



To connect the 1011TS to a 1010P flow computer



8.4 SELECTING THE THICKNESS GAUGE

Turn on the Meter and press the **MENU** key.

Next, press the **→** key. Observe the cursor pointing to [Dual Channel Flow].

Meter Type	>Dual Channel Flow
Meter Facilites	Dual Path Flow
	Ch 1+2 Flow
	Ch 1-2 Flow
	Thickness Gauge

Use **↓** to move the cursor to [Thickness Gauge].

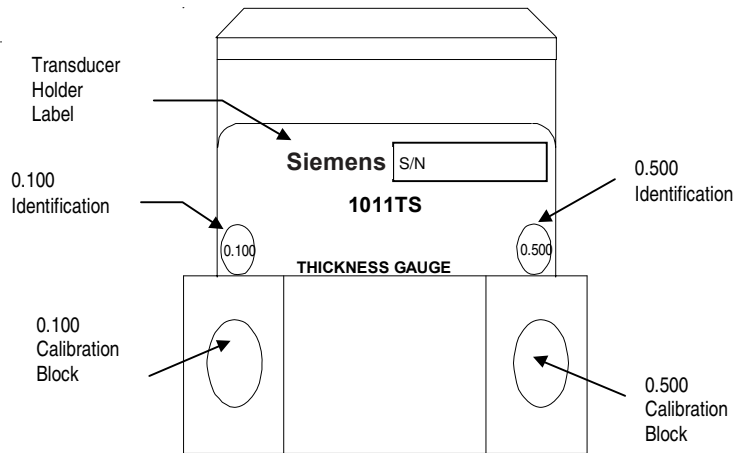
Meter Type	Dual Channel Flow
Meter Facilites	Dual Path Flow
	Ch 1+2 Flow
	Ch 1-2 Flow
	>Thickness Gauge

Press **ENT** to enable the Thickness Gauge. This selects the Thickness Gauge main menu. Here you can proceed to measure the wall thickness or calibrate your thickness gauge transducer.

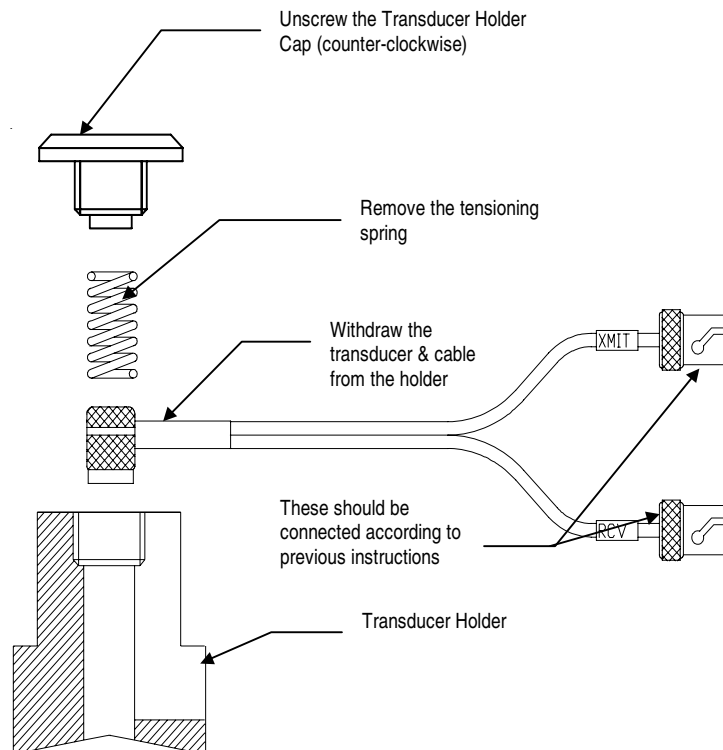
Measure Thickness	
Calibration	


8.5 CALIBRATING THE THICKNESS GAUGE

If you purchased the 1011TS thickness transducer separately then calibrate the transducer before using it to measure a pipe wall. The 1011TS Transducer Holder includes two built-in steel calibration blocks. One is 0.100" thick and the other is 0.500" thick (see below). You will use these blocks in conjunction with the Thickness Gauge Calibration menu to calibrate your transducer.




To calibrate the 1011TS transducer, remove it from its holder:




Press the  key to move the highlight to Calibration.


Measure Thickness
Calibration

Press the  key to select the Calibration menu.

Automatic
Manual

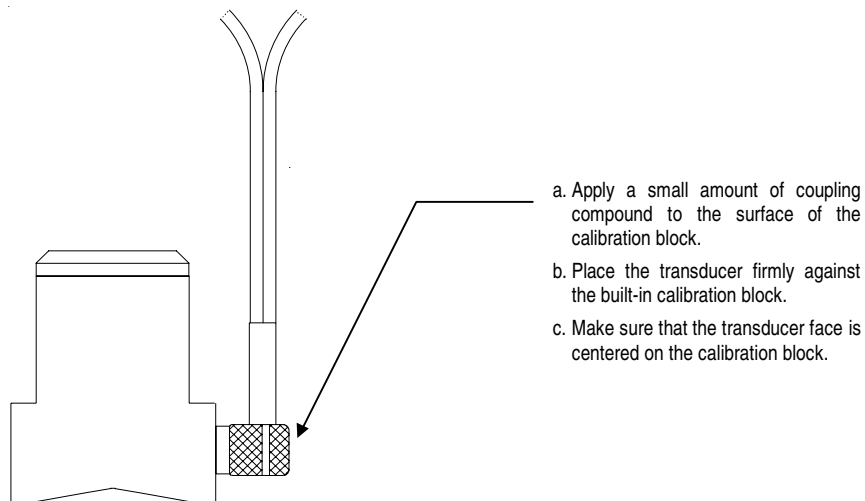
Press the  key to select the Automatic Calibration menu.

