Field Manual SITRANS FUS1010 NEMA-4X/ IP 65 Clamp-On Multi-Function Flowmeter

SIEMENS SITRANS FUS

7	8	9	/	MENU	CLR	▲	ENTER
4	5	6	*	HELP	◄	▼	►
3	2	1	−	+/-	CTRL	ALT	DATA LOG
0	.	=	+	F1	F2	F3	F3

sitrans
FUS1010

SIEMENS

1010NFM-3J

Siemens Energy & Automation's Standard Warranty

This warranty applies to flow metering and leak detection systems.

SIEMENS ENERGY & AUTOMATION CORPORATION (the Company) warrants to the original purchaser of this equipment as presented in Section 1 of **Siemens Energy & Automation, Inc. Standard Terms and Conditions of Sale (10/1/2004).**

To obtain repair or replacement within the terms of this Warranty, a Return Merchandise Authorization number (RMA) must be obtained from Technical Service by calling (631) 231-3600 prior to shipment. This RMA number must appear prominently on the outside of all returned packages. Returned merchandise must include packing slip with specification of defect(s) and be shipped freight prepaid, directly to **Siemens Energy & Automation Corporation, 155 Plant Avenue, Hauppauge, NY 11788**.

Equipment or material returned for Certification, Validation, Repair, or Replacement may result in the loss of memorized pipe site date in equipment computer memory. Siemens Energy & Automation can save and then restore this data for some NEMA type systems and all Portable systems, if requested at the time of equipment return. A fee may be imposed for this service.

This Warranty does not extend to costs incurred for removal or reinstallation of the equipment, or to damage to equipment, accessories or components caused by such removal or reinstallation.

This Warranty does not apply to any equipment or part thereof, which in the opinion of the Company has been damaged through alteration, improper installation, mishandling, misuse, neglect, lightning strike, or other accidents. THE EXTENT OF THE COMPANY'S LIABILITY UNDER THIS WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT PROVIDED ABOVE AND, IN NO EVENT, SHALL THE COMPANY'S LIABILITY EXCEED THE PURCHASE PRICE PAID BY PURCHASER FOR THE PRODUCT.

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SIEMENS
FIELD MANUAL

IMPORTANT NOTICE

Controlotron is now part of:

Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit (PI BU)
CoC Ultrasonic Flow

SITRANS FUS 1010N
NEMA-4X CLAMP-ON
MULTI-FUNCTION FLOWMETER

ATTENTION

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

Field Manual 1010NFM-3J
August 2006

For use with Operating System
Software Version 3.01.05B or later

Prepared By _____ Date _____

Engineering _____ Date _____

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Manual Changes

NOTE: For the latest updates and revisions to this field manual go to *www.controlotron.com/downloads.htm* and check the Product Manual listing.

MANUAL ADDENDUM

SETUP PROCEDURE FOR WET-FLOW CALIBRATED 1010 SYSTEMS

System 1010 Uniflow Portable & NEMA Flowmeter Systems

Manual Addendum
July 2002

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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.

MANUAL ADDENDUM

SYSTEM 1010
EXPANDED I/O OPTION

(For Systems Equipped With 1010N-7 Modules)

Manual Addendum
May 2002

FOR TECHNICAL ASSISTANCE:
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EXPANDED I/O OPTION
(For Systems Equipped With 1010N-7 Modules)

INTRODUCTION

The 1010N-2 I/O Module and 1010N-7 Expanded I/O Module both provide current (Io1, Io2), voltage (V01 and Vo2) and pulse rate (Pgen 1 and Pgen 2) analog outputs. The Expanded I/O Module Option allows users to drive as many as four additional 4-20 mA loop-powered instrumentation outputs. The following information is intended to be used with the I/O Data Control and Span Data sections and Analog Output Trim Menu in the field manual.

The System 1010 flowmeter provides an Analog Output Setup menu (see below) that allows the user to assign data functions for these output signals (refer to Analog Output Setup in the appropriate 1010 field manual). In addition, refer to Installation Drawings 1010N-2-7 and 1010N-7-7 in the field manual appendices for additional connection information and terminal block numerical designators.

NOTE: All meters in the System 1010N and DN product family can accept the Expanded I/O Module Option except 4-Channel meters.

Use this menu to assign data functions to analog outputs. →

```
Siemens              Dual Path          SITE1
Assign Data to Analog Outputs

 Analog Out Setup
 Relay Setup
 Analog Input Setup




I/O Data Control
```

EXPANDED I/O MODULE OPTION

The Expanded I/O Module Option provides expanded Io analog outputs. It is implemented through the use of a 1010N-7 Expanded I/O Module occupying the same position as the 1010N-2 I/O Module. This option allows users to drive up to four additional 4-20mA loop-powered instrumentation outputs. *Note that the meter menu does not indicate that these supplementary outputs are present and available.* The outputs, in addition to being loop-powered, are isolated from one another as well as the meter.

Expanded I/O Module Option Identification

To verify that your meter has the Expanded I/O Module Option installed check the following:

The designation **A1** should be part of the flowmeter part number.

For example: 1010ENRE-T1**A1**KGS

1010N-2 I/O Module

The conventional 1010N-2 I/O module provides the following:

- Two self-powered, isolated 4-20 mA current loops (signals Io1 and Io2) that are assignable and spannable by the user to many flowmeter variables such as flow, sonic velocity, signal strength, etc. These self-powered outputs also provide an industry-standard fault indication by dropping to 2 mA if assigned to flow rate and under fault conditions. *Note that these outputs, though isolated from the system, are NOT isolated from each other*.

- Two 0-10 Vdc outputs (signals Vo1 and Vo2) that are also assignable and spannable by the user as above. These are also self-powered, but are not isolated from the system.

- Two 0-5000 Hz Pgen signals (Pgen1 and Pgen2) also assignable and spannable by the user. These are TTL level pulses.

The 1010N/DN class of meters has a total of six analog outputs as indicated above. In addition (refer to Installation Drawings 1010N-2-7 and 1010N-7-7):

- Alarms/Status/Totalizer pulses are generally presented as relay closures as either Mercury Wetted Form 1A or Dry Reed Form C relays.

- Analog inputs, when provided, are in the form of 4-20 mA non-isolated inputs.

- The meter also has four non-isolated totalizer command lines providing Totalizer Clear and Totalizer Hold (NoTot) functionality.

1010N-7 Expanded I/O Module Option

The Expanded I/O Module Option provides all of the above plus the following outputs:

- The four signals that drive the pulse generator outputs (Pgen 1 and Pgen2) and voltage outputs (Vo1 and Vo2) of the meter create four current outputs: Aux Io1, Aux Io2, Aux Io3 and Aux Io4 (see diagram on next page).

- By spanning and assigning a system variable to 0-10 volt (Vo1 and Vo2) or 0-5000 Hz pulse output (Pgen1 and Pgen2) the module simultaneously outputs these signals to the Expanded I/O Module Option Aux outputs. For a 2-Channel meter the programming assignments are as follows:
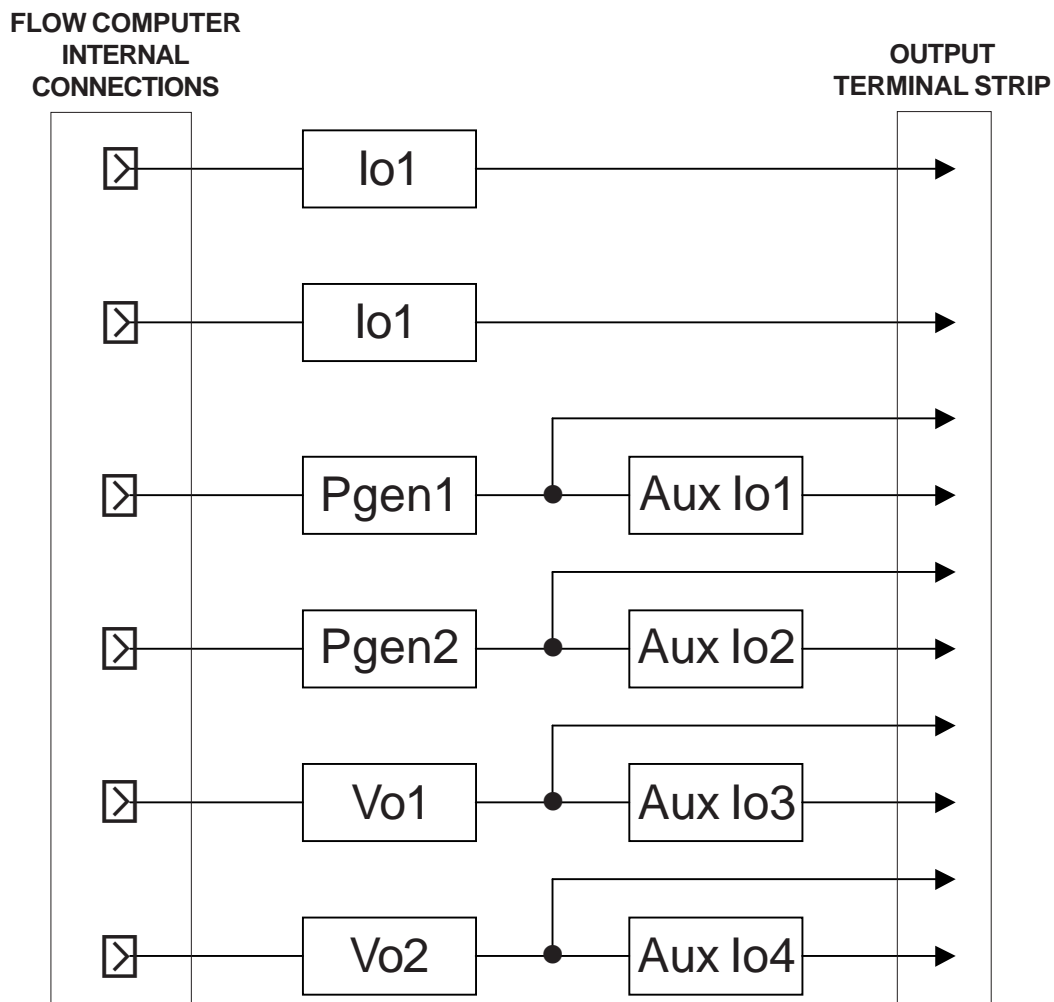
TYPICAL 2-CHANNEL METER EXPANDED I/O OPTION CONNECTIONS

CHANNEL	SIGNAL	AUX Io	METER MENU DISPLAY
CH1	Pgen1	Io1	Vo1
	Vo1	Io3	Pgen1
CH2	Pgen2	Io2	Vo1
	Vo2	Io4	Pgen1

- Note that the four Aux Io outputs are externally powered.

EXPANDED I/O MODULE OPTION PROGRAMMING

The diagram below illustrates the Expanded I/O Module Option programming for a Single Channel meter with a 1010N-7 Expanded I/O Module.

FLOW COMPUTER
INTERNAL
CONNECTIONS

OUTPUT
TERMINAL STRIP

| Io1 |

| Io1 |

| Pgen1 | | Aux Io1 |

| Pgen2 | | Aux Io2 |

| Vo1 | | Aux Io3 |

| Vo2 | | Aux Io4 |

NOTE: The 1010N-7 Expanded I/O Module auxiliary output signals (Aux Io1 - Aux Io4) geneated from Pgen1, Pgen2, Vo1 and Vo2 are "mirrored" output currents. For example, if Vo1 is a 5 Vdc signal then Aux Io3 will be 12 mA.

NOTE: The method used to create auxiliary current loops makes it impractical to generate the 2 mA fault current produced by the primary 4-20 mA outputs of the meter.

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<u>**APPENDICES**</u>

Appendix A - Couplant Installation Instructions *(if applicable)*

Appendix B - Site Setup Considerations for 1010N Blind Systems

Appendix C - Engineering Drawings

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Pipe Table

1.   GETTING STARTED

1.1   INTRODUCTION

Congratulations on your purchase of the Siemens SITRANS FUS1010 NEMA Permanent Flowmeter. Intended for dedicated applications, this versatile transit-time flowmeter is easy to set up and operate. The Model FUS1010 flowmeter represents the state-of-the-art in computerized instrumentation. We are confident that in a very short time, you will appreciate its unrivaled performance and features; especially Siemens's ground breaking enhanced transit-time Digitally Coded MultiPuls technology and the on-line automatic and interactive site setup facility. This manual covers FUS1010 Single Channel, Dual Channel/Dual Path and 4-Channel/4-Path flowmeter types in NEMA-4 or NEMA-7 enclosures. Only the Model 1010FTN and 1010AN flowmeters are equipped to utilize the flow tubes shown in Section 6.

This section shows how to install the System FUS1010 flowmeter with a minimal amount of effort. It will show how to use the Installation Menu to set up the system for transit-time, Reflexor and Flow Tube Clamp-on operation. It also shows the basic connections to and from the flowmeter. For additional information on connections, see the drawings at the end of manual.

1.2   IMPORTANT SAFETY CONSIDERATIONS

The FUS1010 NEMA Permanent meter operates from either an external AC or DC power source. Please observe all the electrical safety codes, etc., that apply to your application. We recommend that only experienced personnel with knowledge of local electrical codes and safety operating procedures perform the installation and wiring. It is solely the user's responsibility to operate this equipment safely. Siemens cannot accept responsibility for any damage that may occur due to failure to observe any local safety rules.

If this equipment is used for a hazardous application (high line pressure, hostile liquid characteristics, perilous atmosphere, etc.), the end-user must ensure that only properly trained personnel are involved in its installation and operation.

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.

1.3   FLOWMETER INSTALLATION STEPS

Typical steps to complete the installation procedure.

- Collect the site data (pipe and liquid data, part numbers, etc.)
- Choose a mounting location for the flow computer and transducers.
- Mount the flow computer at the selected location.
- Prepare pipe for transducer mounting.
- Access the Installation Menu and create a site (see paragraph 1.7.3).
- Enter pipe parameters (see paragraph 2.2).
- Invoke transducer install procedure (see paragraph 2.4).
- Mount transducers on pipe and connect to flow computer (see Section 3).
- Complete transducer install menu operation (see paragraph 2.4).

1.4   THE KEYPAD ENABLE SWITCH

All System 1010N models provide a keypad enable/disable switch to prevent unauthorized access to the Installation Menu. In addition, a password entry option is available (see Channel Setup). The keypad enable/disable switch is located inside the lockable enclosure just above the I/O wiring terminal. Please switch to the enable position before proceeding further. If necessary, see Drawings 1010N-7, 1010DN-7 or 1010MN-7 for location details.
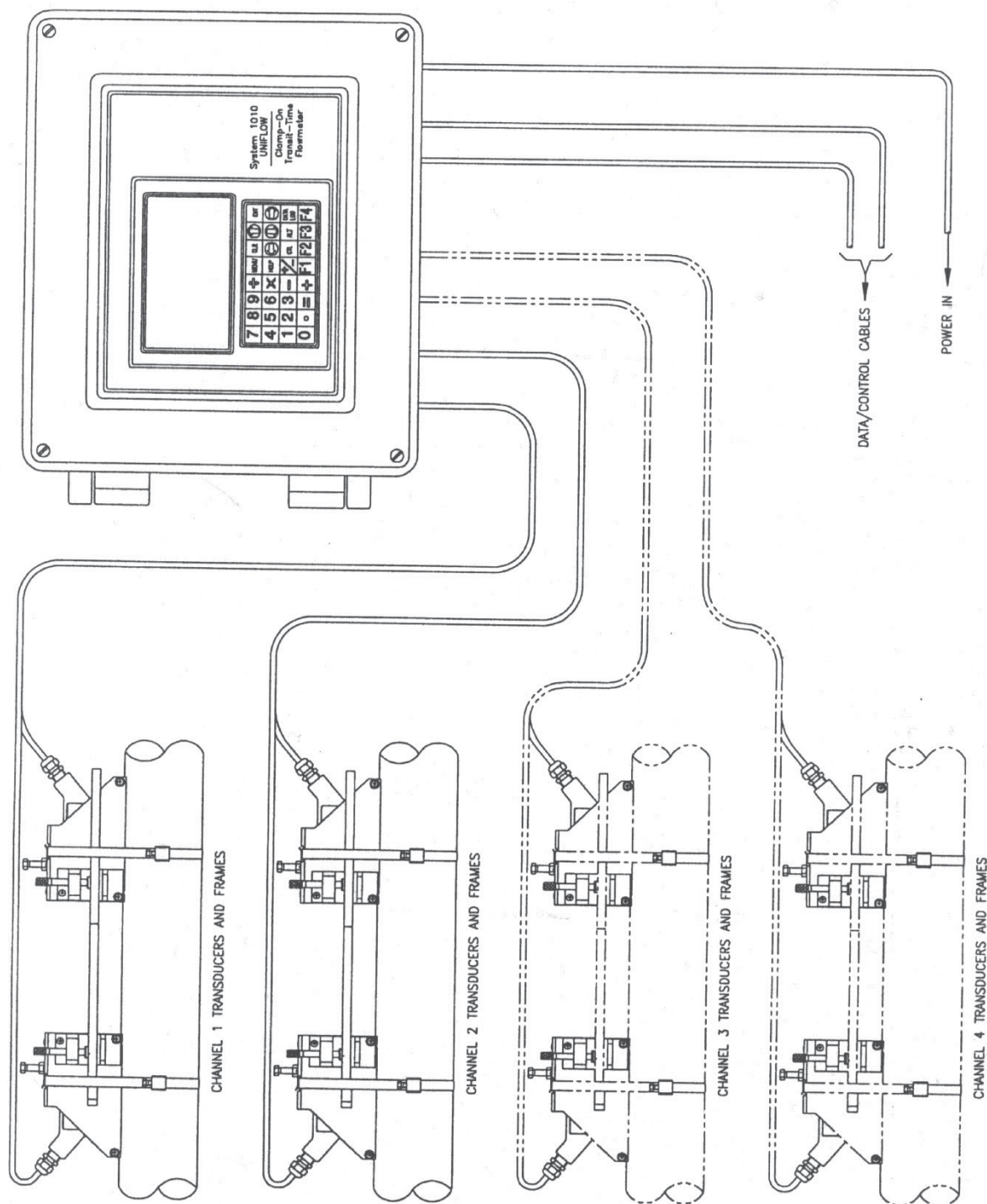
TYPICAL SYSTEM - 1010N PERMANENT CLAMP-ON SYSTEM
Flow Measurement Sub-system (4 channel system depicted here)

1.5   THE 1010N KEYPAD

The 1010N 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 setup by using their serial data port (see Appendix B).

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 alphanumeric characters as needed.