Set Xdcr Zero	0.100
Select Material	Steel
Calibrate Material	0.500

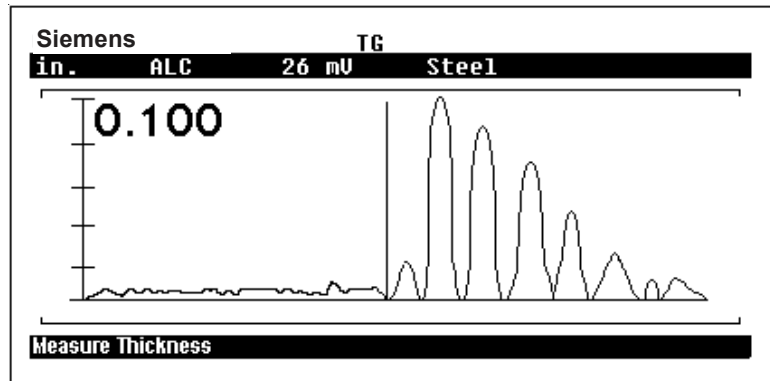
Press the  key to edit the [Set Xdcr Zero] value. Note that an equal (=) sign appears before the number: [=0.100]

Set Xdcr Zero	=0.100
Select Material	Steel
Calibrate Material	0.500

Now you have to place the 1011TS transducer flush onto the [0.100] calibration block on the transducer holder:



Holding the transducer against the calibration block, press **ENT** to calibrate the [Set Xdcr Zero] value. The thickness screen shows the 0.100 measurement (similar to figure below):

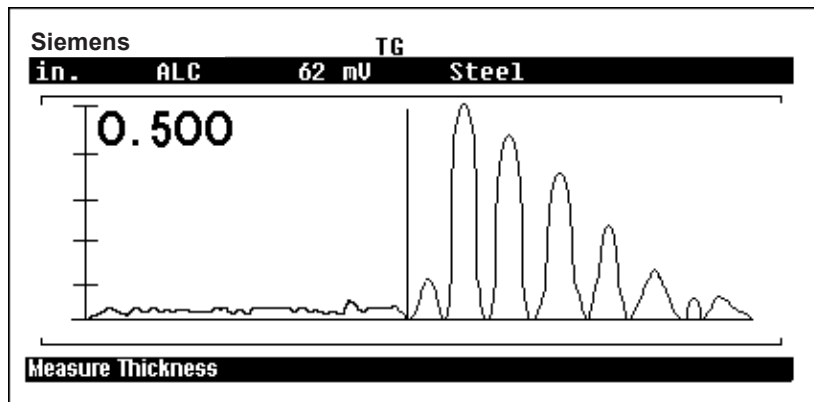


Press the **MENU** key to return to the calibration menu. Use the **↓** to move the highlight to [Calibrate Material], then press the **→** to enable editing. Note that an equal (=) sign appears before the number: [=0.500].

Set Xdcr Zero	0.100
Select Material	Steel
Calibrate Material	=0.500

Now you have to place the 1011TS transducer flush on to the [0.500] calibration block on the transducer holder. Press **ENT** to set the [Calibrate Material] value.

The thickness screen shows the 0.500 measurement (similar to figure below):



Press the **MENU** key to return to the menu. This completes the calibration procedure. The 1011TS thickness gauge transducer is now certified for operation with the flow computer.

NOTES



- Repeat the calibration procedure for best accuracy.
- The thickness screen shows the 0.500 measurement (similar to figure above). This calibrates the 1011TS satisfactorily for most pipe materials. If you have reason to suspect its accuracy on your material, try the calibration procedure using a sample of your pipe material of a known thickness.
- If your pipe material is not listed in the “select material” menu, then refer to paragraph 8.6 “Manual Calibration of Thickness Gauge.”

8.6 MANUAL CALIBRATION OF THICKNESS GAUGE

The “Manual” calibration of the 1011TS thickness transducer allows you to view or modify the actual calibration parameters used by the 1010P for wall thickness measurement.

To access the manual calibration menu, enter the “Calibration” menu and then press  to highlight the “Manual” menu item.

Automatic
Manual

Press  to enter the Manual calibration list. The parameters listed below can be edited by pressing the  key after highlighting the desired parameter.

Zero Set (usecs)	6.600
Select Material	Steel
Modify Vpl (ips)	232000
Data Lock Level	37
Reset Defaults	No

Zero Set (uSecs)

The “Zero Set” item indicates the delay time (or fixed time) of the ultrasonic thickness transducer. This parameter represents the fixed time the ultrasonic signal spends inside the probe itself and is automatically subtracted from the total transit time. If you have not already performed the automatic calibration using the built-in calibration blocks, then you should enter the values “T0” (printed on the back of the thickness transducer) into this menu cell. You will need to remove the transducer from the holder to read this value. (**Note:** Changing the “Zero Set” value will overwrite any previous automatic calibration.)

Select Material

The “Select Material” item enables you to select a pipe material from a list of the most common materials. Selecting a pipe material automatically loads the sound velocity information (Vpl) for review or editing. If your pipe material is not found in the built-in list of materials, then you can select any material and then modify its sound velocity to match that of the actual pipe. (see “Modify Vpl” menu item).

Modify Vpl (ips)

This menu item shows the longitudinal sound velocity of the selected pipe material in inches per second. If the sound velocity of your pipe material is accurately known, then you can edit this value for a more precise wall thickness measurement. The table below shows the longitudinal sound velocity of common pipe materials, some of which are already included in the 1010 wall thickness gauge material list.

NOTE: Changing the “Vpl” value will overwrite any previous automatic calibration.

Longitudinal Sound Velocity (Vpl) of Various Pipe Materials

Material	Vpl (ips)	Material	Vpl (ips)
Aluminum	257,000	Inconel	224,400
Black Iron	232,000	Monel	212,600
Aluminum	257,000	Nickel	222,000
Black Iron	232,000	Polycarbonate	89,000
Brass	174,000	Polyethylene (HD)	95,700
Cast Iron	189,000	Polyethylene (HD)	76,800
Copper	183,000	PVDF	90,500
Copper Nickel (70/30)	208,000	PVC (Plastic)	95,000
Copper Nickel (90/10)	196,700	Steel (mild)	232,300
Ductile Iron	189,000	Steel (Stainless 347)	228,000
Glass	215,000	Titanium	240,000

Data Lock Level

The “Data Lock Level” represents a thickness gauge receive amplitude, below which the meter will not perform a wall thickness measurement. When the thickness gauge transducer is pressed against a pipe wall, the amplitude level rises above this level and the computer automatically measures the wall thickness. When the transducer is removed from the pipe wall, the amplitude should fall below this level and the previous thickness reading will become “locked” on the screen until the next wall reading. If the amplitude does not fall below the lock level, the previous reading will remain locked and the meter will not automatically reset for the next wall thickness reading.


The default setting of the “Data Lock Level” should provide problem free wall thickness measurement on most pipe materials. However, if the meter fails to operate as described above, refer to the troubleshooting guide below.

Troubleshooting Guide


Condition	Possible Cause/Remedy
Thickness measurement occurs before placing the transducer on the pipe wall.	Apply couplant to the pipe instead of the transducer. Increase Data Lock Level gradually until condition ceases.
Thickness measurement will not occur.	Try pressing the [CLR] key. If the meter then performs a thickness measurement, the Data Lock Level needs to be increased. If pressing [CLR] does not force a measurement, then Data Lock Level needs to be decreased.

Reset Defaults: Resets “Zero Set”, “Vpl” and “Data Lock Level” back to the factory default setting.