1.6   INTRODUCTION TO THE 1010N MENU SCREENS

The figure below shows a typical 1010N menu screen (in this case, the Pipe Data Menu).
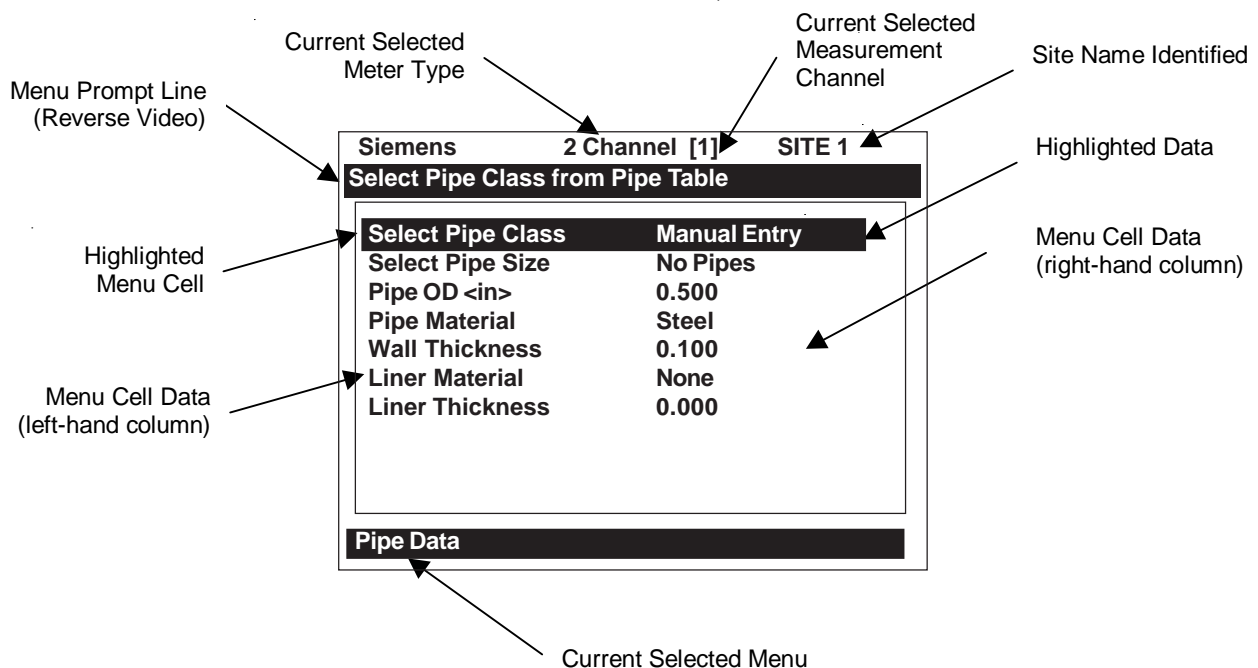
TYPICAL INSTALLATION MENU SCREEN

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	The menu cursor (highlight bar) shows where you are currently working by reversing the display colors for that cell (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 are accessing (e.g., Pipe Data).

1.7   HOW TO USE THE INSTALLATION MENU

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

```
Siemens              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
 Clamp-on
```

1.7.1   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.

ver. 3.01.00

WELCOME   SITRANS
           FUS1010

sitrans
                    SIEMENS

Software
Version
(x.xx.xx)
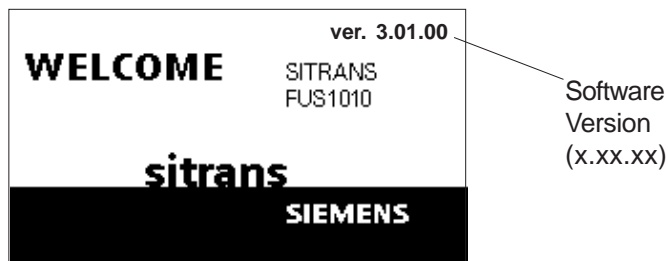
Make sure the keypad enable switch is in the correct position then press the <MENU> key to select the menu. The first time you access the Installation Menu, you can leave it only by saving a site or by turning the meter off. After installing and activating a site, use the <MENU> key to toggle between a graphic display screen and the last accessed menu location.

Siemens   2 Channel [1]   Channel 1
Select Meter Type

Meter Type   >Dual Channel Flow
Meter Facilities   Dual Beam Flow
**   Ch 1 + 2 Flow**
**   Ch 1 - 2 Flow**

Siemens   Site   [1]
Select Meter Type

Meter Type   Single Channel
Meter Facilities
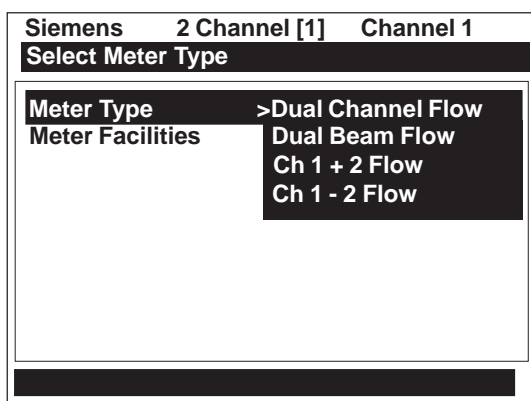
Top menu screen for dual-channel system   *Top menu screen for single-channel system*
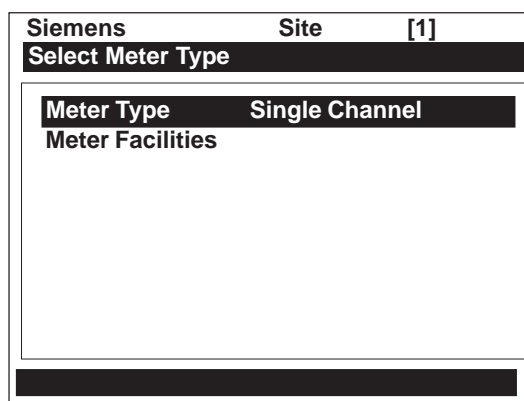
When you press the <MENU> key, the cursor arrives at the first level of the installation menu. Refer to the sample screens above. The left screen is from a dual-channel model. The right screen is from a single channel model. Note that two columns, one on the left-hand side and the other on right-hand side, divide the screen. 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.

1.7.2 HOW TO ENTER DATA

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

- Another series of menu cells (may become left 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

Examine the screen below. It shows how to use an option list to select a liquid for your application. How to access this menu will be explained later. 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 - the right-hand column shows the 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 the <Right Arrow> changes the left-hand column to [Select Liquid]. Pressing the <Right Arrow> 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              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
```

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

To select an option list item, move the cursor to the item and then press the <ENT> key. This places your selection at the top of the list and moves you out of the option list to the next menu cell. Examine screen on next page. The option list item: [Diesel Fuel] 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            Diesel
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 instance, the Datalogger Data option list allows you to select any or all of the available data items for your reports. You can use the <Up and Down Arrows> to move the cursor through the list. If you press <ENT> to select an item, a plus sign (+) appears next to that item. The cursor remains so that you can make other selections. To deselect a previously selected item, move cursor next to that item and press <CLR>. Use <Left Arrow> 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


Liquid Class
```

Entering Numeric Data

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

NOTE: All Numeric Data cells provide a four-function calculator via the 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 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 1010N 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 the <Right Arrow> 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 <Up> or <Down Arrows> to scroll through a single-character list. For example, as shown below, an <Up Arrow> at the first character position produces the letter: uppercase [A]. Pressing the <Right Arrow> moves the cursor to the second position.

```
┌─────────────────────────────────────────┐
│ Controlotron      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 <Right and Left Arrows> to move through the character positions. If you wish touse numbers in your string, you can type them directly from the keypad. After you finish selecting your string, press <ENT> to register it.

1.7.3 THE METER TYPE MENU

This is the first list presented upon entering the Installation Menu. Select the type of meter required for your application. The meter automatically conditions Installation Menu choices to suit the selected meter type. The following paragraphs introduce the available meter types for dual channel systems.

NOTE: On Single Channel systems, you do not get a choice of meter types, sincethis requires two independent measurement channels. However, you can operate the single channel with any optionally supplied measurement technology. Some four channel models provide four-path and channel summing operation.

Dual Channel

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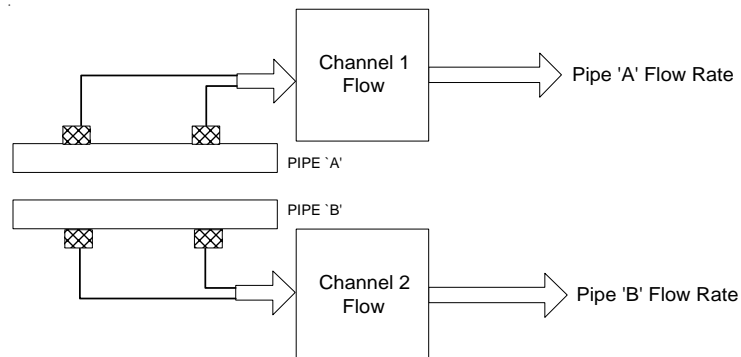
Dual Path

Dual Path 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 allowed. Benefits include highest available precision and enhanced immunity to distorted flow profile conditions.
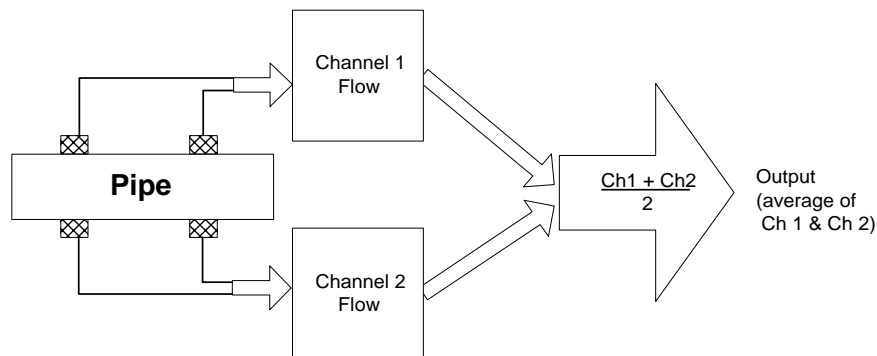
Channel 1+2 and Channel 1-2

Arithmetic operation produces data output via a virtual Channel 3, proportional to sum or difference of the liquid and energy 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.
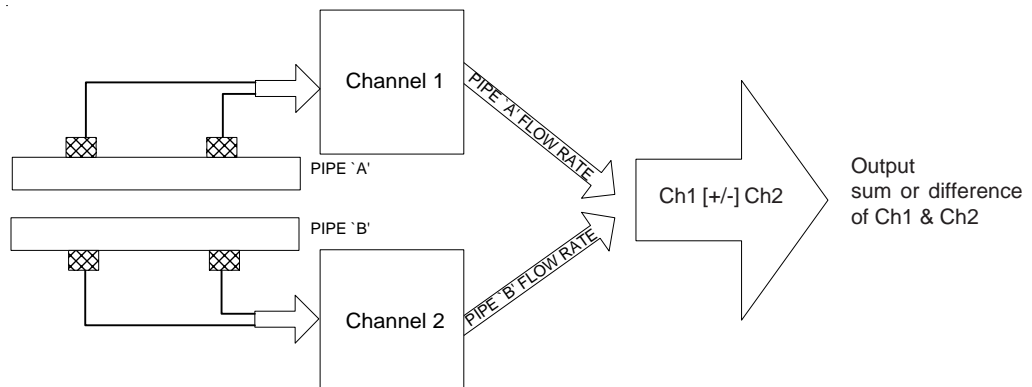
Channel 1-2 produces a data output via a virtual Channel 3, proportional to the difference of the liquid and energy flow of two independent pipes. You have to set-up the two channels independently. Only clamp-on or in-line transit-time operation is supported.

1.7.4   ESSENTIAL INFORMATION FOR USERS OF MULTI-CHANNEL 1010's

Multi-Channel Meter Type

If your 1010 is a multi-channel model, it offers 2 or 4 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'll show you later how to "get around" this limitation for times when you need all your multi-path meter's resources for a single measurement channel.

If one, two or three channels are running when you are trying to setup the last channel, it could take a very long time for the setup; some 10 to 15 minutes should be expected. A great time saver would be to turn each channel off after setup (setup one channel at a time) and reactivate all after everything is setup; then the setup time goes very quickly.

Your **datalogger** and **site storage memory,** being bulky 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 whose nominal characteristics are identical. 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 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, cross-flow or an off-center higher-rate flow core, which can cause a single path machine to mis-report 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 1 and Path 2. Your 1010 meter facilitates this by copying pipe data that you installed as Path 1 and Path 2 data 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 provide for each physical channel to focus mainly on the physical measure-

ment task. User output data, however, is mostly reserved for the virtual or system channel. This includes the totalizer functions. Analog data is largely reserved for the virtual or system channel as well as the totalizer functions, analog outputs and datalogger. In some instances, access is also provided to the path channel's data in order to facilitate the gathering of diagnostic information; thus minimizing menu clutter, but preserving as much functionality as practicable. Totalizer control via lead-in function key is provided by F3 (dual-path meter) and, since there is no F5, F1 (four-path version). The Diagnostic Menu area has been similarly setup to provide data (Path 1, Path 2 and Path 1 and 2) generated by the physical measurement channels when selected, but, to suppress elements only provided by the virtual channel. As mentioned above, use a partially installed multipath site in order to direct all meter input/output to a single measurement path. Simply install the single available physical path and you'll produce data based on only this physical input and obtain the same functionality as provided to the single channel 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 [→] key presses. 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 [ENT] to select it.

Make sure that the keypad enable switch is in the [Enable-Up] position. Turn on power and press [MENU] 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].

```
Siemens   2 Channel  [1]   Channel 1
Select Meter Type

Meter Type       >Dual  Channel  Flow
Meter Facilities  Dual  Path  Flow
                  Ch  1 + 2  Flow
                  Ch  1 - 2  Flow



Pipe  Data
```

Press the ⟶ twice. This selects [Dual-Channel Flow] and then places the cursor next to [Clamp-on] for Channel 1. Note that some models do not support all flow sensor types.

```
Siemens        2 Channel  [1]      Channel  1
Choose  Channel  1  Flowmeter  Type

  Channel  1              >Clamp-on
  Channel  2               FlowTube
                           Reflexor




  Dual Channel Flow
```

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 paragraph 2.1.1)

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].

```
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
```

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 (max.) 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 block cursor shows [S]. Press ➡.

NOTE: The character [S] remains at the first character position and 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 ⬇. Notice 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 **ENT** 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.

```
Siemens        2 Channel  [1]      SITE1  ▼
Use with Care -- Turn Security On or Off

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


Channel Setup
```

After creating a Site Setup, the assigned name appears in these places.

Flowmeter Installation Flowchart

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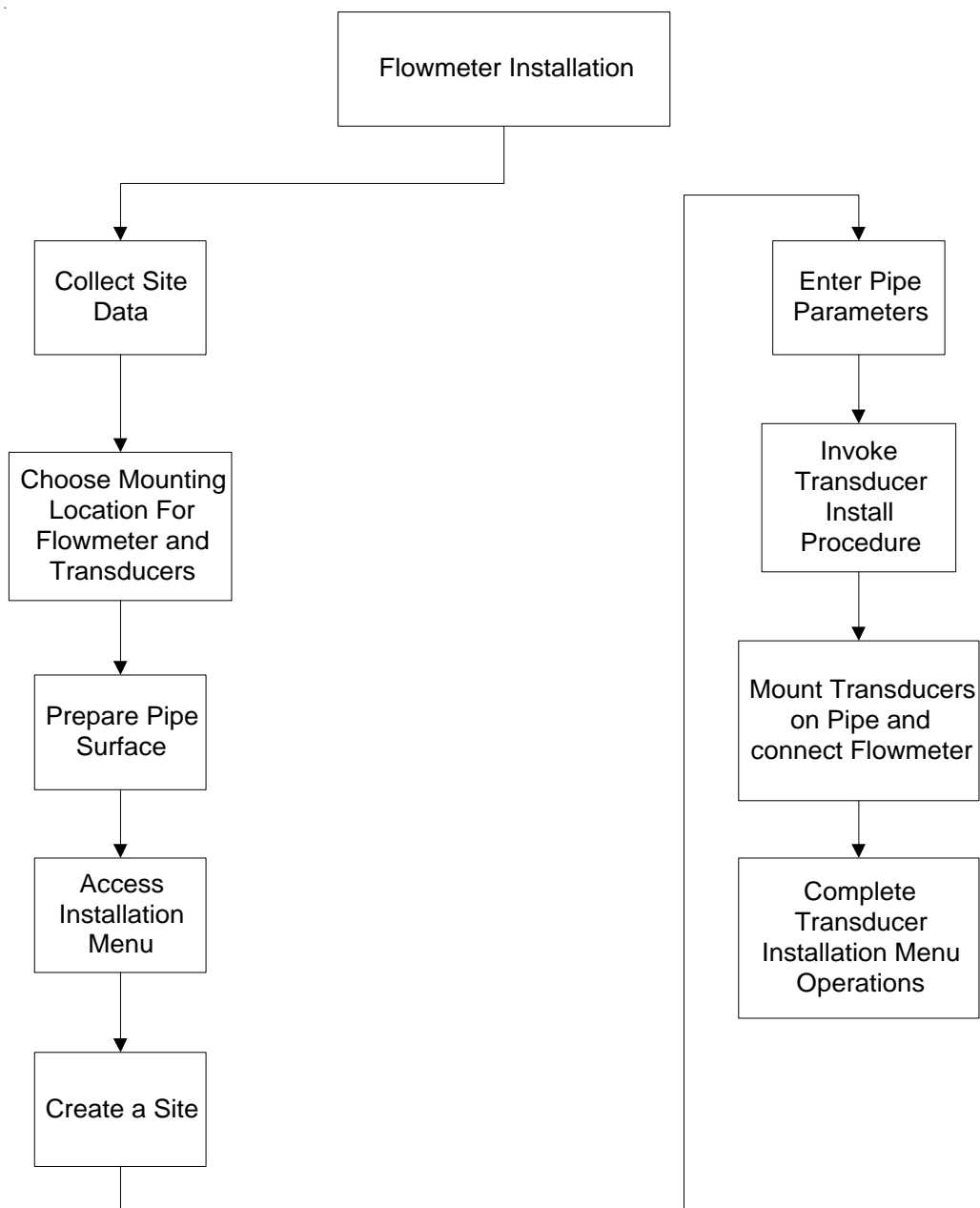
1.8   USING FASTSTART SETUP

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):

●   <u>Pipe Data</u>: The Pipe Data Menu is limited to the selection of pipe pre-sets only. There are no provisions for manual pipe editing.

●   <u>Pick Install Xdcr</u>: This is the same menu as Full Menu Setup (see paragraph 1.7).

1.8.1   CHOOSING THE PIPE CLASS/SIZE

Press [→] 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).

```
Siemens          2 Channel [1]     Channel 1
Select Pipe Class from Pipe Table

 Choose Pipe Class   Manual Entry
 Select Pipe         N/A
 Pick/Install Xdcr




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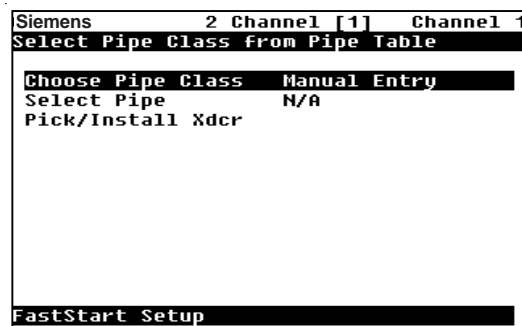
In this example, we will pick the pipe class: [ASA Carbon Steel] by moving the cursor to the selection and then pressing [ENT].

```
Siemens          2 Channel [1]     Channel 1
Select Pipe Class from Pipe Table

 Choose Pipe Class  >Manual Entry
 Select Pipe         ASA StainlessSteel
 Pick/Install Xdcr   ASA Carbon Steel
                     ASA Plastic
                     Metric DN Steel
                     Metric SGP Steel
                     Cast Iron Table
                     Ductile Iron Table
                     Copper Tube Table


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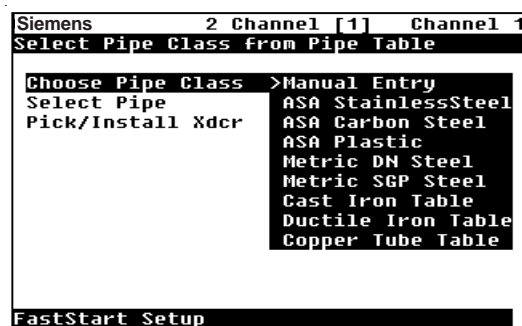
Next, we will pick the pipe size: [1CS80] by moving the cursor to the selection and then pressing ENT . This is all there is to setting up the pipe parameters.

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
```

1.8.2 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 1.7.

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 ENT.

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
Spacing O  Measured Vs m/s
Number In     1506
Spacing M                        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 flowmeter 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 and then, press [ENT].

```
Siemens              2 Channel [1]    Channel 1
▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬

Transducer Model     1011 Universal
Transducer Size      B3
Xdcr Moun
Spacing O  Register Xdcr?
Number In  Yes
Spacing M                         2TP
Ltn Value (in)       0.778
Install Completed?   Install
Empty Pipe Set       Chan Not Setup
Zero Flow Adjust     Chan Not Setup


Pick/Install Xdcr
```

The meter is now ready to report flow. Press [MENU]. The meter will then ask you to save the Site. Saving the Site is optional and will therefore be covered in paragraph 1.7. To abort this item, press [⬅]. This brings up a Flow Display Screen.

```
Siemens              2 Channel [1]    Channel 1

        FLOW  GAL/MIN                    89.68

            0.20

   TOTAL     KGAL       Vs           Vfo
             0.12       1474         G/M
                                     0.00
```
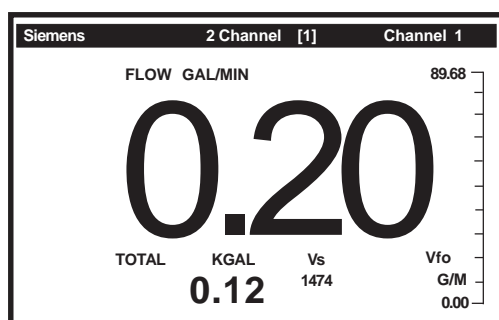
Once your site has successfully installed, you can press [⬇][⬆] to scroll between the available display screens.

The meter is now operational and the display will show flow by pressing the <MENU> key.

Now that you are familiar with the 1010N 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 1010N.

1.9   1010WX CLAMP-ON LIQUID FLOWMETERS

The 1010WX flowmeter model numbers are listed below.

1010WX Series Flowmeters

1010WX
1010DWX
1010MWX

1010WX METER TYPES

The 1010WX series flowmeters are available in Single, Dual Path and Multi-Path versions. The flowmeters may include a display providing flow rate, diagnostics data and keypad interface to access on-screen software setup menus. Safety agency approved 1010WX series flowmeters have hazardous area certification as indicated in the label example below.

NOTE: Graphic displays and local keypads are only available as options. The standard 1010WX is not equipped with a graphic display or local keypad. Refer to Appendix B in this field manual for hardware and software requirements for programming these models.

1010WX FLOWMETER LABEL
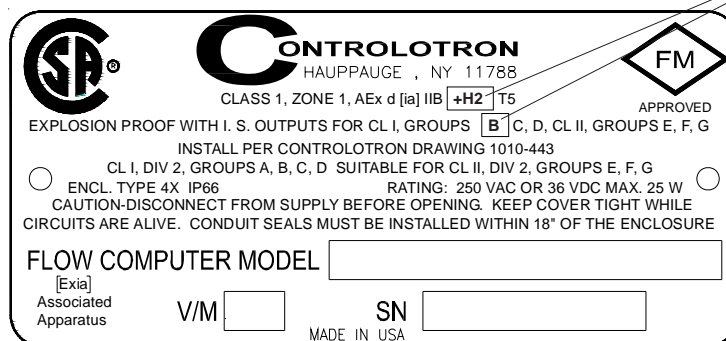
Blank unless flowmeter is rated suitable for hydrogen atmosphere. See "System Hardware" description below.

SYSTEM HARDWARE

ENCLOSURE:

The System 1010WX Series flowmeters have two available case configurations:

Standard 1010WX Case

The System 1010NWX Series flowmeter housed in a cast aluminum enclosure suitable for gas groups up to and including hydrogen **(Class 1, Zone 1, AEx d [ia] IIB +H2 T5)**.

Alternate Light Weight 1010WX Case

The System 1010WX Series flowmeter housed in a lightweight cast aluminum case suitable for gas groups up to and including propane **(Class 1, Zone 1, AEx d [ia] IIB T5)**.

ELECTRONIC MODULES:

All standard 1010DN and 1010MN flowmeter modules are available in the 1010WX series. See the appropriate manual section for functionality of these modules.

DISPLAY AND KEYPAD OPTIONS

The standard 1010WX flowmeters are not equipped with a graphic display or local keypad. The local display and keypad are options that can be combined with different case enclosure configurations, which include the standard case with a window, the standard case without a window, the lightweight case with a window and the lightweight case without a window.

CAUTION: Consult local codes for permit needed to setup units using the graphic display and local keypad. Setup must be done with cover opened.
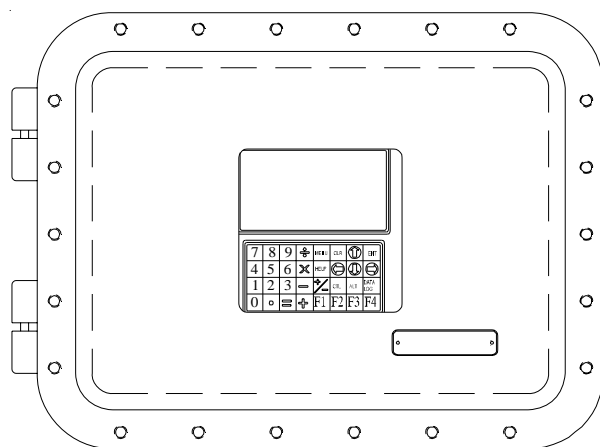
Standard Case Enclosure with Window including the 1010WX equipped with optional graphic display and local keypad.
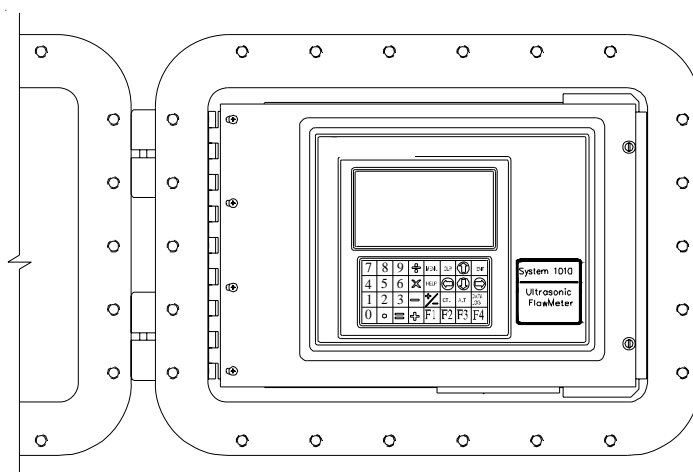
Standard Case Enclosure without Window including the 1010WX equipped with optional graphic display and local keypad. (Shown with cover opened.)

2. THE 1010N INSTALLATION MENU

Programming System 1010N requires no special experience or training. This field manual contains all the necessary information. If you intend to connect this instrument to an external device, then please have the instruction manual for the device available for reference. The following paragraphs present a generic menu reference that applies to all configurations of 1010 NEMA 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 1010N 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.

The conventions used with these instructions are:

● 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.

General Installation Menu Notes:

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

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

● 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 system's defaults.

2.1   THE CHANNEL SETUP MENU

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

CHANNEL SETUP MENU STRUCTURE

Channel Setup ⇨	Recall Site Setup	⇨	*Site Name 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
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 [ENT] .This triggers a pop-up window that asks if you intend to use the original transducer position (recommended). This means that you have to remount the transducers exactly as they were in the previous install.

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

Press [ENT] . 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 [ENT]

To enable a channel:

To access the [Channel Enable] option list press [→]

Move the cursor to [Yes] by pressing [↓][↑]

To enable the measurement channel press [ENT]

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 the <Right Arrow> to access the menu cell entry field and then pressing <ENT>. This creates a "nameless" Site Setup. However, if you intend to use the meter's multi-site storage facility, you must enter a unique site name for each site setup you want to retain in site storage memory.

<u>To Create and Name a new Site Setup:</u>

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 ⟦ENT⟧

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 option list until you enter the correct password. Therefore, <u>it is essential that you never forget or misplace the password.</u> 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. The flowmeter will allow a <F4> Reset Sequence when Security is active, however, it also contains a Menu Enable switch that allows you to inhibit this function (see drawing 1010N-7).

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

<u>To activate Site Security:</u>

To access [Site Security] option list press ⟦→⟧

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

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

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

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

To activate Site Security press **ENT** .

2.1.5 HOW TO DELETE A SITE SETUP

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

To delete a stored Site Setup:

To highlight [Delete Site] press ⬇️

To access the [Delete Site] option list press ➡️

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

To delete the obsolete site setup press **ENT**

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 <ENT> to save the Site Setup. You can change the listed site name by following the procedure below. You may select up to eight characters. If you decide to use numbers or a decimal point in the site name, you can 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 ENT .
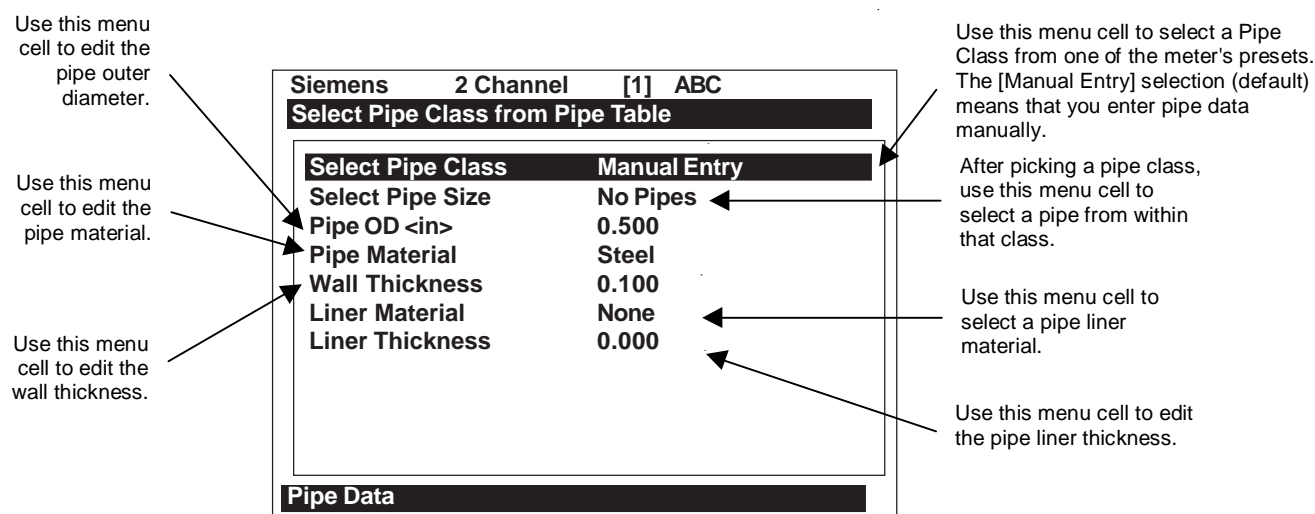
2.2   THE PIPE DATA MENU

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.

Use this menu cell to edit the pipe outer diameter.

Use this menu cell to edit the pipe material.

Use this menu cell to edit the wall thickness.

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

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

Use this menu cell to select a pipe liner material.

Use this menu cell to edit the pipe liner thickness.

Siemens	2 Channel	[1] ABC
Select Pipe Class from Pipe Table		
Select Pipe Class	**Manual Entry**	
Select Pipe Size	**No Pipes**	
Pipe OD <in>	**0.500**	
Pipe Material	**Steel**	
Wall Thickness	**0.100**	
Liner Material	**None**	
Liner Thickness	**0.000**	
Pipe Data		

THE PIPE DATA MENU STRUCTURE

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

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

THE PIPE DATA MENU STRUCTURE (*continued*)

Pipe Data (cont.) ⇨	Pipe Material ⇨	⇕ Steel
		ABS
		Aluminum
		Black Iron
		Brass
		Cast Iron
		CuNi (70/50)
		CuNi (90/10)
		Copper
		Ductile Iron
	⇕	FRP
		Glass
		Hastelloy
		Inconel
		Nickel
		Polyethylene
		PVC (Plastic)
		Silicone
		Teflon
		Titanium
⇨	Wall Thickness ⇨	x.xxx *(numeric entry)*
⇨	Liner Material ⇨	⇕ None
		Cement
		Coal Tar
		Enamel
	⇕	Glass
		Plastic
		HDPE
		Teflon
		Rubber
⇨	Liner Thickness ⇨	x.xxx *(numeric entry)*

2.2.1 HOW TO SELECT A PIPE CLASS

The 1010N 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.

<u>To select a Pipe Class:</u>

To access the [Pipe Class] option list press ⊖

To scroll through the available classes press ⬇ ⬆

To select the class that fits your application press ENT

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].

<u>After selecting a pipe class:</u>

> To access the [Select Pipe Size] option list press ⮕

> To scroll to the required pipe press ⬇ ⬆

> To register selection press `ENT`

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.

<u>To enter the Pipe OD:</u>

> 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 `ENT`

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 <Down Arrow> to accept the default setting for this menu cell.

<u>To select a Pipe Material:</u>

> To access the [Pipe Material] option list press ⮕

> To scroll to the required pipe material press ⬇ ⬆

> To register selection press `ENT`

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.

To enter the Pipe Wall Thickness:

To enable numeric entry press ⊡

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

To register the pipe wall thickness press ENT

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 the <Down Arrow> twice to bypass to the next two menu cells. The [Liner Material] option list offers a selection of common liner materials.

To select a Liner Material:

To access the [Liner Material] option list press ⊡

To scroll to the required Liner Material press ⊡⊡

To register selection press ENT

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 line thickness value.

To register the data press ENT

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 value of your liquid unless you are sure of your data.

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

The Temperature Range menu cell allows you to specify the expected temperature range at the transducer mounting location. The default setting: [-40°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.

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

Use this menu cell to select an upstream pipe compensation correction table.

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

The UniMass Table is used to associate the metered liquid's current temperature and sonic velocity with its specific gravity and viscosity.

Use this menu cell to specify the temperature range of the liquid.

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

APPLICATION DATA MENU STRUCTURE

Application Data ⇨	Liquid Class ⇨	Select Liquid ⇨	⇕ 20% Ethylene Glyclol
			50% Ethylene Glyclol
			27% CaCl Brine
			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 ⇨	Viscosity cS	x.xx *(numeric entry)*		
	⇕	Density SG	x.xxx *(numeric entry)*		
	UniMass Table ⇨	Disabled			
	⇨	Constant Temp ⇨	Create/Edit Table ⇨	Table Point	New
				Vs	xx.xxx
				S.G.	xx.xx
		⇕	⇕	Viscosity (cS)	x.xxx
				Accept	⇕ Yes / ⇓ Clear Pt.
			⇨ Clear Table ⇨	No/Yes	
			⇨ Table Active ⇨	Yes/No	
	⇕ ⇨	Constant Vs ⇨	Create/Edit Table ⇨	Table Point	New
				Temperature	xx.xxx *
				S.G.	x.xxx
		⇕	⇕	Viscosity (cS)	x.xxx
				Accept	⇕ Yes / ⇓ Clear Pt.
⇕			⇨ Clear Table ⇨	No/Yes	
			⇨ Table Active ⇨	Yes/No	
	⇨	Changing Temp & Vs ⇨	Table Active ⇨	Yes/No **	
	Temp Range ⇨	⇕ -40F to 250F			
	⇕	-40F to 375F			
		-40F to 450F			
	Pipe Config ⇨ (Change to Up-stream Piping)	Fully Developed***			
		1 Elbow			
		Dbl Elbow +			
		Dbl Elbow -			
		Valve			
	⇕	Expander			
		Reducer			
		Norm Entry			
		Header Inlet			
		Intrusions			
	Anomaly Diams	xxxx (numeric entry)			

*   Must recognize degrees C, degrees F selection.

**   Vs, SG and Viscosity must be greater than 0.0. Enable permitted only after table contains at least two entries of correctly formatted data.

***   Pipe Configuration Default.

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

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

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. Only Ethylene Glycol (20 & 50%), CaCl Brine (27%) and all water entries provide energy metering services.

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 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 specific gravity of the liquid.

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.

```
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
```

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 ENT

How to Edit the Estimated Vs (liquid sonic velocity)

During transducer installation, the flow computer bases its initial transducer spacing recommendation on the value stored in this menu cell. Estimated Vs m/s allows you to review and modify (if necessary) the Vs value for the liquid class you selected. After you install the transducers, the computer will measure Vs directly. If the displayed (or edited) Vs stored in this menu cell is accurate, the transducers will be spaced correctly. This will eliminate the need to re-space the transducers after their initial installation. However, if the estimated Vs is substantially different from the measured value, the computer will request you to re-space the transducers during the transducer install procedure.

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

To edit the Estimated Vs m/s:

To activate numeric entry press ⊖

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

To register the data press ENT

How to Edit the Viscosity (cS) Setting

The [Viscosity cS] menu cell shows the kinematic viscosity of the selected liquid (in centistokes). The viscosity value is particularly important for high viscosity liquids. The meter requires an accurate liquid viscosity to compute the flow profile compensation. If the displayed viscosity is correct, bypass this menu cell by pressing the <Down Arrow>. Please be aware that the viscosity of the liquid affects the Reynolds Number compensation applied to the final rate output. Therefore, inaccurate data could cause flow data errors. Edit this entry only if you know the true viscosity of your liquid. 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 [ENT]

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 [ENT]

2.3.2 UniMass TABLE

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

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

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

- Input data consists of sonic velocity (Vs) and temperature.

- Output data consists of specific gravity (S.G.) and viscosity (cS) at the specified Vs and temperature.

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

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

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

- From handbooks of physical or chemical data.

- Directly measured in the laboratory using your 1010, its RTD temperature sensor and a non-flowing measurement cell (standpipe).

- After installation on the process pipe if specific gravity and/or viscosity data regarding the liquid can be locally obtained via samples or from on-line instrumentation.