8.7 MEASURING THE PIPE WALL THICKNESS

After calibrating the 1011TS transducer, you can proceed to take a pipe wall measurement. Press the  key twice to move back to the main Wall Thickness menu.


Measure Thickness
Calibration

Press the  key to move the highlight to Measure Thickness.



Measure Thickness
Calibration

Press the  key to enter the Measure Thickness menu.

Pick Pipe Material	Steel
Measure?	No

Note that the default material is: **Steel**. If this is your pipe material, then you can bypass the next step. To pick a different pipe material, press the  to select the Pipe Material option list.

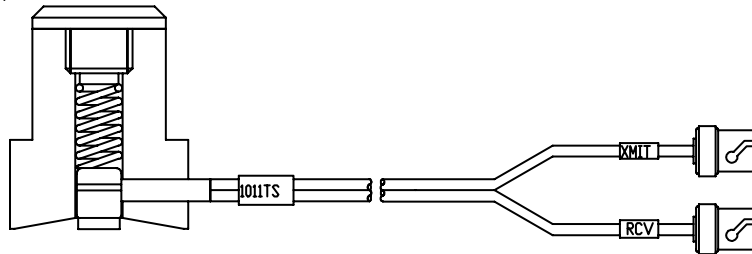
Pick Pipe Material	>Steel
Measure Thickness	Aluminum
	Black Iron
	Brass
	Cast Iron
	Copper
	CuNi (70/30)
	CuNi (90/10)
	Ductile Iron
	Grass
	Nickel
	PVC (Plastic)
	Teflon



Use the  key to move the cursor to your pipe material, then press  to select it. Your pipe material appears in the right-hand column. The highlight moves to [Measure Thickness].

Pick Pipe Material	Steel
Measure?	No


Next, prepare the pipe surface for taking a measurement. Remove all traces of paint or any type of coating. A bare metal surface prepared with an abrasive paper, free of pits, welding seams or any type of discontinuity is required for the best accuracy. Apply some ultrasonic couplant on the prepared pipe surface.


NOTE: If necessary, reassemble the 1011TS as shown below.

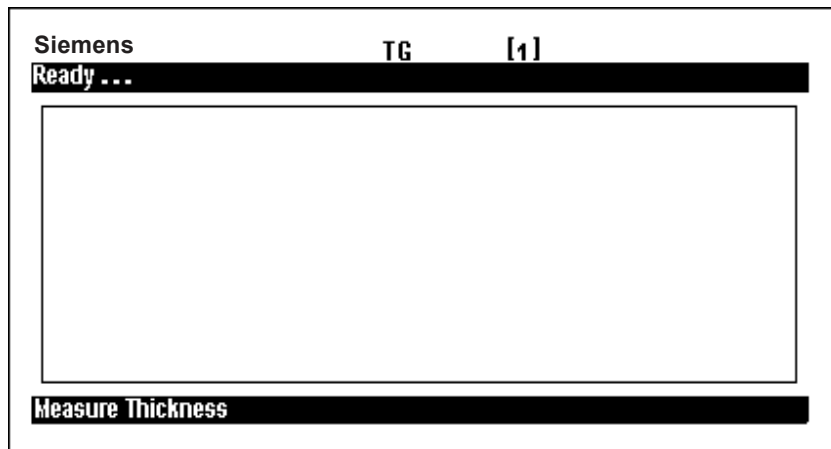


Press  to access the Measure Thickness option list, then press  to move the cursor to [Yes].

Pick Pipe Material	Steel
Measure?	No
	>Yes

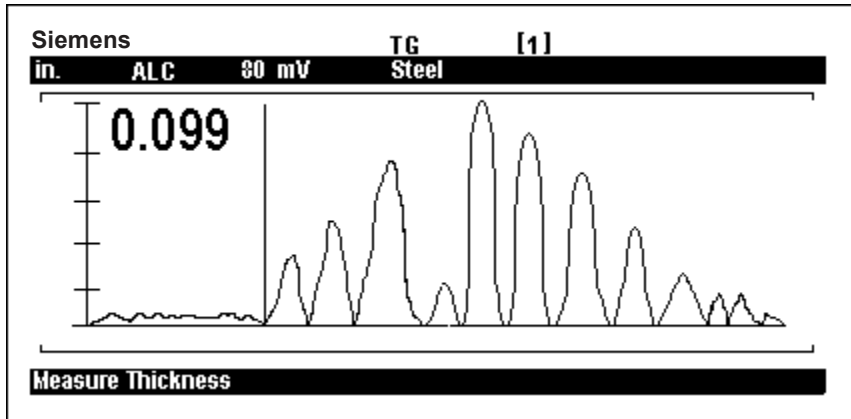
Press  to activate the Thickness Gauge.

Press  to invoke the thickness measurement. This selects the graphic screen. **[Ready...]** appears at the top of the screen (similar to the example below):



Now you are ready to measure the wall thickness. Place the transducer assembly on the prepared surface, within the applied couplant. Use moderate downward pressure to ensure sonic coupling and a square contact between the transducer face and the pipe wall. The screen automatically shows the pipe wall thickness numerically and in graphic form (similar to the example shown below). If you want to re-check your reading, maintain pressure and then press the **CLR** key to reset the display.

If you want to take subsequent measurements at another location, lift off the transducer from the pipe wall for about one second to clear the display.



When you finish using the Thickness Gauge:

Do not turn off the meter. Press the **MENU** key to return to the [Thickness Gauge] menu.

Press **←** twice to return to [Meter Type].

Press **→** to access the [Meter Type] option list.

Meter Type	>Thickness Gauge
Meter Facilites	Dual Channel Flow
	Dual Path Flow
	Ch 1+2 Flow
	Ch 1-2 Flow

Select a flowmeter by pressing **↓** to move the cursor to the desired type, for example: [>Dual Channel Flow].