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

APPLICATION DATA MENU EXPLANATIONS FOR UniMass TABLE

The UniMass Table resides within the Application Data menu, however, in Flow Tube (FT) instruments it resides within the [Liquid Data] menu.

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

[Disable] - Press the <Right Arrow> to access tables and enable UniMass routine.

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

[Constant Temp] - Press the <Right Arrow> to access. The [Constant Temp] UniMass Table can be used for multiple liquid applications with tightly controlled constant temperature or single liquid applications with varying temperature (ideal if temperature is not measured).

This function simply associates changes in liquid sound velocity with changing SG and Viscosity.

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

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

- *Vs [Vs Value]*

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

- *S.G. [Specific Gravity]*

  This is the specific gravity of the process liquid at the Vs and Temperature for this table entry. The specific gravity is defined as the density of the sample divided by the density of water at 20^0 C $(68^0$ F).

- *Viscosity [Liquid Viscosity (cS)]*

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

- *Clear Table [Yes/No]*

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

- *Table Active [Yes/No]*

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

[Constant Vs] - Press the <Right Arrow> to access. The [Constant Vs] UniMass Table can be used for single liquid applications where temperature is directly measured. Availability of liquid properties relative to temperature greatly simplifies the implementation of this table.

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

Alternate Data Entry Method

If you wish, you may input the data table via the meter's serial port. To accomplish this, the meter must be in Direct Command Mode (not Menu Mode or Data Display Mode). You can recognize this mode by noting that the meter responds to a <CR> input with a "? for menu" prompt. The meter will accept a text file of the correct format into the UniMass table data structure directly.

An example of the format for a four point data file is as follows:

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

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

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

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

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

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

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

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

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

Gasoline and Diesel fuel UniMass input file.

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

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

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

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

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

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

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

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

3. Select the desired default channel for download of the UniMass table. In HyperTerminal type "cv 0" for Channel 1, "cv 1" for Channel 2, "cv 2" for the virtual channel of a dual beam system or "cv 4" for 4-Beam systems.

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

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

2.3.3 HOW TO SELECT A PIPE TEMPERATURE RANGE

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

If you know that the pipe temperature will exceed 250ºF 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 ENT

2.3.4   PIPE CONFIGURATION

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

To select a Piping Configuration:

To access the option list press ⟶

To highlight the desired piping configuration press ⬇ ⬆

To register selection press ENT

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

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**
Dbl Elbow +
Dbl 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 Menu Structure

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

* Default

PIPE CONFIGURATION OPTION LIST DEFINITIONS

Fully Developed   Fully Developed flow, as would be expected for very long straight pipe runs or installation downstream of a flow condition.

1 Elbow   Single 90 degree Elbow upstream of transducer installation.

Dbl Elbow +   Double out-of-plane Elbows upstream of transducer installation.

Dble Elbow -   Double in-plane Elbows upstream of transducer installation.

Valve   To Be Determined.

Expander   Pipe expansion upstream of transducer installation.

Reducer   Pipe reduction upstream of transducer installation.

Norm Entry   To Be Determined.

Header Inlet   Header or pipe manifold upstream of transducer installation.

Intrusions   To Be Determined.

2.4   THE PICK/INSTALL XDCR MENU

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

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

The flow computer will adjust its parameters to optimize performance based on your selections. The Ltn 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 - HARD-WARE INSTALLATION GUIDE be reviewed. Refer to the Pick/Install Xdcr menu and menu structure shown below for menu cell descriptions and details.

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

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

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

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

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

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

```
Siemens        2 Channel    [1]    FLOW1
Scroll List and select desired Model

Transducer Model      1011 Universal
Transducer Size       B3
Xdcr Mount Mode       Reflect
Spacing Offset        Spacer Bar PB-1
Number Index          0
Spacing Method        Track 1012TAH
Ltn Value (in)        0.565
Install Complete?     No
Empty Pipe Set        MTYmatic
Zero Flow Adjust      Actual Zero

Pick/Install Xdcr
```

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

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

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

PICK/INSTALL XDCR MENU STRUCTURE

Pick/Install Xdcr ⇨	Transducer Model⇨	991 Universal		
	⇕	1011 Universal		
		1011 Hi Precision		
	Transducer Size ⇨	*1011 Universal*	*991 Universal*	*1011H High Precision*
		⇕ A1	⇕ 0A	⇕ A1H
		A2	0	A2H
		B1	1	A3H
		B2	2A	B1H
		B3	2	B2H
		C1	3A	C1H
	⇕	C2	3	C2H
		C3	4A	D1H
		D1	4	D2H
		D2	5A	D4H
		D3	5	
		E1		
		E2		
		E3		
⇕	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 (in) ⇨	2.00 (generated)		
	Install Completed? ⇨	⇕ No [Yes]	*[Yes] indicates successful install*	
		Install		
		Install Transfer		
	Empty Pipe Set ⇨	⇕ MTYmatic		
	⇕	Set Empty		
		Actual MTY		
	Zero Flow Adjust ⇨	⇕ AutoZero	*Reflect mount only*	
		ZeroClr		
	⇕	Reversamatic		
		Actual Zero		
		ZeroMatic		

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 the <Down Arrow>.

<u>To select a Transducer Type:</u>

To access the [Xdcr Type] option list press

To move the cursor to the required transducer model press

To store your selection press ENT

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).

<u>To select a Transducer Size:</u>

To access the [Transducer Size] option list press

To move the cursor to the desired transducer size press

To select the transducer press ENT

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.

<u>To select a Xdcr Mounting Mode:</u>

To access the [Xdcr Mount] option list press

To move the cursor to the required mounting type press

To store selection press ENT

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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. 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 (labels) to simplify transducer placement. One transducer is located at the Reference position, while the other one is located at the Number Index position. The Number Index cannot be directly edited. However, the Spacing Offset can be changed via its option list. Changing the Spacing Offset will alter the reported Number Index. Maximum spacing offset provides moderately greater signal levels but, in some cases, slightly decreased zero flow stability.

If the flow computer reports "Use Ltn," you have to measure the distance between the upstream and downstream transducers. The flow computer issues the actual distance between the transducers in inches or millimeters (See 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. Therefore, you can select either one for the Reference position. You must connect the Up transducer cable to the transducer mounted on the upstream side of the mounting track. This lets the meter display the flow direction correctly.

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

To select a different Spacing Offset

        To access to [Spacing Offset] option list press ⟶

        To move the cursor to the desired offset press ⬇ ⬆

        To store selection press ENT

2.4.6 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.

2.4.7 THE Ltn MENU CELL

This view only menu cell shows the distance in inches or millimeters between the front faces of the transducers along the axis of the pipe. If you are mounting the transducers without a track or spacer bar, you have to space them according to this value (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.

2.4.8 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 Controlotron's 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            4
  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 proceed to page 2-27__ and 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 flowmeter is going through the drives (see menu screen below), press the <ALT> and <MENU> keys simultaneously.

Siemens 2 Channel [1] SITE1	Siemens 2 Channel [1] SITE1
Key [Install] after mounting transducers	**Drive 11**
Transducer Model 1011 Universal	**Transducer Model** 1011 Universal
Transducer Size B3	**Transducer Size** B3
Xdcr Mount Mode Direct	**Xdcr Mount Mode** Direct
Spacing Offset Minimum	**Spacing Offset** Minimum
Number Index 4	**Number Index** 4
Spacing Method Track 1012TP	**Spacing Method** Track 1012TP
Ltn Value (in) 0.217	**Ltn Value (in)** 0.217
Install Completed? **No**	**Install Completed?** **Install**
Empty Pipe Set Channel Not Setup	**Empty Pipe Set** Channel Not Setup
Zero Flow Adjust Channel Not Setup	**Zero Flow Adjust** Channel Not Setup
Pick/Install Xdcr	**Pick/Install Xdcr**

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

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

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

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

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 <Ctrl> and <MENU>. The following typical pop-up prompt will appear: **Drive =0**
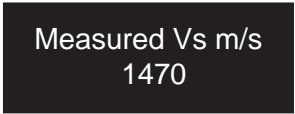
Using the numeric keys enter the desired drive code and press <ENT>.

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 the 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 sucessful completion of the initial makeup, the 1010 will show you a pop-up window with the measured Vs as shown below.

<div align="center">

Measured Vs m/s
1470

</div>

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 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 `ENT`

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

To repeat the Initial Makeup process press `ENT`

After the flow computer completes its Initial Makeup command, the [Install 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 <ENT>. This resets the option list. You can now repeat the install routine described previously.

2.4.9 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.

NOTE: NEVER perform this procedure when the pipe is full.

To perform the Actual MTY Procedure:

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

To move the cursor to [Actual MTY] press ⬇ then `ENT`
   [Empty Pipe   Press Enter] appears on the menu prompt line.

Empty the pipe completely, then press `ENT`.

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

Refill the pipe completely, then press `ENT`.

How to Use the MTYmatic Command

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

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

To start MTYmatic:

> To access the [Empty Pipe Set] option list press ➡️

> Move the cursor next to [MTYmatic] press ➡️

> To invoke MTYmatic press ENT

How to Use the Set Empty Command

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

To enter an Empty Pipe Alarm Threshold:

> To access the [Empty Pipe Set] option list press ➡️

> To move the cursor to [Set Empty] press ⬆️

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

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

> To store the Set Empty number press ENT

2.4.10 ZERO FLOW ADJUST MENU

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

AutoZero

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

Actual Zero

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

ReversaMatic

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

<u>Using Actual Zero</u>

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

<u>To invoke Actual Zero:</u>

Access the [Zero Flow Adjust] option list by pressing ⊡

Press ENT . A pop-up window prompts you to set the current flow rate (in selected rate units) to equal zero (0.000).

NOTE: If a flow offset is desired (i.e., to test analog outputs) then press <Right Arrow> to enable numeric entry.

Press ENT to start the Actual Zero process.

When you send the command, the flow computer analyzes the current flow rate for up to sixty seconds, integrating (averaging) the data for the best zero correlation. During this time, the menu prompt at the top of the display screen shows a timer that counts from zero to sixty. You can allow zero averaging for the entire period, or cancel the process at any time by pressing the <ENT> key. This controls the amount of data the meter averages to obtain a zero level.

Using ReversaMatic

If site conditions do not permit stopping the flow rate at the mounting location, and Reflect Mount is not possible, then use the ReversaMatic routine to establish the zero flow level.

To invoke ReversaMatic:

● To access the [Zero Flow Adjust] option list press ⟹

● Move the cursor to [ReversaMatic]. Press **ENT** to invoke the routine.

● The meter begins to measure the positive flow rate. "Positive" flow refers to flow moving from upstream transducer location to the downstream transducer location. Note top prompt line shows:
   Reversamatic Action

● Upon completion, the meter beeps and the display screen shows:
   Reverse Xdcrs / Press ENT.

● Now remove then remount the upstream and downstream transducers in their reversed positions. Mount the Up transducer (without removing its cable) in the Down transducer/cable location. Mount Down transducer with its cable in the Up transducer/cable location. When remounting the transducers, couple them to the pipe properly. Press <ENT> (after re-installing the transducers).

● The flow computer measures the negative flow rate briefly, then beeps and repeats the
   Reverse Xdcrs / Press ENT prompt.

● 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)

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          2 Channel          SITE1
Conforms Indicated flow to Actual Zero

Transducer Model        1011 Universal
Transducer Size         B3
Xdcr Mount Mode         Reflect
Spacing Offset          Minimum
Number Index            7
Spacing Method          Track 1012TP
Ltn Value (in)          ReversaMatic
Install Completed?      ZeroMatic
Empty Pipe Set          Auto Zero
Zero Flow Adjust        Actual Zero
                        ZeroClr

Pick/Install Xdcr
```

Select the [ZeroMatic] menu cell by pressing ⬇ or ⬆ then press **ENT**

```
Siemens          2 Channel          SITE1
ZeroMatic Active        [6:................:0]

Transducer Model        1011 Universal
Transducer Size         B3
Xdcr Mount Mode         Reflect
Spacing Offset          Minimum
Number Index            7
Spacing Method          Track 1012TP
Ltn Value (in)          0.778
Install Completed?      Yes
Empty Pipe Set          Channel Not Setup
Zero Flow Adjust        ZeroMatic


Pick/Install Xdcr
```

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

```
Siemens        2 Channel         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 Channel Flow
```
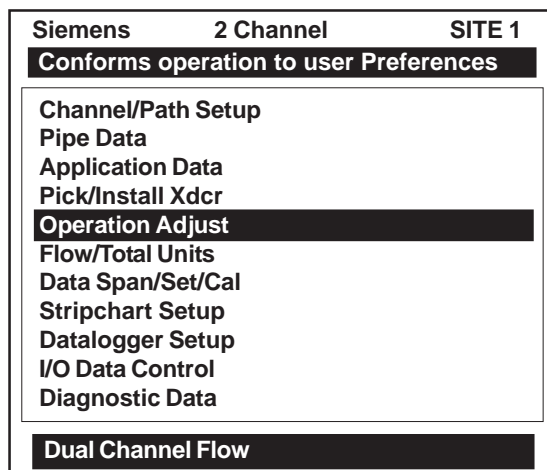
To disable the ZeroMatic function:

Select the [Pick/Install Xdcr] menu cell from the Dual Channel 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 Channel 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 a Deadband, (usually a very low flow rate), below which, the flow output will be forced to zero. You can also select the meter response to a continuous Fault condition.

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

Use this menu cell to enter a 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.

```
Siemens        2 Channel   [1]     BCD
Determine Fault Memory Delay

Damping Control          Smart Slew
Deadband Control         0.000
Memory/Fault Set         Memory
Memory Delay <sec>       120
Reflexor Zero/Fault Set  Fault



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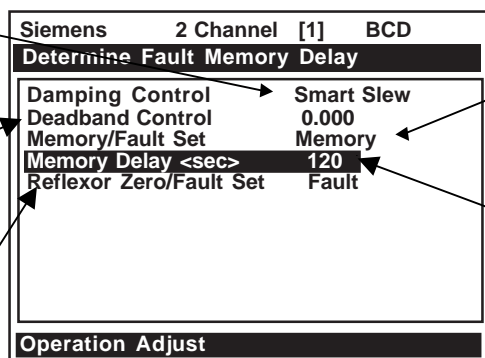
Use this menu cell to select meter response to a fault condition. Fault drops outputs to zero. Memory retains last valid reading for duration of Memory delay.

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

OPERATION ADJUST MENU STRUCTURE

Operation Adjust	⇨	Damping Control	⇨	⇕	Smart Slew	x *(numeric selection)*
					Time Average	xx.x *(numeric entry)*
		Deadband Control	⇨		x.xx *(numeric entry)*	
	⇕	Memory/Fault Set	⇨	⇕	Memory	
				⇩	Fault	
		Memory Delay (sec)	⇨		xxx *(numeric entry) (hidden in Fault Mode)*	
		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 best combination of data smoothing and quick response to sudden rate changes. It performs data scatter damping during steady flow periods while maintaining the ability to respond instantaneously to changing flow rates. SmartSlew values range from [1 to 9]. The default is [6]. Pick a higher number to slow meter response to a rate change. Time Average integrates the instantaneous flow rate over a selectable time period. You enter a value (in seconds), which sets the time it takes the meter to respond to a rate change. The default is 10 seconds. Enter any amount of time up to 60 seconds maximum.

To edit the default SmartSlew setting:

To access the [SmartSlew] option list press ⟶ three times.

Scroll the numeric list to the desired choice press ⬇ ⬆

To register the new value press **ENT**

To select Time Average:

To access the [Damping Control] option list press ⟶

To move the cursor down to [Time Average] press **ENT**

To enable Time Average entry press ⟶

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

To register the new value press **ENT**

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 **ENT**

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, 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] by pressing ⬇
>
> To make selection press | ENT |
>
> 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 number keys to type the delay in seconds.
>
> To register the new value press | ENT |

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

The Flow/Total Units 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 energy and flow rate and total outputs. After making your selections, a view-only menu cell shows the resultant scaling. Another menu cell lets you adjust the output resolution by selecting a display range.

This system provides three totalizer display modes:

POSFLOW	*Positive (forward)/flow total only*
NEGFLOW	*Negative (reverse)/flow total only*
NETFLOW	*The net of the Positive and Negative/flow (default)*

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

Key	Command	Description
F1 F2 **1** F3 F4	CLEAR (also clears overflow)	Resetting the Totalizer registers clears all total data accumulated during operation. *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>.*
F1 F2 **2** 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 **3** 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.
F1 F2 **4** F3 F4	CLEAR (Batch/Tot Register)	Clears the Batch Sample totalizer register. See Batch/Sample Tot.
F1 F2 **6** 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.

THE FLOW/TOTAL UNITS MENU STRUCTURE

Flow/Total Units ⇨	Volume 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
		Flow Display Scale ⇨	⇕ mGAL/MIN
			GAL/MIN
		⇕	KGAL/MIN
		Total Volume Units ⇨ ⇕	⇕ *Same list as*
			Flow Volume Units
		Totalizer Scale ⇨	⇕ GAL
			KGAL
		⇕	MGAL
		Total Resolution ⇨	000X0000
			⇕ 0000X000
		⇕	00000X00
		Totalizer Mode ⇨	⇕ NEGFLOW
			NETFLOW
		⇕	POSFLOW
		Batch/Sample Total ⇨	x.xxx *(numeric entry)*

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

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

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

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

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

```
Siemens      2 Channel  [1]     FLOW1
Choose desired Flow rate volume units

Flow Volume Units      Gallons <US>
Flow Time Units        MIN
Flow Display Range     Autorange
Flow Display Scale     GAL/MIN
Total Volume Units     Gallons <US>
Totalizer Scale        KGAL
Total Resolution       00000x00
Totalizer Mode         NETFLOW
Batch/Sample Total     0.000


Flow/Total Units
```

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

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

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

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 Units] option list press ⟶

To move the cursor to the required units press ⬇ ⬆

To store selection press ENT

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:

To access the [Time Unit] option list press ⟶

To move the cursor to the required time units press ⬇ ⬆

To store the time units press ENT

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 Hi range, the meter controls its screen resolution to prevent data overflow at the highest possible flow.

To edit the Display Range:

To access the [Display Range] option list press ⟶

To move the cursor to the required display range press ⬇ ⬆

To store selection press ENT

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 ENT

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 ENT

2.6.6 TOTALIZER SCALE

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

To select a different Totalizer Scale:

To access the [Totalizer Scale] option list press ⟹

Move the cursor to the desired display scale by pressing ⬇ ⬆

To register selection press ENT

2.6.7 TOTAL RESOLUTION

The meter assigns multiplier prefixes for the flow total units you selected (e.g., MGPM). It provides three resolution (or capacity) levels. Therefore, actual Totalizer display units depend on the selected multiplier. Check the total units by accessing the [Totalizer Scale] menu cell.

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

a) The TOTCNT relay output pulses at a maximum rate of .5 pulses per sec. (.5 Hz).

b) The meter sends a totalizer output pulse for every advance of the rightmost visible totalizer digit.

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

To change the default resolution:

To access the [Total Resolution] option list press ⟹

Move the cursor to the required resolution by pressing ⬇ ⬆

To store selection press ENT

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 the <Down Arrow> to accept the default setting.

To select a Totalizer Mode:

> To access the [Totalizer Mode] option list press ⟶

> Move the cursor to the required Totalizer mode by pressing ⬇ ⬆

> To store selection press ENT

2.6.9   BATCH/SAMPLE TOTAL

The meter maintains a separate totalizer register for Batching or Sampling applications. Unlike the Flow Total registers, you cannot access this register directly. It is used for relay control only. If you assign the system relay to this function, a momentary (200 mS) relay pulse occurs whenever the BATCHTOT register accumulates a specified liquid quantity. You enter the total flow volume required to activate the relay in the Batch/Sample Total menu cell. The numeric entry must reflect the selected flow total units. The Totalizer Display Scaling menu cell shows the applicable flow total units. The sign of the Batch/Sample Total determines positive or negative accumulation.

**NOTE: The Batch/Sample total relay requires the same consideration for 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 TOT accumulation.

> To store data press ENT

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 setpoints for Alarm relay outputs. Additionally, the Calibrate Flow Rate menu allows you to apply external adjustments to the meter's intrinsic primary outputs.

THE DATA SPAN/SET/CAL MENU STRUCTURE

Data Span/Set/Cal ⇨	Span Data ⇨	⇕ Max Flow (Units) ⇨	⇕ x.xxx (numeric entry)	
		Min Flow (Units) ⇨	x.xxx (numeric entry)	
		Max Vs m/s ⇨	x.xxx (numeric entry)	
		Min Vs m/s ⇨	x.xxx (numeric entry)	
	⇕	Max S.G. ⇨	x.xxx (numeric entry)	
		Min S.G. ⇨	x.xxx (numeric entry)	
		Max Viscosity cS ⇨	x.xxx (numeric entry)	
		Min Viscosity ⇨	x.xxx (numeric entry)	
		Max Temperature ⇨	x.xxx (numeric entry)	
		Min Temperature ⇨	x.xxx (numeric entry)	
	Set Alarm Level ⇨	⇕ High Flow (Units) ⇨	⇕ x.xxx (numeric entry)	
		Low Flow (Units) ⇨	x.xxx (numeric entry)	
		High S.G. ⇨	x.xxx (numeric entry)	
		Low S.G. ⇨	x.xxx (numeric entry)	
⇕		High Viscosity cS ⇨	x.xxx (numeric entry)	
		Low Viscosity cS ⇨	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)

Use this menu to set the low and high range for analog outputs.

Use this menu cell to enter a calibration slope factor for volumetric flow (Vfo).

```
Siemens          2 Channel   [1]      Channel 1
Define data Alarm thresholds

Span Data
Set Alarm Levels
Calibrate Flowrate          Intrinsic




Data Span/Set/Cal
```

Use this menu to define setpoints for the alarm relay outputs.
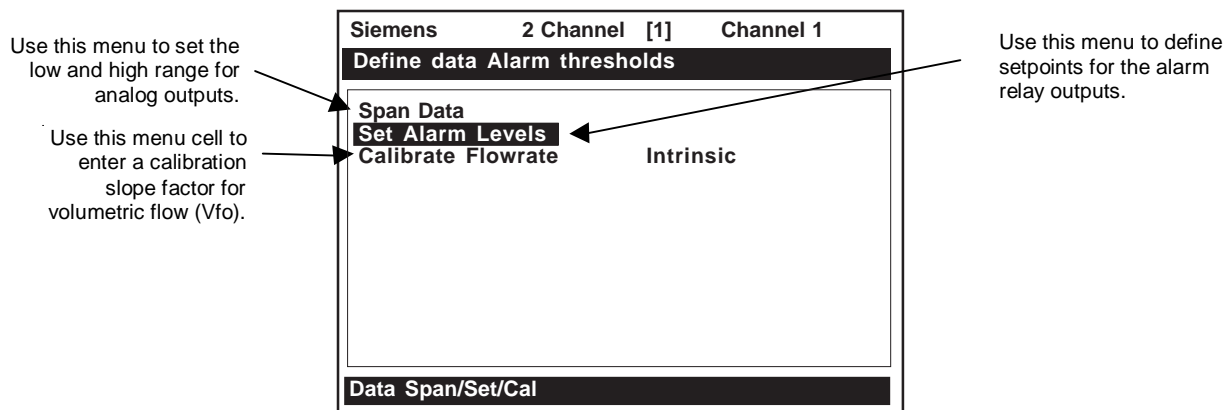
2.7.1 SPAN DATA

The Span Data menu allows you to set 0% and 100% output limits for volumetric flow (Vfo), absolute flow (Vfab), sonic velocity (Vs) and other outputs (see next page). Each menu cell shows appropriate rate units and time base. If you change flow rate units after spanning the system, the computer automatically updates the output data setup to reflect the change. Span limits apply to both the analog outputs and the on-screen stripchart. The flow outputs operate as follows:

Vfo *Spanned Volumetric Flow Rate:*	The minimum and maximum flow rate entries establish the Vfo span. The [Max Flow] menu cell sets 100% of span. The [Min Flow] menu cell sets 0% of span. Use signed numbers for bi-directional spanning. Note that negative (reverse) flow 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.
Vfab *Spanned Absolute Volumetric Flow Rate:*	Vfab is the absolute magnitude of the volumetric flow rate (Vfo). There are no menu cells provided to span this output. Vfab shares the Vfo span entries. The Vfab minimum span is always zero. The maximum span for Vfab is the largest absolute value of either the min. or the max. flow rate (Vfo) entries. For example, a span between +10 GPM and -30 GPM, spans the Vfab output from 0 GPM to 30 GPM.
Vs *Spanned Liquid Sonic Velocity:*	Vs is the sonic velocity in meters-per-second (m/s) of the flowing liquid. The min. and max. Vs entries establish the Vs span. Max Vs (m/s) defines 100% of span. The Min Vs (m/s) defines 0% of span.

<u>**Maximum span values represent**</u>:
  100% of span
  Current output of 20 mA
  Voltage output of 10 Vdc
  Pulse output of 5000 Hz

<u>**Minimum span values represent:**</u>
  0% of span
  Current output of 4 mA
  Voltage output of 0 Vdc
  Pulse output of 0 Hz

Max Flow

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

<u>To enter the Max. Flow Range Setting:</u>

> To activate numeric entry press 🠖

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

> To store the data press **ENT**

Min Flow

The [Min Flow] menu cell stores the minimum range for the flow rate output (Vo). 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.

<u>To set the Min. Flow Range:</u>

> To activate numeric entry press 🠖

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

> To store data press **ENT**

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

Max Vs m/s

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

Min Vs m/s

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

Max S.G.

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

Min S.G.

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

Max Viscosity cS

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

Min Viscosity cS

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

Max Temperature

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

Min Temperature

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

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 energy or flow rate, liquid interface (Vs) and liquid aeration alarm functions. Entry of all alarm setpoints is accomplished using the selected rate units. You can enable or disable a Makeup Alarm Latch to keep the makeup alarm active until you reset it manually by an <Fn>6 simultaneous key press.

To access the Alarm Setpoints menu press 	extbf{⊟}.

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 ENT

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 ENT

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

High S.G.

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

Low S.G.

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

High Viscosity cS

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

Low Viscosity cS

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

High Temperature

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

Low Temperature

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

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

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

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 **ENT**

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 executes an in-process makeup to restore operating parameters. During the makeup, the meter sets a Makeup Alarm flag, which clears upon completion. Therefore, unless you were monitoring the unit continuously, you could miss the fact that an In-process Makeup occurred. The Makeup 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 **ENT**

2.7.3   CALIBRATE FLOW RATE

The 1010's intrinsic calibration is excellent as confirmed by numerous laboratory and field trials under diverse application conditions. We thus can confidently say that in any given application, the majority of conventional flowmeters can not match the system's measurement range or its linearity. Some applications may require an output adjustment to match an official external reference. The Calibrate Flow Rate menu allows you to select a calibration mode. The right-hand column shows the active calibration mode. You can select Intrinsic (factory), Kc (Slope Correction) or Multipoint (Non-linear) Calibration. Selecting either of the external calibration modes will not eliminate the Intrinsic (factory) calibration. You can use this menu cell to switch between Intrinsic, Kc or Multipoint at any time.

Kc Calibration

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

To obtain the Kc factor, compare flow total data taken simultaneously from the 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. *NOTE: Always enter the + or - sign first.*

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 enter the required Kc (as calculated above). Note that the Kc value can be negative or positive. Enter the - or + sign first, then type in the calibrated value.

To store the data press ENT.

Note that Kc now appears in the right-hand column of the [Calibrate Flow Rate] menu cell with its new value. Also note that this Kc value can be viewed on the site printout.

MultiPoint Calibration

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

(a) Selecting up to 10 separate calibration points by entering a raw (un-calibrated) flow rate.

(b) Entering a negative or positive correction for each calibration point that you select.

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

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

Use these to match System 1010N'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 ENT

This selects the MultiPoint calibration screen, which shows:

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

Press ⟱ 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 ENT . 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 ENT . The highlight returns to the [Point #] field.

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

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 ENT . The cursor moves to the [% Correction] field.

To enable numeric entry press ENT

Use the numeric keys to type the required % correction for point #2. Press ENT .

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.

Use this menu cell to select a data item to display on the stripchart.

Use this menu cell to select whether the stripchart shows data as either a rate or a percentage of span.

Siemens	Dual Path	SITE1
Select Data Units or Percent Display		
Select Data	LiquIdent	
Data Display	**Data Rate Units**	
Time Base	1 second	
Stripchart Clear	Yes	
Stripchart Setup		

Use this menu cell to clear the current stripchart.

Use this menu cell to select an update interval for the stripchart.

THE STRIPCHART SETUP MENU STRUCTURE

⇨ Stripchart Setup	⇨ Select Data	⇨ ⇕ Vfo
		Vfab
		Visc
	⇕	Temp
		Vs
		Valc
		Vaer
		Vsg
	⇨ 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)
- Visc .... (viscosity)
- Temp .... (temperature)
- Vs .... (sonic velocity)
- Valc.......................... (signal amplitude)
- Vaer .... (aeration/cavitation)
- Vsg .... (spanned unsigned flow magnitude)

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 ENT

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 ENT

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, of which 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 ENT

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 ENT

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 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.

Use this menu cell to pick a destination for Datalogger reports.

Use this menu cell to select items for Datalogger reports.

Use this menu cell to select real-time Datalogger triggers.

```
Siemens        Dual Path    Path 1
Select datalogger destination

Datalogger  Mode        Off
Datalogger  Data        None
Log Time Interval        1 Min.
Data Logger Events        None
Display Datalogger        Off




Datalogger  Setup
```

Use this menu cell to select a logging interval.

Use this menu cell to send Datalogger reports to selected destination and pick up a line wrap mode.

THE DATALOGGER SETUP MENU STRUCTURE

⇨ Datalogger Setup	⇨ Datalogger Mode ⇕	⇨ ⇕ Off Memory RS-232 Output
	⇨ Datalogger Data ⇕	⇨ ⇕ None Site Id Date Time Flow Average Flow Raw Flow Total Vs Valc Aeration S.G. Alarms Temperature Delta T (usecs) Analog Inputs
⇕	⇨ Log Time Interval ⇕	⇨ ⇕ 5 Sec. 10 Sec. 15 Sec. 30 Sec. 1 Min. 5 Min. 15 Min. 30 Min. 1 Hr. 2 Hr. 4 Hr. 6 Hr. 12 Hr. 24 Hr. Demand
	⇨ Datalogger Events ⇕	⇨ ⇕ None Relay 2 Relay 1 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 [ENT]

2.9.2 DATALOGGER DATA

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

None	Default – Datalogging is disabled.
Site ID	You entered this site name when you created the site.
Date	The report date according to the meter's real time clock. (Format: MM.DD.YYYY)
Time	The report time according to the meter's real time clock. (Format: HH.MM)*
Flow	The instantaneous flow measured at the time of the report.
Average Flow	The average flow rate measured since the last report.
Raw Flow	The uncompensated flow rate in in/sec2 (only zeroed - no Reynolds number curve applied).
Total	The total flow accumulation measured at the time of the report.
Vs	The average liquid sonic velocity since the last report.
Valc	The signal strength measured at the time of the report.
Aeration	The aeration percentage recorded at the time of the report.
S.G.	Specific Gravity at current operating temperature.
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 aand 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 (see next page).

Alarm Letter Codes and Descriptions

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

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

To select Datalogger Data items:

To access the [Datalogger Data] option list press ⊡. Move the cursor to 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 cursor to desired item by pressing ⊡ ⊡ then press ENT to select it. Note that a plus sign(+) appears before the item.

To de-select Datalogger Events:

To move the cursor to the item press ⊡ ⊡ then CLR . Note that this removes the plus sign (+) from the item.

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

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 ENT

To scroll the on-screen datalogger display:

To display one line at a time press ⊡

Use ✚ key to scroll down one screen (10 lines) at a time.

Use = key to jump to 15 lines of the last screen.

In No Line Wrap mode:

Use ⊡ or ⊡ to scroll one column to the left or right. Use ALT + ⊡ or ALT + ⊡

To scroll 8 columns to the right or the left. To get out of the display, press MENU

NOTE: In single channel 1010's 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, 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 report.

2.10 THE I/O DATA CONTROL MENU

This menu becomes available after picking a Meter Type and Channel.

Use this menu to assign functions for the meter's analog outputs and optional inputs. The Analog Out Setup assigns functions to the meter's current, voltage and pulse rate outputs. Each menu cell presents an option list of the available data items. In addition, you can set up the alarm relays, enable and span the analog input ports.

Use this menu to assign data functions to analog outputs.

Use this menu to assign alarm functions to relay outputs.

Use this menu to enable and span optional analog inputs.

```
Siemens          Dual Path        SITE1
Assign Data to Analog Outputs

Analog Out Setup
Relay Setup
Analog Input Setup




I/O Data Control
```
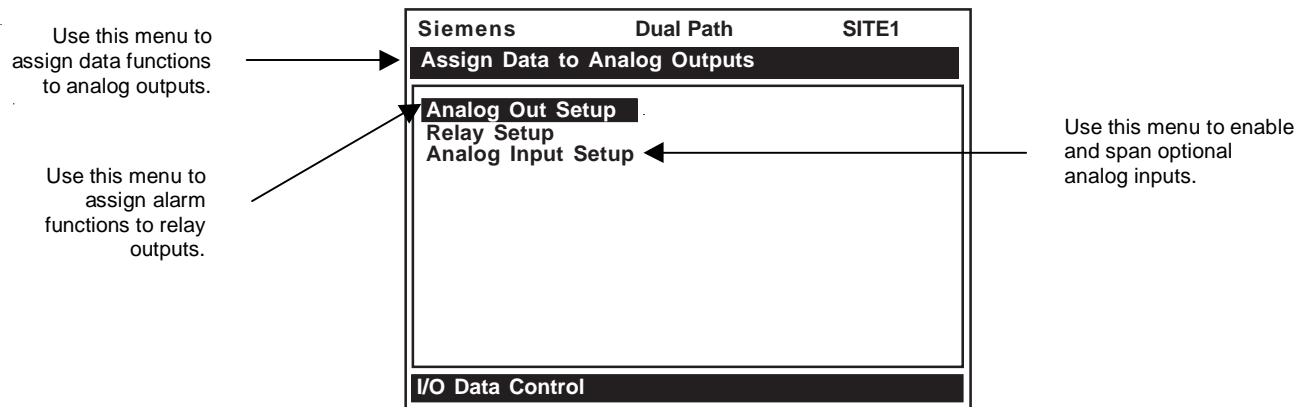
THE I/O DATA CONTROL MENU STRUCTURE

I/O Data Control ⇨	Analog Output Setup ⇨	Io1/Io2 ⇨	⇕	Vfo
				Vfab
				Vs
				Valc
				Vaer
			⇕	Vsg
				Viscosity
				T1
				Iin1
		⇕		Iin2
				Iin3*
				Iin4*
		Vo1/Vo2 ⇨		*See Io option list*
		Pgen1 ⇨		*See Io option list*
⇨	Relay Setup ⇨	Relay 1 ⇨	⇕	Off
				Power On
				S.G.
				Hi Temperature
				low Temperature
				High Flow
				Low Flow
				Flow Alarm
			⇕	Fault Alarm
⇕	⇕			Spacing
				Empty
				Aeration
				Interface
				Reverse Flow
				BatchTot
				Pos Total
				Neg Total
				Soft Fault (Multi-beam)
	⇨	Relay 2 ⇨		*See Relay 1 list for 2, 3 & 4*
⇨	Analog Input Setup ⇨	Iin1 ⇨	Input ⇨ ⇕	Off
				Aux (X or F-Option)
				S.G. (F-Option)
				cS (F-Option)
				cP
			⇕	PSIA (BAR) - (F-Option)
				BARA
	⇕			Deg F
				Deg C
			4 mA	*numeric entry*
			20 mA	*numeric entry*
	⇨	Iin2 ⇨	Input ⇨	See Iin1 option list
		⇕	4 mA	*numeric entry*
			20 mA	*numeric entry*

*For Multi-Path and Arithmetic operating modes only.

2.10.1 ANALOG OUTPUT SETUP

System 1010 provides current, voltage and pulse-rate analog outputs. Analog Output Setup allows you to assign data functions for these signals. The 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
Vsg	Spaned specific gravity
Viscosity	System liquid viscosity
T1	Current liquid temperature
Iin1, Iin2	Represents a re-transmit of the analog input signals (e.g., Pressure and Temp inputs can be transmitted on the 4/20 mA output.)
Iin3, Iin4	Same as Iin1 and Iin2 above but only available for operation in Multi-Beam and Arithmetic modes.

NOTE: For Multi-Channel meters, refer to drawing 1010MN-7 for details. For Expanded I/O modules, refer to drawing 1010N-7-7 and Addendum 1010FMA-14 for details.

Table To Determine Proper I/O Installation Drawings

Model Number and I/O Module	Installation Drawing and Page Number*
1010N	**1010N-2-7 (Sheet 2 of 2)**
1010N with 1010N-7 Expanded I/O Module	**1010N-7-7 (Sheet 2 of 3)**
1010DN	**1010N-2-7 (Sheet 2 of 2)**
1010DN with 1010N-7 Expanded I/O Module	**1010N-7-7 (Sheet 2 of 3)**

*Note: For Ultra Precsion transducers see 1010N-7-7 (sheet 3 of 3).

Assigning Io Output Functions

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

CAUTION: Do not connect to a powered loop.

To assign a function for the current output:

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

To move the cursor to the desired data function press ⊡ ⊡

To store selection press ENT

Assigning Vo Output Functions

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

<u>To assign a function to the voltage output:</u>

To access the [Vo] option list press ⟶

To move the cursor to the desired data function press ⬇ ⬆

To store selection press ENT

Assigning Pgen Output Functions

The Pgen analog output is a buffered TTL-compliant pulse rate signal, similar to the pulse outputs of flowmeters such as turbines. It varies linearly from 0-5000 Hz in relation to a selected data function.