APPENDIX A

Engineering Drawings

FLOW COMPUTER DRAWINGS

1010WDP-7	Installation Drawing, Dual-Channel Weather Proof Portable Flowmeter
1010WDP-8	Outline Dimensions, Dual-Channel Weather Proof Portable Flowmeter

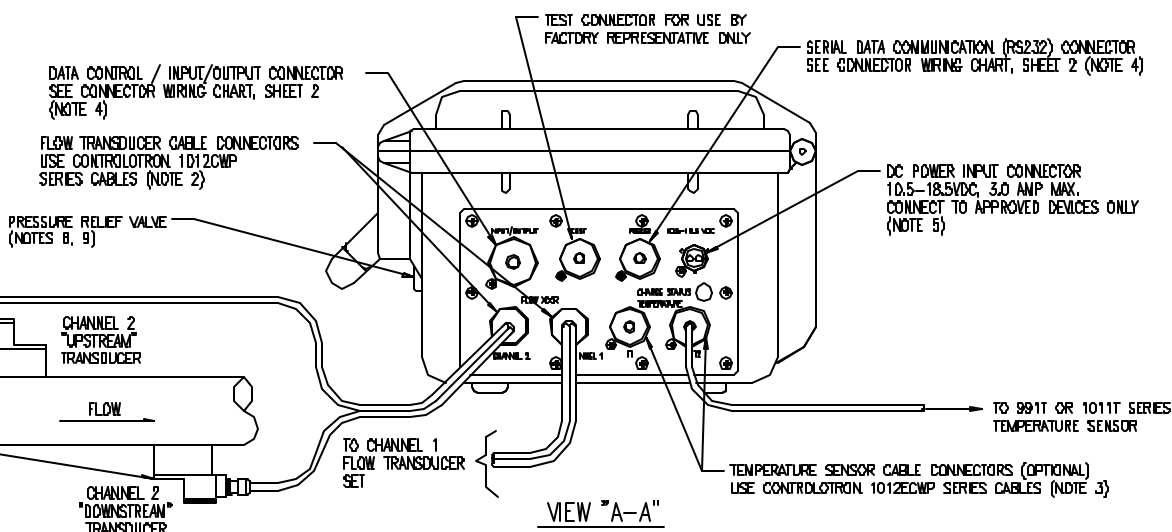
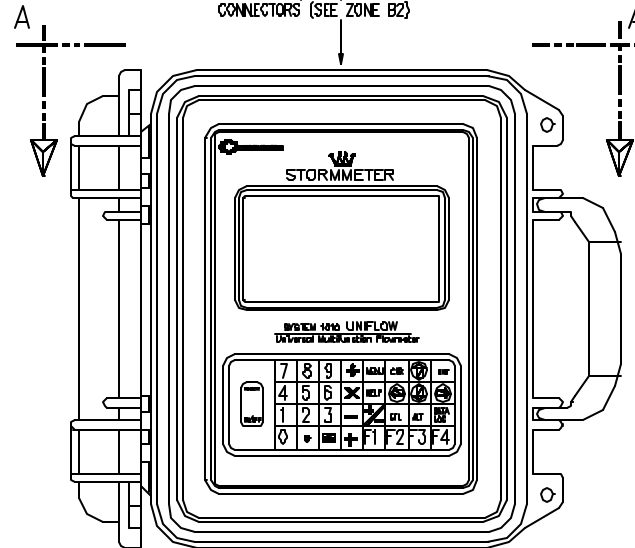
TRANSDUCER AND ACCESSORY DRAWINGS

1011AP-8	Installation/Outline Drawing, Snap-On Transducer
1015BC-1-8	Installation/Outline Dimensions, 1010 Portable Power Adapter/Battery Charger

NOTES:

1. SEE 1010 FIELD MANUAL FOR COMPLETE START-UP PROCEDURE AND USER PROGRAMMABLE I/O FUNCTIONS.
2. FLOW TRANSDUCER CABLE SETS (10120WP SERIES) HAVE TWO TRANSDUCER CONNECTIONS MARKED "UP" AND "DN" FOR CONNECTIONS TO "UPSTREAM" AND "DOWNSTREAM" TRANSDUCERS, RESPECTIVELY. SEE THE APPROPRIATE TRANSDUCER INSTALLATION DRAWING FOR CONNECTIONS AT THE TRANSDUCER END.
3. SEE THE 1010 FIELD MANUAL FOR USE OF THE OPTIONAL TEMPERATURE SENSOR INPUTS. SEE THE APPROPRIATE TEMPERATURE SENSOR INSTALLATION DRAWING FOR CONNECTIONS AT THE SENSOR END. IF ONLY ONE SENSOR IS IN USE, TERMINATE THE SECOND SENSOR CONNECTOR WITH SHORTING PLUG 1015ES-WP.
4. CONNECTOR KIT 1015XWP INCLUDES MATING CONNECTORS FOR RS232 AND INPUT/OUTPUT WIRING. CONNECTORS SUPPLIED ARE SOLDER-CLIP STYLE WITH POTTING SHELLS. UNSCREW THE POTTING SHELL TO MAKE CONNECTIONS IN ACCORDANCE WITH CHARTS ON SHEET 2. NOTE THAT SOLDER TERMINALS ARE MARKED WITH LETTERS AS INDICATED. REPLACE THE POTTING SHELL AND FILL WITH AN APPROPRIATE POTTING COMPOUND TO EFFECT A WEATHERPROOF SEAL.
5. FOR EXTENDED OPERATING TIME, USE AUXILIARY BATTERY PACK MODEL 1015EW (SEE DRAWING 1015EW-8), TO CHARGE INTERNAL BATTERY, USE POWER ADAPTER MODEL 1015BK-1W (SEE DRAWING 1015BK-1W-8).
6. REPLACE CONNECTOR CAPS WHEN CONNECTORS ARE NOT IN USE TO INSURE PROTECTION AGAINST THE ENVIRONMENT.
7. INPUT/OUTPUT FUNCTIONS NOTES; (SEE SHEET 2)
 - a) LOGIC LEVEL STATES:
HIGH: 5 TO 3 VOLTS
LOW: 1 TO 0 VOLTS
 - b) LOAD CAPABILITY VARIES WITH SUPPLIED VOLTAGE. MAXIMUM LOAD FIGURES INCLUDE WIRING.
8. CLOSE AND LATCH COVER AND TIGHTEN RELIEF VALVE SNUIG WHEN USING UNIT IN WET AREAS.
9. CLOSE VALVE FOR SHIPPING; STORAGE. OPEN 1/2-1 TURN TO EQUALIZE PRESSURE BEFORE OPENING ENCLOSURE COVER.

TRANSDUCER, DATA/CONTROL AND POWER CABLE CONNECTORS (SEE ZONE B2)



DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON- INCHES ± .1 (MM) ± .2	CONTRACT NO. _____ DR. H.J. DATE 8/4/84 CHK. _____ DATE _____ ENG. _____ DATE _____ PROJ. _____ DATE _____ APPD. _____ DATE _____ CERTIFIED _____ DATE _____		 HAUPPAUGE, NY 11788 INSTALLATION WIRING DUAL CHANNEL, WEATHERPROOF PORTABLE FLOWMETER	
	SIZE C	CODE IDENT NO. 21614	1010WDP - 7	REV. D
SCALE: NONE		WT. _____	SHEET 1 OF 2	

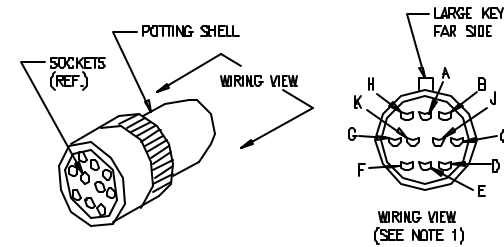
INPUT/OUTPUT CONNECTORS (SEE WIRING VIEW, ZONE A4)