<u>To assign a function to the Pgen output:</u>

To access the [Pgen] option list press ⟶

To move the cursor to the desired data function press ⬇ ⬆

To store selection press ENT

PULSE OUTPUT (Pgen Wiring)

1010N & 1010DN with 1010N-2 Modules
Installation Drawing 1010N-2-7 (Sheet 2 of 2)

TB2

PIN#	SIGNAL	FUNCTION	NOTES
11	PGEN 1+	FREQUENCY OUTPUT 1	0 - 5000 Hz, 5 Volt Logic, Square Waveform
12	PGEN 1-	REF. GROUND	
13	PGEN 2+	FREQUENCY OUTPUT 2	
14	PGEN 2-	REF. GROUND	

1010N & 1010DN with Expanded 1010N-7 I/O Modules
Installation Drawing 1010N-7-7 (Sheet 2 of 3)
(Standard, High Performance and Enhanced Performance Flowmeters)

TB2

PIN#	SIGNAL	FUNCTION	NOTES
9	PG1	FREQUENCY OUTPUT 1	0 - 5000 Hz, 5 Volt Logic, Square Waveform
10	PG2	REF. GROUND	
11	PG3	FREQUENCY OUTPUT 2	
12	PG4	REF. GROUND	

2.10.2 RELAY SETUP

Use this menu to assign a function to channel relays. System 1010 supports 2 types of relay outputs, Alarm Relay and Pulse Relay. Alarm Relay outputs operate in "fail-safe" mode. The relay(s) are energized under normal conditions - an alarm condition causes the relay(s) to de-energize until alarm clears. The Pulse Relay output supports totalizer and batch relay functions. Output is a pulse width approximately 200 ms; maximum activation rate is 2.5 pulses per sec. If totalizer pulses exceed this rate, excess pulses are stored in an overflow register. This allows the relay to "catch up" when flow decreases enough.

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

RELAY OPTION LIST

Not Used	Not Active
Power Off	Power Off alarm occurs when power fails
S.G.	Specific Gravity value relay trip-point
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 ⟶

To move the cursor to the desired Relay assignment press ⬇ ⬆

To store selection press ENT . Repeat procedure for Relay 2.

2.10.3 ANALOG INPUT SETUP *(optional function)*

The Analog Input Setup function assigns an active analog input to a measurement channel/path. The meter provides four DC current input ports for single and Dual Channel units. The DC current input ranges from a zero level of 4 mA to a full scale of 20 mA. The [Analog Input Setup] menu cell allows you to enable this port and then span it to any desired scaling.

For example, when using the analog input viscosity function the numeric variables might be spanned as follows: 4mA=1 (water) and 20mA=100 (more viscous liquid). This spanning configuration allows the meter to use this constant numerical change to improve calibration in real time. The various flowmeter models allow you to associate the analog input to active system variables such as specific gravity, viscosity and others (see table on next page).

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 ⇨	Iin1 ⇨	Input	⇕ Off
				Aux
				S.G.
				cS
			⇕	cP
⇕	⇕	⇕		PSIA
				BARA
				Deg F
				Deg C
			4 mA	*numeric entry*
			20 mA	*numeric entry*
		Iin2/Iin3/Iin4	See Iin1 option list	

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

Setting up the Analog Current Input

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

From Analog Input setup:

To access the [Iin] option list press the <Right Arrow> twice.

To move the cursor down to [Aux (n)] press the <Down Arrow> and then <ENT>. This enables the port to receive an input current. The cursor moves to [4 mA].

To enable numeric entry press the <Right Arrow>. Type a numeric value corresponding to a 4 mA input signal. To store the data press <ENT>. This moves the cursor to [20 mA].

To enable the numeric entry press the <Right Arrow>. Type the numeric value corresponding to a 20 mA input signal. To store the data, press <ENT>.

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

DIAGNOSTIC DATA MENU STRUCTURE

⇨ Diagnostic Data	⇨ Flow Data	⇨ ⇕ Flow
	⇕	Flow Vel F/S
		Total
		Vs m/s
		Signal mV
		Valc %
		Vaer %
		Alarm Status
		Ancal
		HiFlow
		LoFlow
	⇨ Application Info	⇨ ⇕ TN uSec
		TL uSec
		DeltaT nSec
	⇕	Burst/Sec
		% Accepted
		Last Makeup
		Makeup Status
	⇨ Liquid Data	⇨ ⇕ Temp 1
		Temp 2
		Reynolds #
⇕	⇕	Specific Gravity
		Viscosity cP
		Pressure
		Viscosity cS
	⇨ Site Setup Data	⇨ ⇕ fx (drive)
		N (burst length)
		Ltn in
		Vfmax
		Vs max m/s
	⇕	Vs min m/s
		Empty %
		Samples/Cycles
		Max Damping
		Min Damping
		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. The Test Facilities menu provides test/control functions to optimize operation, analyze application conditions and to recover system operation.

```
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          Quad 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	This is a real-time (updated) flow total display in current total units (e.g., KGAL).
Vs m/s	Current liquid sonic velocity (Vs) in m/s. The Vs value depends on the liquid and its temperature. This menu cell allows "fine-tuning" when highlighted. Press the [+] key (coarse adjustment) or the [1] key (fine adjustment) to increase the reading, or the [-] key (coarse adjustment) or the [2] key (fine adjustment) to decrease the reading. ***CAUTION: Incorrect usage will result in reduced accuracy.***
Signal (mV)	Xdcr signal strength (in mV). This is the amplitude of the transittime 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 alarm

AnCal	Flow Rate Simulator for calibrating external devices, etc. Highlight this item then press the Right Arrow to enable numeric entry. Type desired simulated flow rate. Be aware of the units prefix (K, M, etc.). **NOTE: AnCal remains active only while you remain in this menu cell.**
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 Controlotron customer service engineer may ask you to edit these settings during a support session. In such a case, a <Right Arrow> at the menu cell enables numeric entry.

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

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

AnCal

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

Siemens	Dual Path	SITE1
Flow Rate Simulation Control		
Flow GAL/MIN		**120.00**
Flow Vel F/S		**4.23**
Total GAL		**5645.820**
Vs m/s		**1274.33**
Signal mV		**44**
Valc %		**57**
Vaer %		**13**
Alarm Status		**------M--**
AnCal GAL/MIN		**> 120.000**
HiFlow GAL/MIN		**1577.9**
LoFlow GAL/MIN		**-1577.9**
Flow Data		

The M status is asserted due to the method used to simulate flow data.

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

To activate AnCal:

Move the cursor to the [AnCal]menu cell by pressing [⬇][⬆]. 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
% Accepted                      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.
% Accepted	The running tally of accepted and rejected 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. Depending on the 1010 model, Temp 1 & 2, Viscosity cP, Viscosity cS and Pressure are also offered.

LIQUID DATA MENU ITEMS

Temp 1	Current Liquid Temperature
Temp 2	Current Liquid Temperature
Reynolds #	Current Reynolds number
Specific Gravity	Current specific gravity
Viscosity cP	The absolute viscosity of a liquid dynamically measured in centipoise.
Pressure	Derived spanned from analog input.
Viscosity cS	Kinematic viscosity of a liquid measured in centistokes.

```
 Siemens      2 Channel  [1]    Channel 1
 Current Reynolds number

 Temp 1                        78.5
 Temp 2                        50.0
 Reynolds #                    318017
 Specific Gravity              1.000 S.G.
 Viscosity cP                  1.000 cP
 Pressure                      14.5 PSIA
 Viscosity cS                  1.000 cS



 Liquid Data
```

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 transit 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/mm)	Spacing distance between the transducers. It will be in inches or millimeters, depending on default units.
Vfmax	The flow velocity (in selected units) corresponding to one whole cycle offset between upstream and downstream receive signals.
Vs max m/s	Maximum correctly calibrated Vs for current transducer spacing.
Vs min m/s	Minimum correctly calibrated Vs for current transducer spacing.
Empty %	Value of Empty Alarm Setting. The meter will declare an empty status if signal strength drops below this value.
Samples/Cycle	Digital sampling rate.
Max Damping	Maximum signal damping. Use to average digital data when an unstable condition occurs.
Min Damping	Minimum signal damping. Use to average digital data when an unstable condition occurs.
HF	Flow registration correction parameter.

Introduction to [HF] Menu Item

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

Using the [HF] Menu Item

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

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

● This menu is only accessible for the transducer channels, not the virtual (average flow) channel of the flowmeter. (i.e., Diagnostics Path 1 or Path 2, but not Path 1 & 2).

● The 1010 flowmeter will inhibit the "Automatic" installation of the [HF] parameter if the flow rate is insufficient (too low) to accurately measure the required correction. If the maximum flow rate for the application is relatively low then this correction should not be required.

● If the flow rate is very high and the flowmeter is reporting erroneous or unstable flow, then the flowmeter may already be having trouble resolving the upstream and downstream signals. In this event, it may be necessary to first lower the flow rate to a moderate level before performing the "Automatic" HF adjustment. Once this is done the flowmeter should be able to properly measure the highest flow rates without problems.

● The limits of the "HF" parameter are +/- 0.7 and <u>any attempt to manually install a larger value will cause the flowmeter to abort the installation of the parameter.</u>

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

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

● At the [Meter Type] Menu, press the <Right Arrow> and then <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		
Samples/Cycle	29	
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		
Samples/Cycle	29	
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
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 <u>measured</u> 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
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
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.

```
Siemens        2 Channel   [1]      Channel 1
Right arrow invokes an InProcess Makeup

Makeup                      No
Graph                       No
Tx Up                       No
Tx Dn                       No
Fixed ALC                   No
Tx Up Fixed ALC             No
Tx Dn Fixed ALC             No
Graph AutoZero              No


Test Facilities
```

To start a Test Routine:

To scroll the cursor to the test routine press ⬇ ⬆

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

To start the routine press ENT

To end the routine press ⬅

TEST FACILITIES COMMANDS

Makeup	Commands the meter to re-acquire the receive signal.
Graph	Enables an on-screen signal display. To access graph parameters, press <Right Arrow>. Select [Yes]. Press <ENT>. Scroll and press <ENT> to select parameter(s). Press <Left Arrow> to return to graph and view selected parameters.
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	Waveform of the ZeroMatic signal reference.

* 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 ENT to start the makeup routine.

Detection Mode

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 below 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.
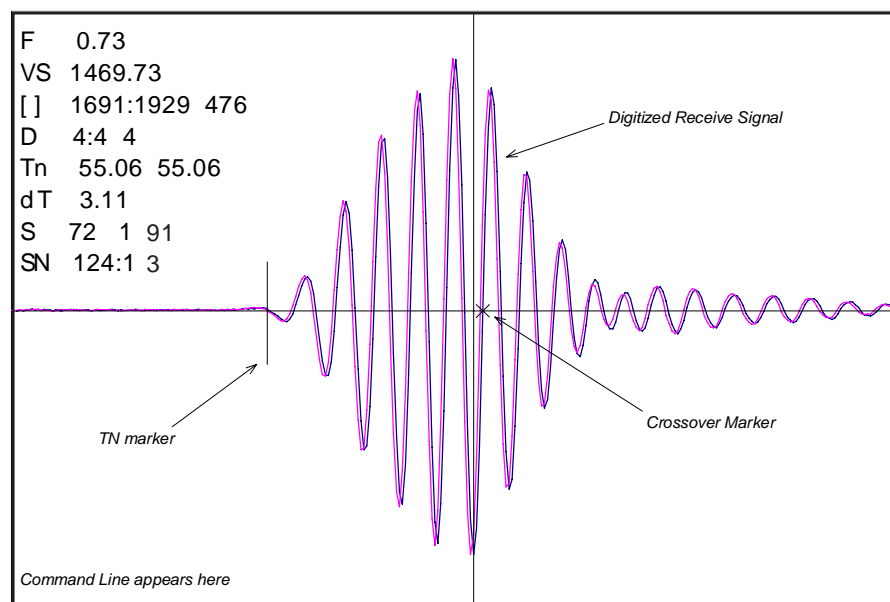
Entering the Diagnostic Graph Screen

Before you can view the Diagnostic Graph Screen the 1010 flow channel must first be properly in-stalled and operating in a non-empty condition (refer to the appropriate 1010 Field manual). If a previ-ously 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 [Diag-nostic 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 individu-ally 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 (Tn) where the 1010 flowmeter perceives the arrival of the ultrasonic signal. There are actually two Tn markers, one for the upstream arrival time and one for the downstream arrival time. For proper liquid sound velocity measurement these Tn markers should be positioned near the beginning edge of the receive waveform 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 Tn mark position press the <3> key on the keypad to bring up the [TnSet] command. Pressing the <+> or <-> keys will cause the Tn marker to move later or earlier, respectively. The change from the default value (in samples) will appear in the number to the right of the command. As you adjust the Tn marker, both Tn and Vs (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.

```
F     0.73
VS    1469.73                                                      Envelope Signal
[ ]   1691:1929  476
D     4:4  4
Tn    55.06  55.06
dT    3.11
S     72  1  91                                                    Envelope Threshold
SN    124:1  3


                                                                  Crossover Marker

        TN marker

   HiSet
```
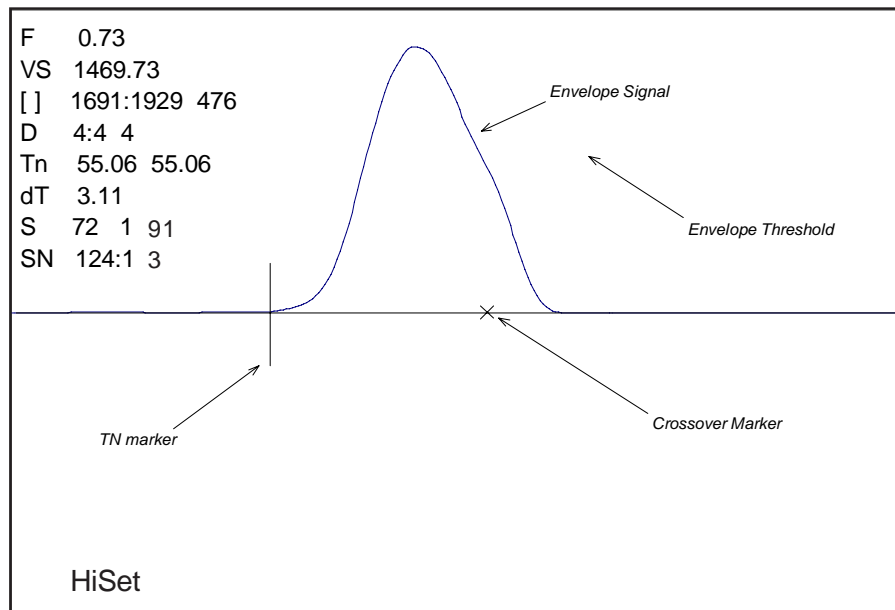
If it appears that the default placement of the Tn marker is incorrect or unstable, it can be adjusted by pressing the <5> key on the keypad to invoke the [EnvSet] command (while viewing the envelope screen). A horizontal line representing the envelope threshold level will appear along with a number 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 intermittant 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 *[Channel Setup➔Channel Enable➔Yes]*. 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 Data? Yes/No
<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	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 [ENT]	Response while trying to recall/delete a site setup when no Sites are stored.
Not Installed	Response to an attempt to access a menu function that is not included.
Re-space Index	Upon measuring the liquid sonic velocity (Vs), the meter recommends re-spacing the transducers to improve performance.
Invalid Setup (use Direct Mount)	During the Initial Makeup, the system detects invalid transducer spacing, erroneous liquid/pipe parameters, or some other factor that prevents it from completing the Initial Makeup. This may be due to one of the following: • An out-of-range data entry. • An invalid condition (e.g., overlapping transducers in Reflect Mode). If selecting Direct Mode does not resolve, review all site setup and transducer installation choices; particularly data entered for the pipe and liquid.

(continued)

MESSAGE	DESCRIPTION
	• In Reflect Mode, the flow computer detects that the pipe wall signal may infringe upon the liquid signal. Use Direct Mode instead. Press <ENT>, <UP Arrow>, <DOWN Arrow>, or <LEFT Arrow> to abort install routine. Continue programming other site data in anticipation of re-solving the difficulty later. Call technical support for help if necessary.
Low Signal - Press [ENT]	During the Initial Makeup, the meter decides that the level of the receive signal is insufficient for proper operation. Some reasons for low signal are: • Invoking [Install Completed?] on an empty pipe. • Coupling compound insufficient, not applied, or evaporated. • A disconnected or broken transducer cable. • You need to condition the pipe at the mounting location. • 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 Mode	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. Appears if the meter cannot complete an Initial Makeup. It means that the pipe and/or liquid conditions do not permit a receive signal that meets the flow detection standards. The system will not be able to operate. Attempt to improve operating conditions by reinstalling the transducers at a different spacing offset, or even at a different location on the pipe. In addition, switching from Reflect to Direct Mount may solve the problem. However, operation may not be possible if there is poor liquid or pipe wall sonic conductivity or extreme liquid aeration.

NOTE: If you receive a Detection Fault message, it is strongly recommended that you con-tact 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 on the next page shows the sequence of the [F4] routine.