TERMINAL	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES
A	GND.	SIGNAL GROUND	RETURN FOR SIGNALS			#18-#22 AWG	1000 FT. MAX.	
B								
C	R1B	LOGIC OUT 1	LOGIC LEVEL STATE	STATUS INDICATOR/ALARM	10 LOADS MAX.			SEE NOTE 7a
D								
E	R2B	LOGIC OUT 2	LOGIC LEVEL STATE	STATUS INDICATOR/ALARM	10 LOADS MAX.			SEE NOTE 7a
F								
G	R3B	LOGIC OUT 3	LOGIC LEVEL STATE	STATUS INDICATOR/ALARM	10 LOADS MAX.			SEE NOTE 7a
H								
J	R4B	LOGIC OUT 4	LOGIC LEVEL STATE	STATUS INDICATOR/ALARM	10 LOADS MAX.			SEE NOTE 7a
K	PGEN1	FREQUENCY OUTPUT 1	ASSIGNABLE LOGIC LEVEL PULSE TRAIN	PULSE DRIVEN FLOW MEASUREMENT	5 LOADS MAX.			SEE NOTE 7a
L	PGEN2	FREQUENCY OUTPUT 2	ASSIGNABLE LOGIC LEVEL PULSE TRAIN	PULSE DRIVEN FLOW MEASUREMENT	5 LOADS MAX.			SEE NOTE 7a
M	V _{o1}	VOLTAGE OUTPUT 1	ASSIGNABLE 0 TO +10VDC	RECORDING, MONITORING ETC.	5K Ω MIN.			
N	V _{o2}	VOLTAGE OUTPUT 2	ASSIGNABLE 0 TO +10VDC	RECORDING, MONITORING ETC.	5K Ω MIN.			
P	I _{o1}	CURRENT OUTPUT 1	ASSIGNABLE 4 TO 20mA	RECORDING, MONITORING ETC.	0-1000 Ω @ 30VDC 0-450 Ω @ 18VDC			SEE NOTE 7b
R	I _{o2}	CURRENT OUTPUT 2	ASSIGNABLE 4 TO 20mA	RECORDING, MONITORING ETC.	0-1000 Ω @ 30VDC 0-450 Ω @ 18VDC			SEE NOTE 7b
S	I _o POWER	EXT. CURRENT LOOP PWR	USER SUPPLIED +18 TO +30VDC	DRIVE CURRENT OUTPUTS	50mA MIN.			
T	GND.	SIGNAL GROUND	RETURN FOR SIGNALS					
U	CNTRL1	LOGIC IN 1	TTL LEVEL STATE	NOTOT CH.1	100K Ω			SEE NOTE 7a
V	CNTRL2	LOGIC IN 2	TTL LEVEL STATE	NOTOT CH.2	100K Ω			SEE NOTE 7a
W	CNTRL3	LOGIC IN 3	TTL LEVEL STATE	CLRTOT CH.1	100K Ω			SEE NOTE 7a
X	CNTRL4	LOGIC IN 4	TTL LEVEL STATE	CLRTOT CH.2	100K Ω			SEE NOTE 7a
Y	I _{in1}	CURRENT INPUT 1	4 TO 20mA	EXTERNAL SENSOR INPUT	200Ω			FLOWMETER LOAD
Z	I _{in2}	CURRENT INPUT 2	4 TO 20mA	EXTERNAL SENSOR INPUT	200Ω			FLOWMETER LOAD
a	V _{in1}	VOLTAGE INPUT 1	0 TO +10VDC	EXTERNAL SENSOR INPUT	100KΩ			FLOWMETER LOAD
b	V _{in2}	VOLTAGE INPUT 2	0 TO +10VDC	EXTERNAL SENSOR INPUT	100KΩ			FLOWMETER LOAD
c	GND.	SIGNAL GROUND	RETURN FOR SIGNALS					

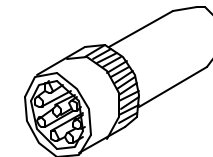
RS232 CONNECTOR (SEE WIRING VIEW, ZONE C1)

PIN	SIGNAL	DESCRIPTION	WIRING	CABLE LENGTH
B	RX1	STANDARD RS232 SIGNAL LEVELS	BB	SHIELDED DATA CABLE 24 GA. MIN. DEPENDS UPON BAUD RATE 50 FEET AT 9600 BAUD WITH STANDARD CABLE
C	TX1	ALL CONTROL LINES ARE DEFAULTED TO READY STATE	BA	
D	DTR1		CD	
E	GND.		AB	
G	RTS1		CA	
H	CTS1		CB	

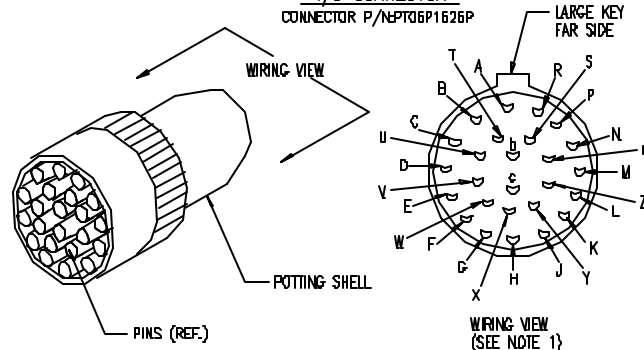
RS232 CONNECTOR
CONNECTOR P/NPT08P1210S



1015ES-WP SHORTING PLUG
(SEE NOTE 3)



I/O CONNECTOR
CONNECTOR P/NPT08P1626P



DO NOT SCALE THIS DRAWING

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

INCHES (MM)
± .1 ± .2

CONTRACT NO.