```
[Power On/Off + F4] ─────▶ [Clr Active Memory?] ─────┬──▶ No
                                                      └──▶ Yes
                            ▲
                            ▼
                      [Clr Saved Data?] ─────┬──▶ No
                                             └──▶ Yes
```
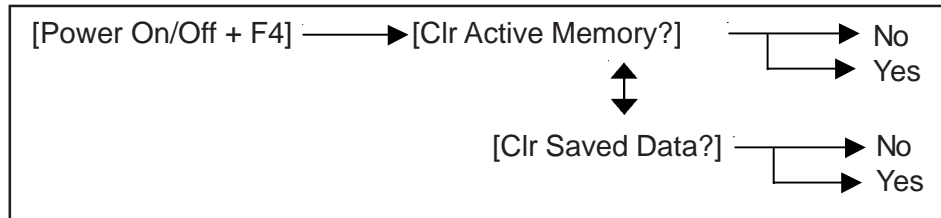
Procedure to clear Active Memory only:

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.

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

To restore operation, press <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 ⬇.

Note that the prompt switches to **[Clr Saved Data? No]**.

To access the F4 Reset option list press ➡.

Press ⬇ 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).

2.11.8   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 flow computer, 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 flow computer and 991 transducers from size 0 to size 3. Note that although the 1010 flow computer operates with our 991 size 4 and 5 transducers, testing of these sizes with a 1010 flow computer is not currently supported.

2.11.9   USING THE 1012TB-1 AND 2 TEST BLOCKS

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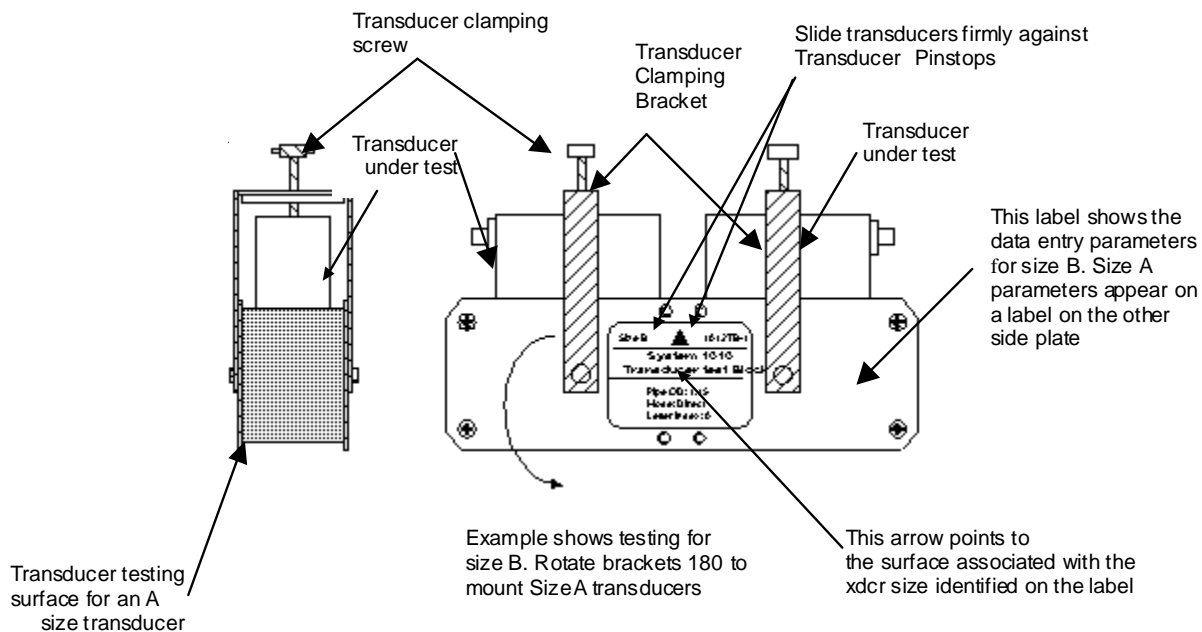
MOUNTING TRANSDUCERS ON A 1012 TRANSDUCER TEST BLOCK

1. 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.

2. 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.

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

4. 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].

5. 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.

6. 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 & 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
1012TB1	A	16.5	Steel*	2.54*	Reflect	Nominal	7
1012TB1	B	29.2	Steel*	2.54*	Direct	Minimum	4
1012TB2	C	50.8	Steel*	2.54*	Reflect	Nominal	11
1012TB2	D	88.9	Steel*	2.54*	Direct	Minimum	Use Ltn

System Defaults

7. 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.

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

9. Move the highlight down to [Install Completed?] by pressing ⬇ . Access the option list. To move the cursor to [Install] press ⬇⬆ . 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 flow 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 **[Diagnostic Data]** menu. The [Valc %] item must be >35 for dependable operation. In addition, note the reading, then compare it to the [Vfmax] item in the **[Diagnostic Data/Site Setup Data]** menu. The value of the reading should be less than 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.

2.11.10 USING THE 996PSP PIPE SIMULATOR

Using the proper coupling compound, mount the transducers on the pipe simulator as shown below. Slide each transducer until it presses against a pin-stop. Use the clamping screws to hold the transducers in place.
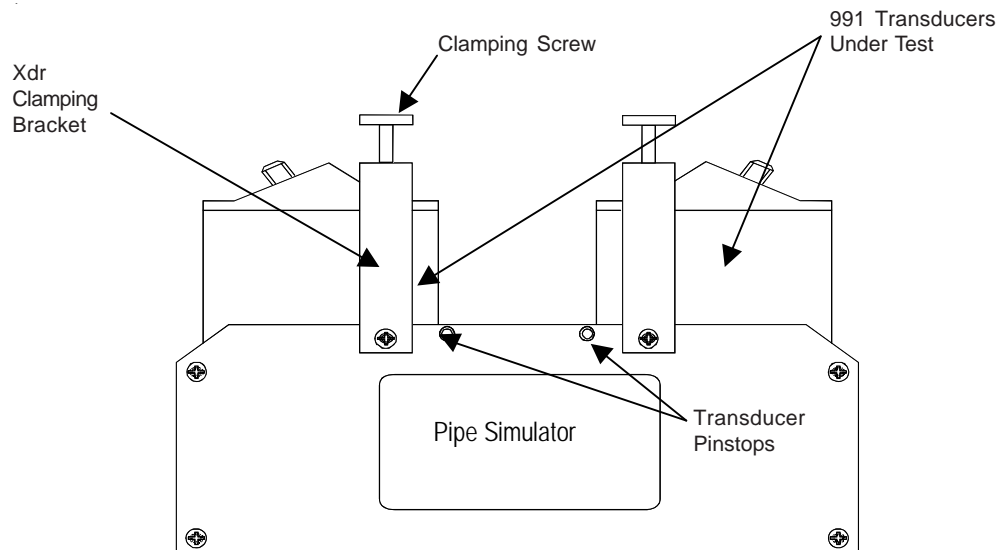
To mount transducers on a 996PSP Pipe Simulator

1. 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.

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

3. 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 the measurement channel you intend to test. Select [Clamp-on] and then [Channel Setup].

4. 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.

5. 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 flow computer generates the Number Index.
** See note below.*

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 flow 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.

6. Access the [Pick/Install Xdcr] menu. Access the [Transducer Model] menu cell. Enter the Transducer Model option list. Select [991 Universal].

7. Check the [Transducer Size] menu cell. If necessary, enter the Transducer Size option list and pick the actual transducer under test.

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

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

10. Check to make sure that the flow 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:

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

2. 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 Siemens for repair.

3. 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.

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

<u>**PROGRAMMING**</u>

❑ 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.

<u>**INSTALLATION/TRANSDUCER MOUNT GUIDELINES**</u>

❑ 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 graph below.

❑ For 1011 Universal Transducers verify "VfMax" is 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 180⁰ 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

<u>Ideal Vsig Display</u>