DR. H.J. DATE 8/4/98

CHK. DATE

ENG. DATE

PROD. DATE

APPD. DATE

CERTIFIED

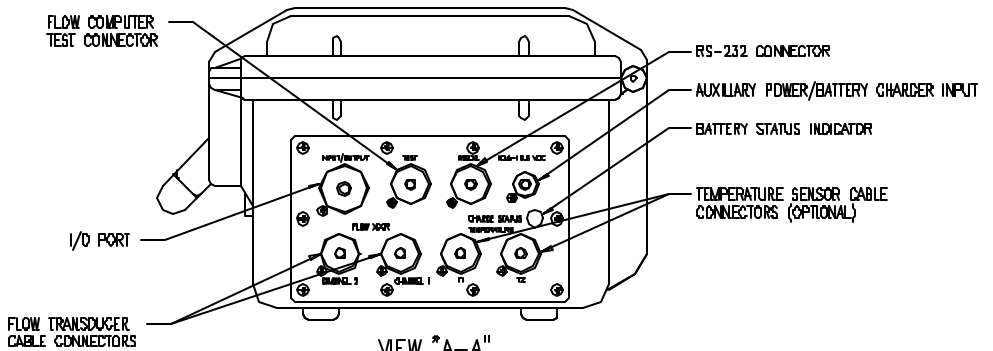
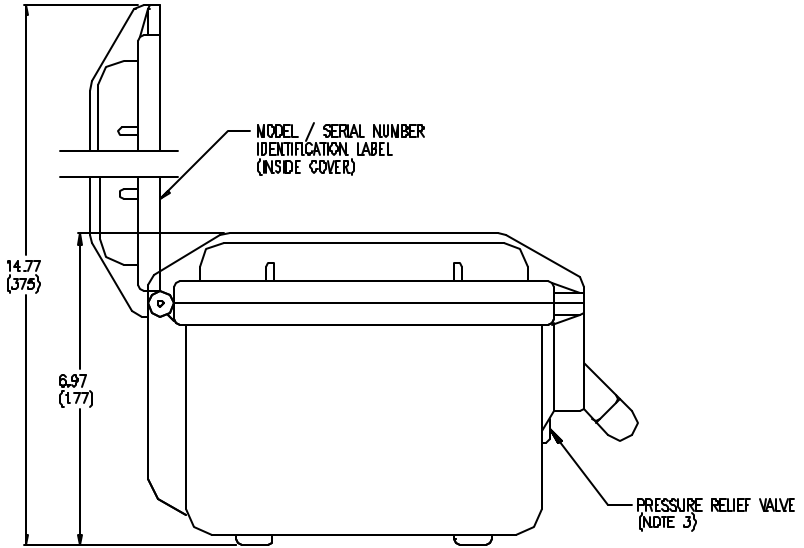
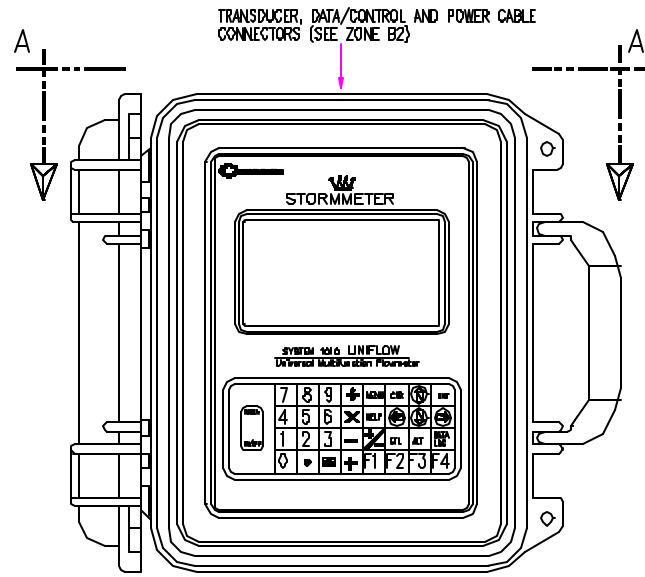
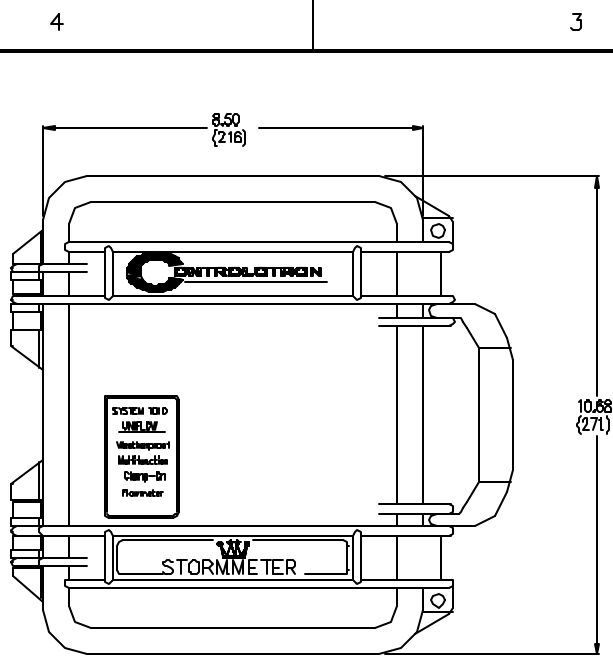
DATE



INSTALLATION WIRING,
DUAL CHANNEL, WEATHERPROOF
PORTABLE FLOWMETER

SIZE C CODE IDENT NO. 1010WDP-7 REV. D

SCALE: NONE WT. SHEET 2 OF 2

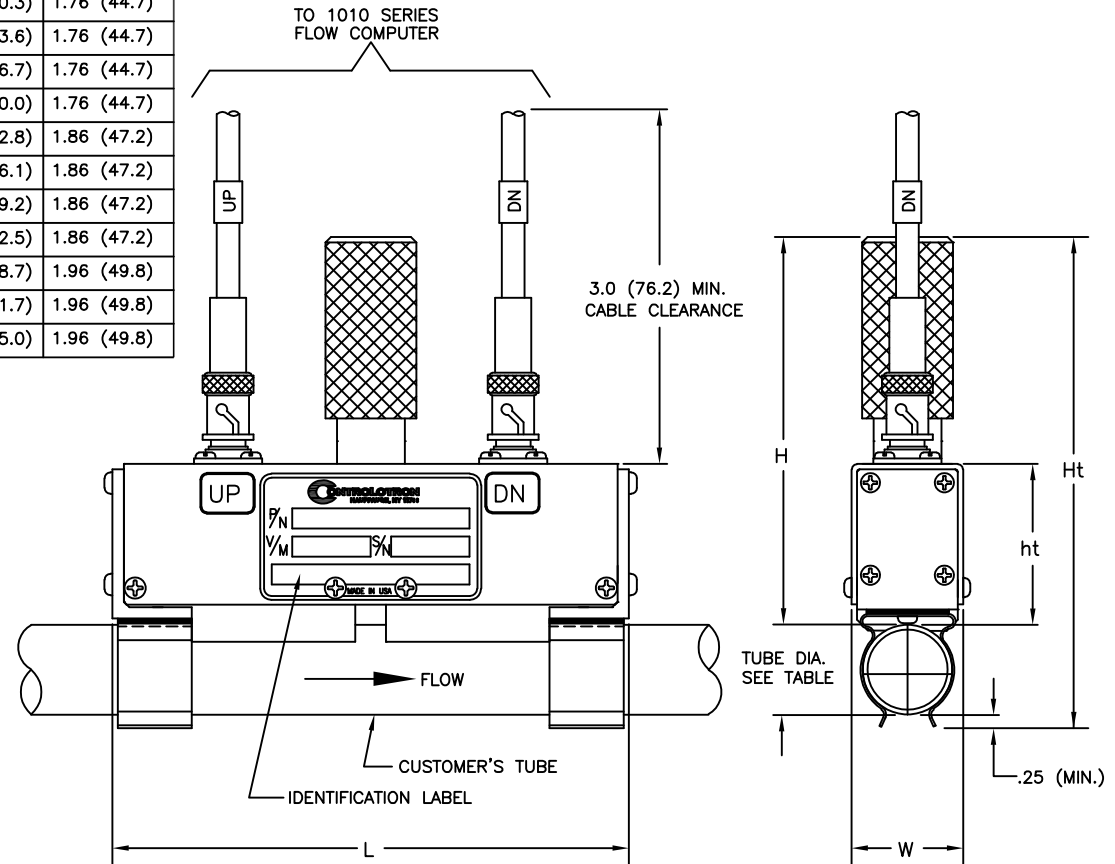


NOTES:

1. SEE DRAWING 1010WDP-7 FOR WIRING CONNECTIONS AND I/O SPECIFICATIONS.
2. SEE THE 1010 FIELD MANUAL FOR COMPLETE INSTALLATION INFORMATION.
3. CLOSE VALVE FOR SHIPPING, STORAGE, OPEN 1/2-1 TURN TO EQUALIZE PRESSURE BEFORE OPENING ENCLOSURE COVER.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON- INCHES ± .1 (MM) ± .2	CONTRACT NO. _____ DR. H.W. DATE 8/4/04 CHK. _____ DATE _____ ENG. _____ DATE _____ PROJ. _____ DATE _____ APPD. _____ DATE _____		 HAUPPALICE, NY 11788	
	CERTIFIED _____ DATE _____		OUTLINE DIMENSIONS DUAL CHANNEL, WEATHERPROOF PORTABLE FLOWMETER	
SIZE C	CODE IDENT NO. 21614	1010WDP - 8	REV. C	SCALE: NONE WT. _____ SHEET 1 OF 1

ASS'Y P/N	TUBE DIA.	L	W	H	Ht	ht
1011AP-4S1-B	.25 (6.4)	3.85 (97.8)	.945 (24.0)	3.96 (101.0)	4.46 (113.3)	1.46 (37.1)
1011AP-5S1-B	.31 (8.0)	3.90 (99.1)	.945 (24.0)	3.96 (101.0)	4.52 (114.8)	1.46 (37.1)
1011AP-6S1-B	.37 (9.5)	3.97 (100.8)	.945 (24.0)	3.96 (101.0)	4.58 (116.3)	1.46 (37.1)
1011AP-8S1-B	.50 (12.7)	4.28 (108.7)	.945 (24.0)	3.96 (101.0)	4.71 (119.6)	1.46 (37.1)
1011AP-10S2-B	.62 (15.9)	5.17 (131.3)	1.07 (27.2)	4.26 (108.2)	5.13 (130.3)	1.76 (44.7)
1011AP-12S2-B	.75 (19.1)	5.53 (140.5)	1.07 (27.2)	4.26 (108.2)	5.26 (133.6)	1.76 (44.7)
1011AP-14S2-B	.87 (22.2)	5.65 (143.5)	1.07 (27.2)	4.26 (108.2)	5.38 (136.7)	1.76 (44.7)
1011AP-16S2-B	1.00 (25.4)	5.77 (146.6)	1.07 (27.2)	4.26 (108.2)	5.51 (140.0)	1.76 (44.7)
1011AP-10S3-B	.62 (15.9)	5.50 (139.7)	1.07 (27.2)	4.36 (110.7)	5.23 (132.8)	1.86 (47.2)
1011AP-12S3-B	.75 (19.1)	5.62 (142.8)	1.07 (27.2)	4.36 (110.7)	5.36 (136.1)	1.86 (47.2)
1011AP-14S3-B	.87 (22.2)	5.74 (145.8)	1.07 (27.2)	4.36 (110.7)	5.48 (139.2)	1.86 (47.2)
1011AP-16S3-B	1.00 (25.4)	6.23 (158.2)	1.07 (27.2)	4.36 (110.7)	5.61 (142.5)	1.86 (47.2)
1011AP-12S4-B	.75 (19.1)	5.76 (146.3)	1.07 (27.2)	4.46 (113.3)	5.46 (138.7)	1.96 (49.8)
1011AP-14S4-B	.87 (22.2)	5.88 (149.4)	1.07 (27.2)	4.46 (113.3)	5.58 (141.7)	1.96 (49.8)
1011AP-16S4-B	1.00 (25.4)	6.00 (152.4)	1.07 (27.2)	4.46 (113.3)	5.71 (145.0)	1.96 (49.8)



NOTES:

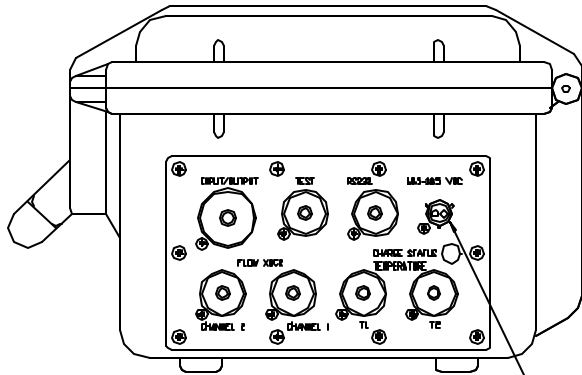
1. CONSULT THE 1010 FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.
2. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER, CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.
3. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.

DO NOT SCALE THIS DRAWING	CONTRACT NO.
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-	DR. H.J. DATE 4/18/01
INCHES ± .1 (MM) ± 2	CHK. _____ DATE _____
MATERIAL:	ENG. _____ DATE _____
FINISH:	PROD. _____ DATE _____
	APPD. _____ DATE _____
	CERTIFIED _____
	DATE _____

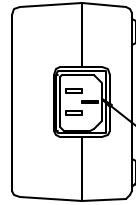
CONTROLTRON HAUPPAUGE, NY 11788		
INSTALLATION/OUTLINE SNAP ON TRANSDUCER		
SIZE C	CODE IDENT NO. 21614	REV. A
SCALE: NONE		WT. _____
SHEET 1 OF 1		

1015BC-1W POWER ADAPTERS ARE USED WITH
1010WP SERIES FLOW COMPUTERS

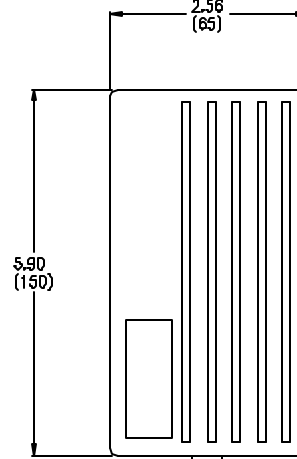
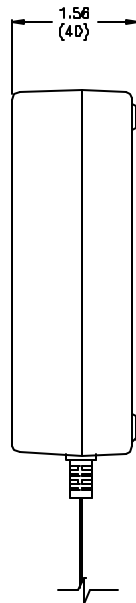
1010WP MODELS
(1010WDP WITH ALL I/O OPTIONS SHOWN)



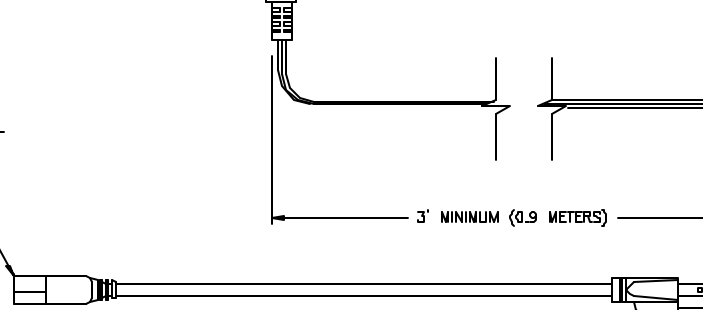
POWER ADAPTER CONNECTOR
(SHOWN WITH CAP REMOVED)



IEC 320 POWER INLET



IEC 320 PLUG



CIRCULAR CONNECTOR,
(2-PIN) .65 (16.5) DIA.

PLUG VARIES WITH
ASS'Y PART No.
(SEE TABLE ABOVE)

1015BC]-1W POWER ADAPTER/BATTERY CHARGER

(SEE NOTE 1)

NOTES:

1. 1015BC-1W POWER ADAPTER/BATTERY CHARGERS ARE SUPPLIED WITH POWER CORDS WITH PLUGS AS TABULATED BELOW.

ASS'Y PART No.	POWER CORD	
	PLUG STD.	RATING
1015BCA-1W	CEE 7/7	10A / 230VAC
1015BCC-1W	AS 3112	10A / 250VAC
1015BCD-1W	BS 1363	5A / 240VAC
1015BCJ-1W	JS 8303	12A / 125VAC
1015BCK-1W	NEMA 5-15P	10A / 120VAC
1015BCL-1W	SEV 1011	10A / 250VAC

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND
TOLERANCES ARE:

CONTRACT NO.

DR HJ DATE 12/14/98
CHK _____ DATE _____
ENG _____ DATE _____
PROJ _____ DATE _____
APPD _____ DATE _____

CERTIFIED
DATE _____



**INSTALLATION / OUTLINE
1010 PORTABLE FLOW COMPUTER
POWER ADAPTER/BATTERY CHARGER**

SIZE C	CODE IDENT NO. 21614	1015BC-1W-8	REV. C
SCALE: NONE	VT.	SHEET 1 OF 1	

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STAINLESS STEEL, HASTELLOY "C" & TITANIUM[△] PIPE

Sched.	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24
5S◇	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000
	I.D.	0.710	0.920	1.185	1.530	1.770	2.245	2.709	3.334	3.834	4.334	5.345	6.407	8.407	10.482	12.438	13.688	15.670	17.670	19.634	21.624	23.563
	Wall	0.065	0.065	0.065	0.065	0.065	0.065	0.083	0.083	0.083	0.083	0.109	0.109	0.109	0.134	0.156	0.156	0.165	0.165	0.188	0.188	0.218
10S◇	I.D.	0.674	0.884	1.097	1.442	1.682	2.157	2.635	3.260	3.760	4.260	5.295	6.357	8.329	10.420	12.390	13.624	15.624	17.624	19.564	21.564	23.500
	Wall	0.083	0.083	0.109	0.109	0.109	0.109	0.120	0.120	0.120	0.120	0.134	0.134	0.148	0.165	0.180	0.188	0.188	0.188	0.218	0.218	0.250
40S	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000						
	Wall	0.109 [⊙]	0.113 [⊙]	0.133 [⊙]	0.140 [⊙]	0.145 [⊙]	0.154 [⊙]	0.203 [⊙]	0.216 [⊙]	0.226 [⊙]	0.237 [⊙]	0.258 [⊙]	0.280 [⊙]	0.322 [⊙]	0.365 [⊙]	*.375						
80S	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750						
	Wall	^147	^154	^179	^191	^200	^218	^276	^300	^318	^337	^375	^432	^500	^500	*.500						

CARBON STEEL and PVC[△] PIPE

Pipe	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	42
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
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.																												
	Wall																												
Sched. 20	I.D.																												
	Wall																												
Sched. 30	I.D.																												
	Wall																												
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									
	Wall	0.109 [⊙]	0.113 [⊙]	0.133 [⊙]	0.140 [⊙]	0.145 [⊙]	0.154 [⊙]	0.203 [⊙]	0.216 [⊙]	0.226 [⊙]	0.237 [⊙]	0.258 [⊙]	0.280 [⊙]	0.322 [⊙]	0.365 [⊙]	0.406	0.438	^500	0.562	0.593									
Sched. 60	I.D.																												
	Wall																												
Sched. 80	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.564	11.376	12.500	14.314	16.126	17.938	19.750	21.564							
	Wall	^147	^154	^179	^191	^200	^218	^276	^300	^318	^337	^375	^432	^500	0.593	0.687	0.750	0.843	0.937	1.031	1.125	1.218							
Sched. 100	I.D.																												
	Wall																												
Sched. 120	I.D.																												
	Wall																												
Sched. 140	I.D.																												
	Wall																												
Sched. 160	I.D.	0.466	0.614	0.815	1.160	1.338	1.689	2.125	2.624		3.438	4.313	5.189	6.813	8.500	10.126	11.188	12.814	14.438	16.064	17.750	19.314							
	Wall	0.187	0.218	0.250	0.250	0.281	0.343	0.375	0.438		0.531	0.625	0.718	0.906	1.125	1.312	1.406	1.593	1.781	1.968	2.125	2.343							

NON-STANDARD CARBON

Size	10	20	24	24
O.D.	10.750	20.000	24.000	24.000
I.D.	10.192	19.375	23.375	22.126
Wall	0.279	0.312	0.312	0.937

The above sizes are produced by pipe mills but dimensions do not conform to any regular standard or schedule.

△ These materials are generally available in Schedules 40 and 80 only.	⊙ Wall thickness 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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Order No.: A5E02617285
Lit. No.: A5E02617285-AB
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