```
F    0.73
VS   1469.73
[ ]  1691:1929  476
D    4:4  4
Tn   55.06
dT   3.11
S    72   1  91
SN   124:1  3
```

Digitized Receive Signal

Crossover Marker

TN marker

Command Line appears here
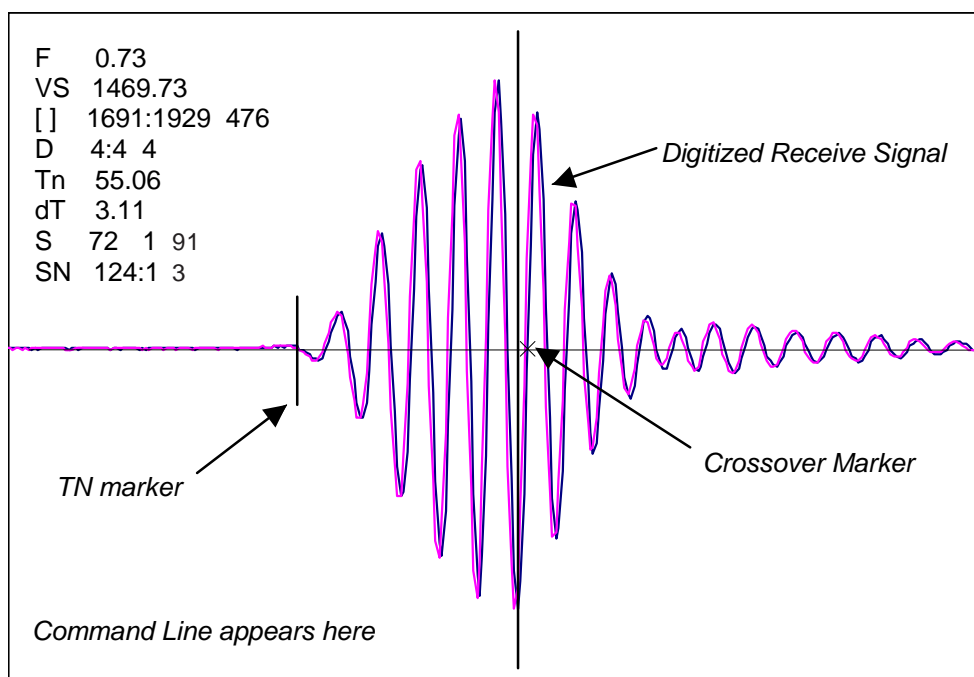
3. HARDWARE INSTALLATION GUIDE

3.1 PREPARING TO MOUNT THE TRANSDUCERS

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

● Selecting a mounting option for your application

● Selecting a location on the pipe

● Preparing the pipe to accept the transducers

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

3.1.1 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:*
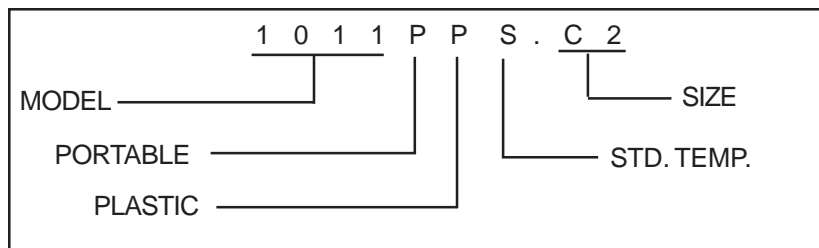
3.1.2 SELECTING A LOCATION FOR CLAMP-ON TRANSDUCERS

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.

Transducer located at 9 o'clock

Transducer located at 3 o'clock

END VIEW
(Horizontal Plane)
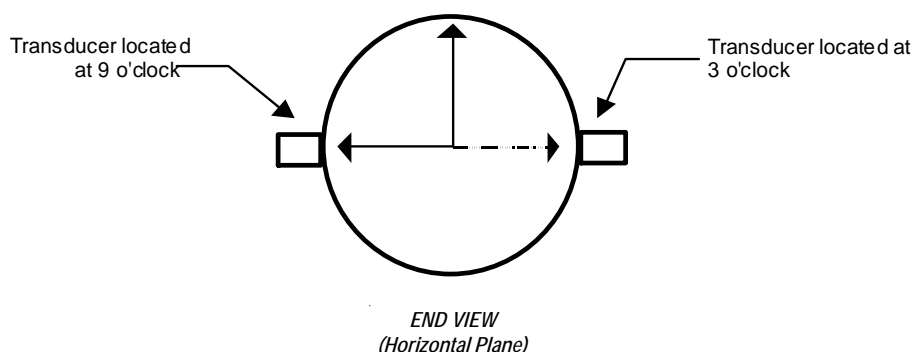
3.1.3   CLAMP-ON TRANSDUCER MOUNTING MODES

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.

Upstream Transducer

Pipe

Downstream Transducer

FLOW

Sonic Path
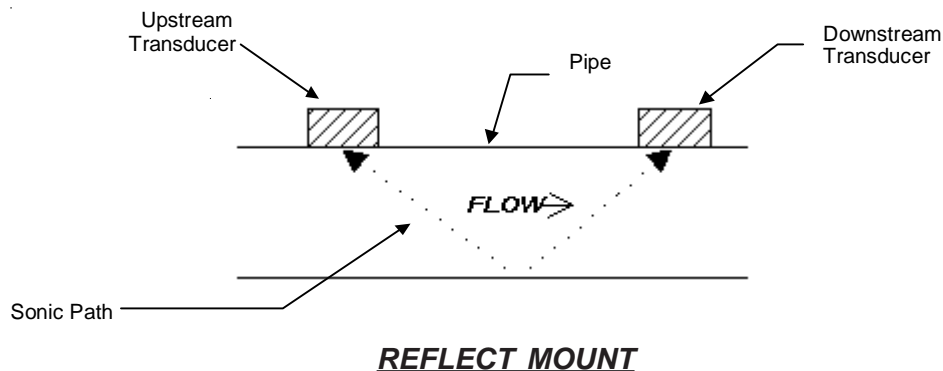
REFLECT MOUNT

(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 stopping flow. 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 can improve 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 mounting length. Therefore, Direct mount may be the only option if the availability of mounting space is limited.
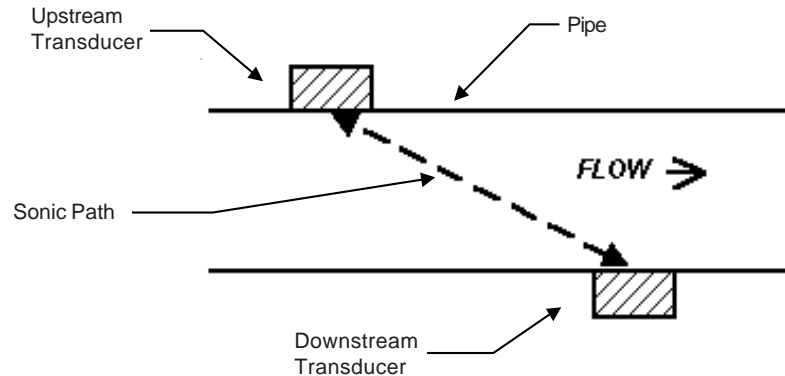
DIRECT MOUNT

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

3.1.4 PREPARING THE PIPE

1. 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.

2. 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.

3. 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.

4. 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.
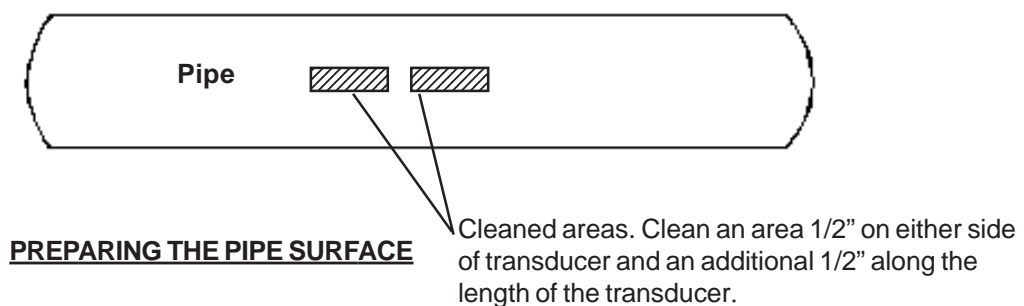
PREPARING THE PIPE SURFACE   Cleaned areas. Clean an area 1/2" on either side of transducer and an additional 1/2" along the length of the transducer.

3.1.5 REFLECT MODE - 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**.**
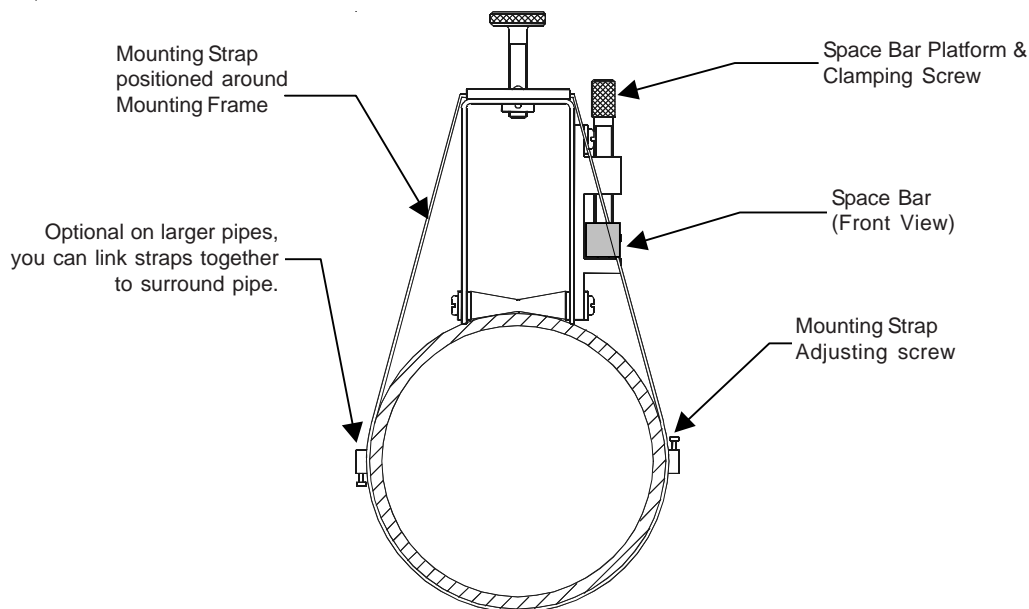
INSTALLATION - REFLECT MOUNT WITH FRAMES AND SPACER BAR
NOTE: Minimum Ltn 0.75 in. (18 mm)
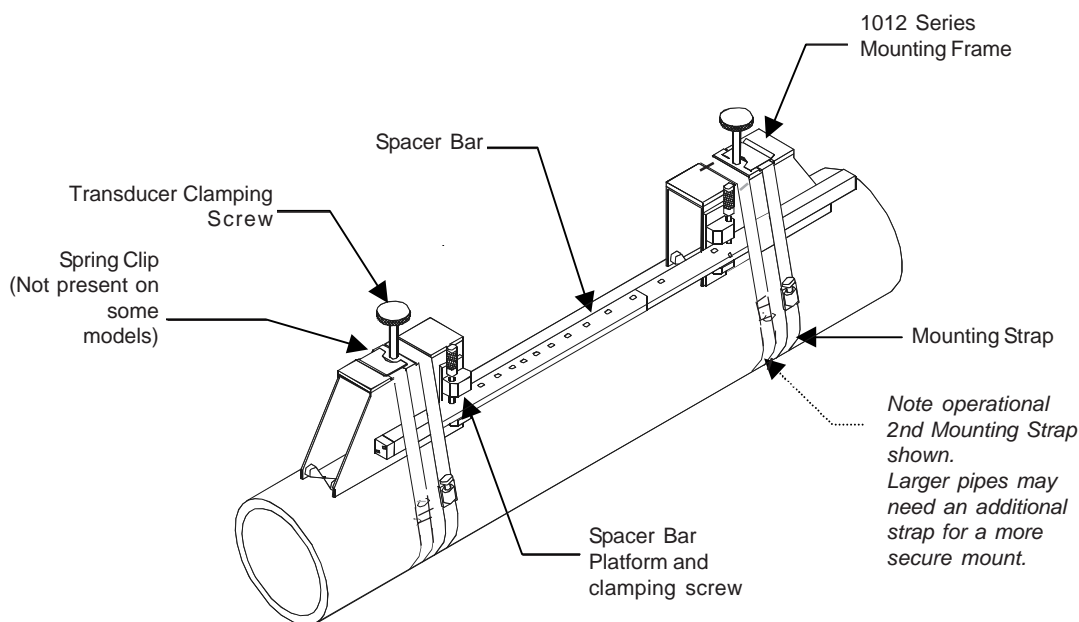
1. Perform all required menu steps until the flow computer issues the number index and prompts you to press [ENT] to finish the transducer install routine. Stop at this point.

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 1010N-7, Single Channel or 1010DN-7 Dual-Channel.

7. You can now press the <ENT> key 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)

3.1.6 REFLECT MODE WITH SPACER BAR ONLY

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

1011 Series Transducer • **Spacer Bar** • **Spring Clip** • **Spacer Bar Number Index Securing Screw** • **Spacer Bar Reference Index Securing Screw** • **Mounting Strap**
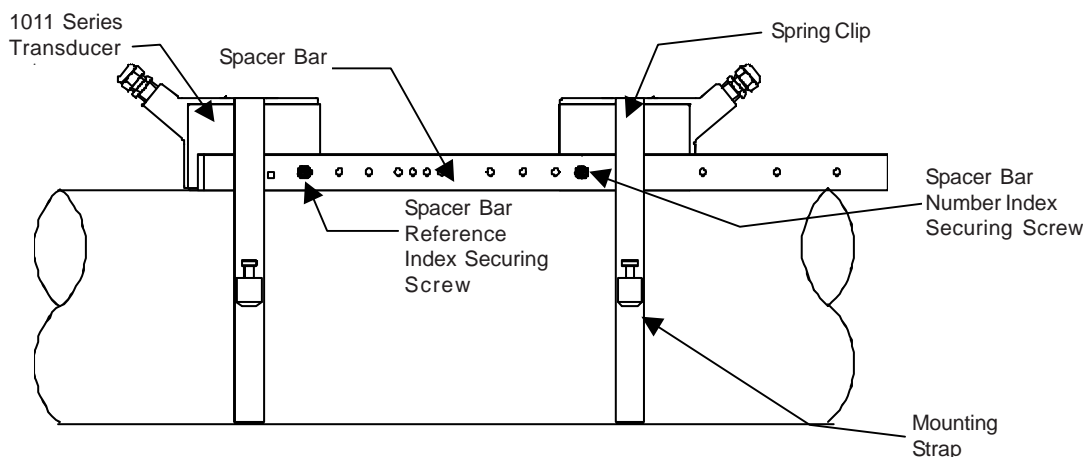
INSTALLATION - REFLECT MOUNT WITH TRANSDUCERS AND SPACING BAR

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" 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.

3.1.7 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.
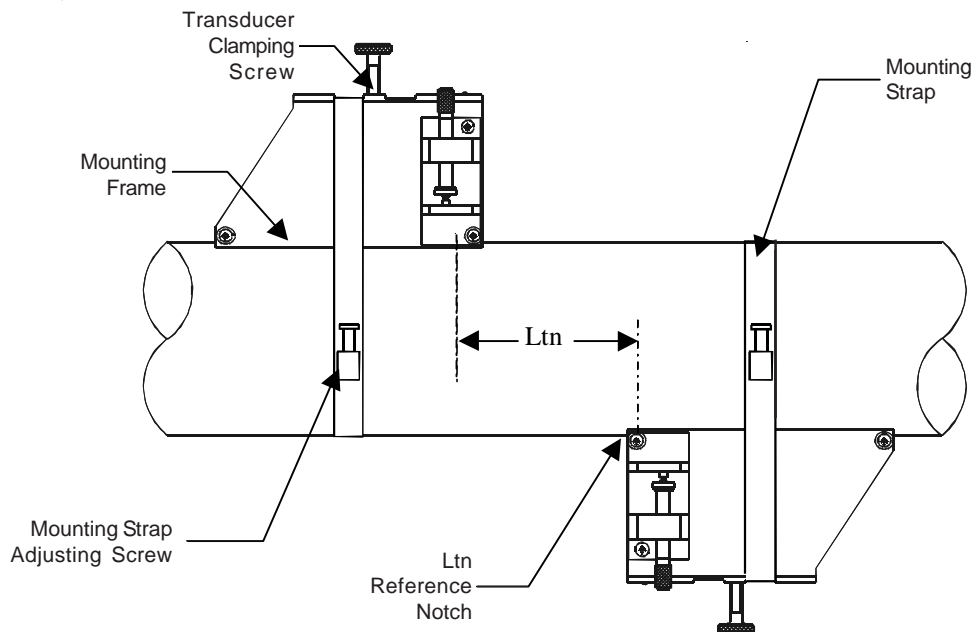
***INSTALLATION - DIRECT MODE WITH TRANSDUCERS, MOUNTING FRAMES
SPACER BAR (*Not Shown*) AND SPACING GUIDE***

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)
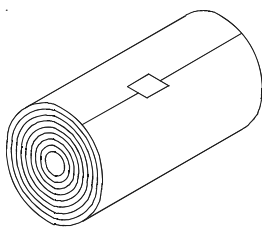
MYLAR SPACING GUIDE

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.

Transducer Clamping Screw

Spring Clip

Mounting Strap

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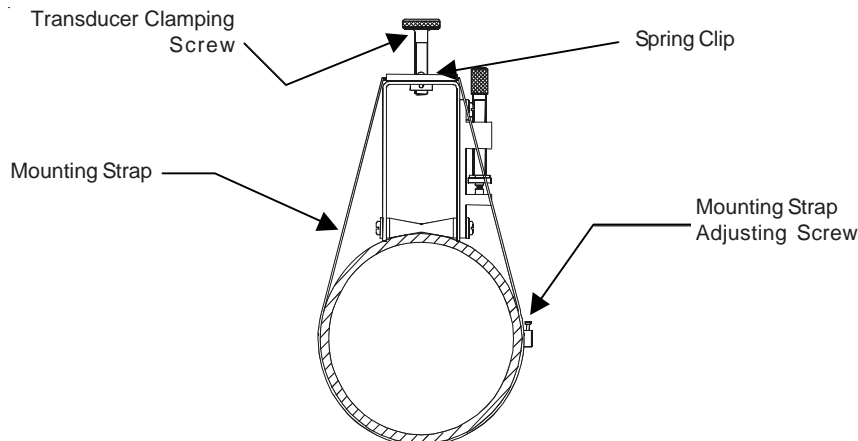
WRAPPING STRAP UNDER PIPE AND ATTACHING TO ADJUSTING SCREW

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

6. Attach the second frame to the spacer bar with an index spacer screw into the index hole specified in Step 1. The angle on the frame should be facing away from the direction the length of the bar is going. Now attach the free end of the spacer bar by inserting an index spacer screw through the REF hole on the spacer bar and then into the hole on the mounted frame. Tighten. Sight to ensure that this frame is lined up in center of pipe and while holding alignment, place a dot (with pencil or

chalk) in the center of the tapered roller at the bottom of the frame (see "A" below). While holding, also mark along the front edge of the frame with pencil or fine chalk line (see B below).
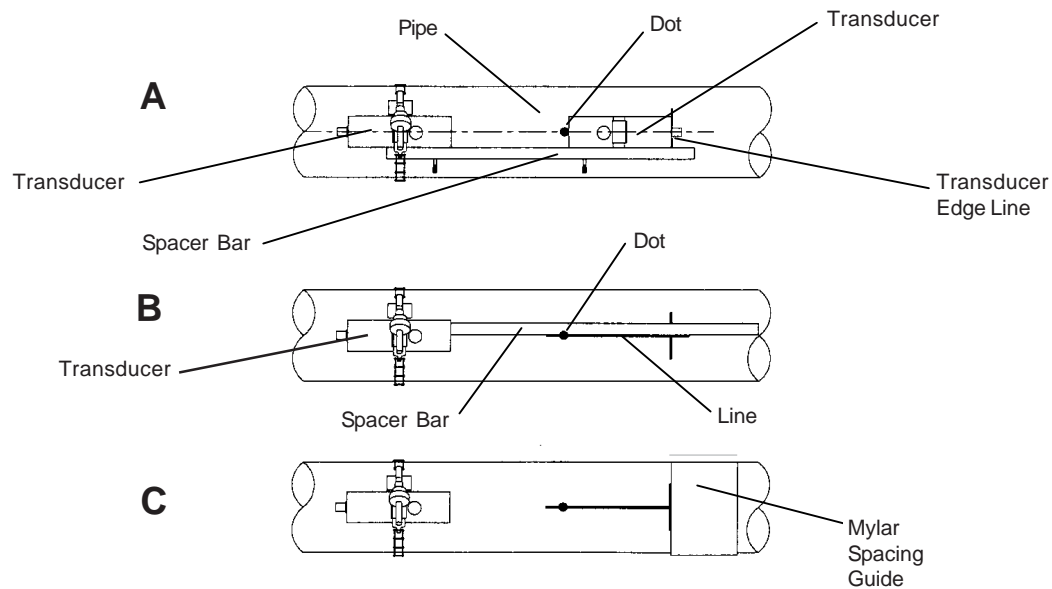
7. Disassemble the spacer bar and the unmounted frame. Use the bar as a straight edge and, with one edge against the mounted frames tapered roller center and the other crossing the dot you drew, draw a line crossing the dot (see "B" above). Set the bar aside.
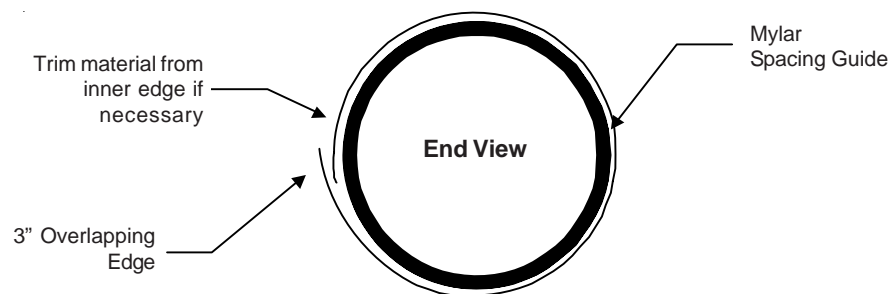
WRAPPING THE MYLAR SPACING GUIDE AROUND THE PIPE

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 be sure not to trim at the overlapping end in order to keep it square*.

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).

SPACING GUIDE

Overlap Edge

Mark (or fold) exactly
at half-way point

CIRCUMFERENCE

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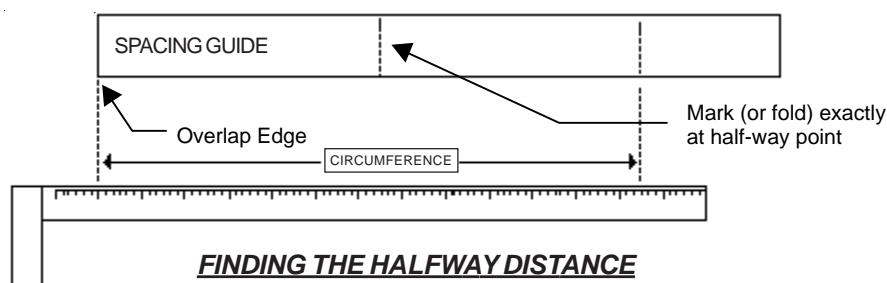
11. Reinstall the spacing guide; its left edge abutting the transducers edge mark on the pipe and the overlapping edge in line with the dot (now a line) on the pipe (see "C" on previous page). Tape it in this position on the pipe. Take the second frame and place it against the edge of the guide with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

9 o'clock
Transducer

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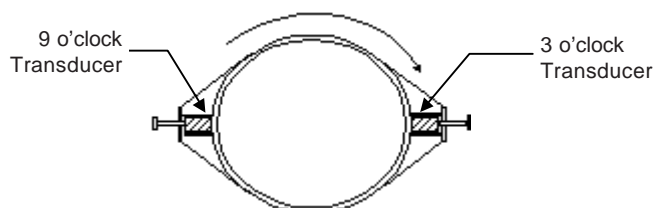
ALIGNING THE TRANSDUCERS FOR DIRECT MODE OPERATION

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

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

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

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

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

17. Return to the menu, and press ENT to finish the transducer install routine.

3.1.8   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 1012TP-7 for reflect mounting of high precision transducers and 1012THP-7 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).

Chain Tension Screw
Upstream Transducer
Transducer Clamping Screw
Downstream Transducer

Flow ➔

Reference Pin Shown Inserted
Track Rail Assembly
Number Index Pin Shown Inserted
Roller Chain

Loop Chain over tension screw hook

Chain Tension Screw

FRONT VIEW ↑
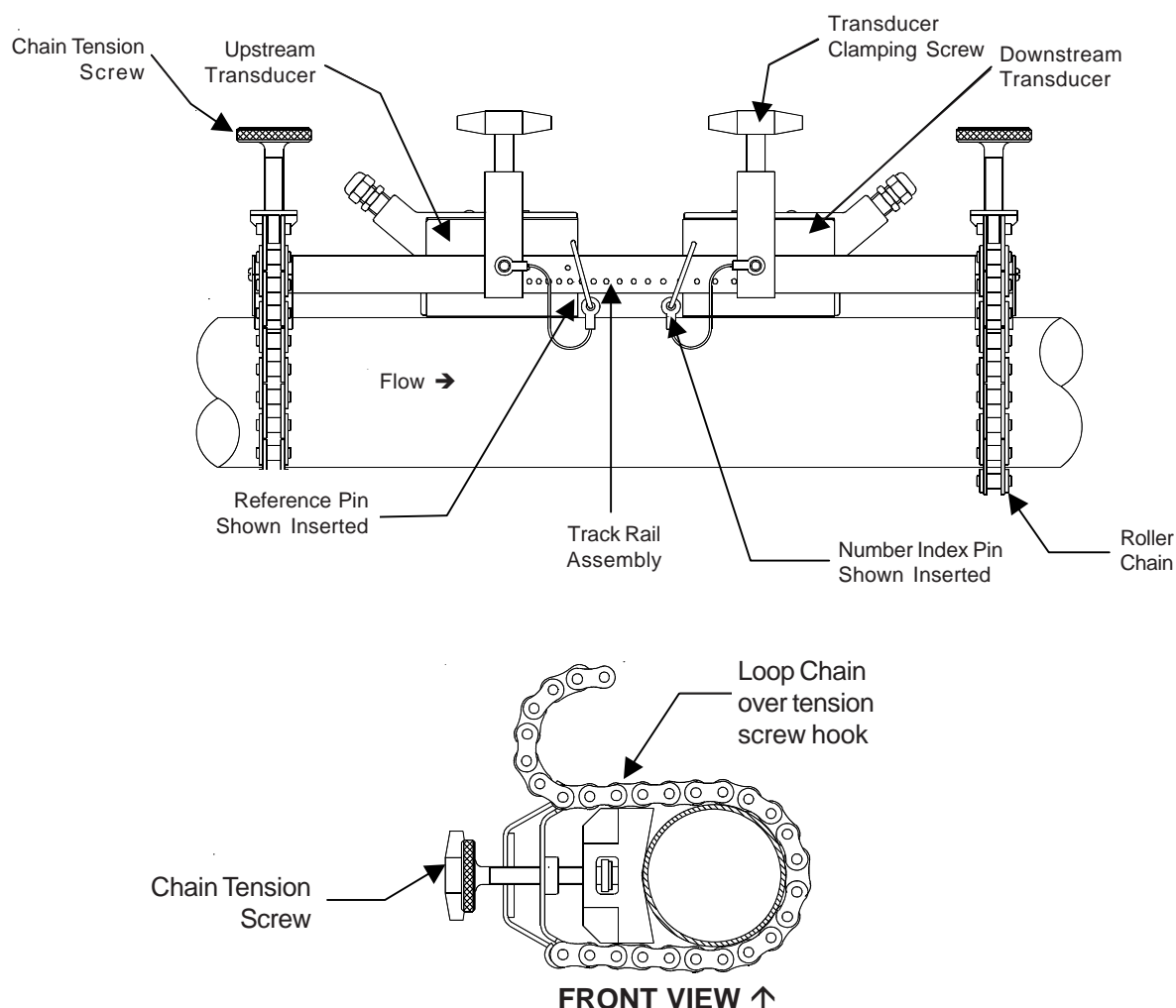
INSTALLATION - REFLECT MOUNT WITH MOUNTING TRACK

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

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

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

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

Installing a 1012T Mounting Track in Direct Mode

Paragraph 2.4 describes the Transducer Installation procedures that lead up to the automatic selection of transducers, mounting mode and spacing method. Shown is a Model 1012T mounting track to accommodate size B3 universal transducers. Examine the figure below which shows a typical Pick/Install Xdcr menu screen. Note the automatic assignment of model numbers for the transducer and mounting track, plus the designation of number index.
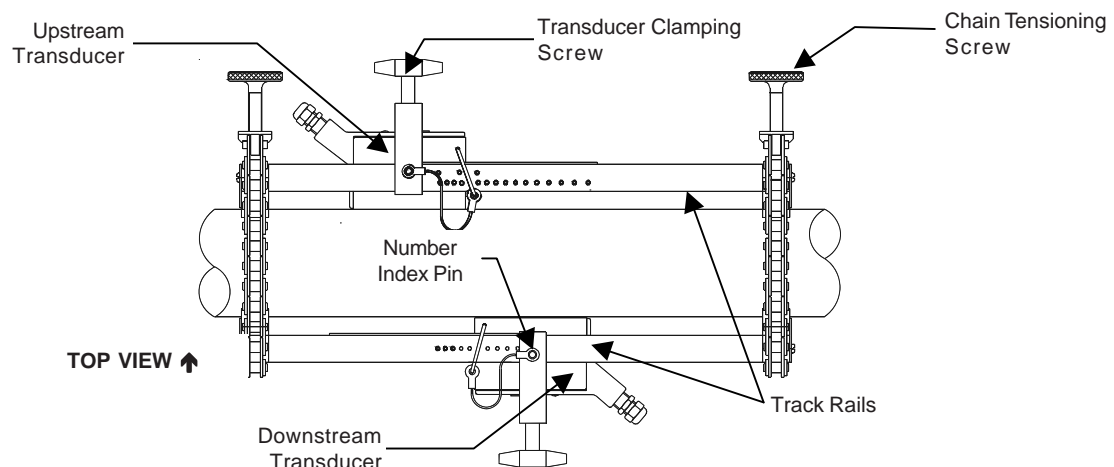
```
Siemens          2 Channel     [1]     SITE1
Key [Install] after mounting transducers

Transducer Model        1011 Universal
Transducer Size         B3
Xdcr Mount Mode         Direct              ←        Note selection of track
Spacing Offset          Minimum                      P/N, Mount Mode and
Number Index            4          ←                 Number Index.
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
```

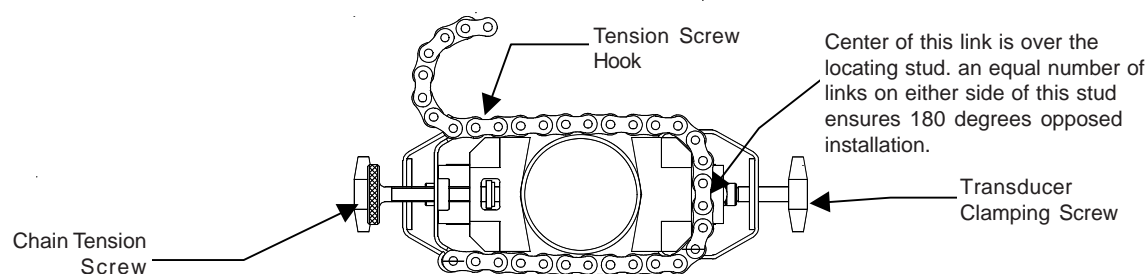1. Perform all required menu steps up until the point where the flow computer prompts you to press ENT to finish the transducer install routine. Note the reported number index.

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

2. The direct mount configuration uses two track rails, one for each transducer, installed 180^0 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).

TOP VIEW ⬆

INSTALLATION – DIRECT MOUNT 180º OPPOSED WITH MOUNTING TRACK

Tension Screw
Hook

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

Transducer
Clamping Screw

Chain Tension
Screw

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

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

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

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

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

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

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

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

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

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

3.2　MOUNTING TEMPERATURE SENSORS

In order to accurately measure temperature differential in energy flow loops, Siemens 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.
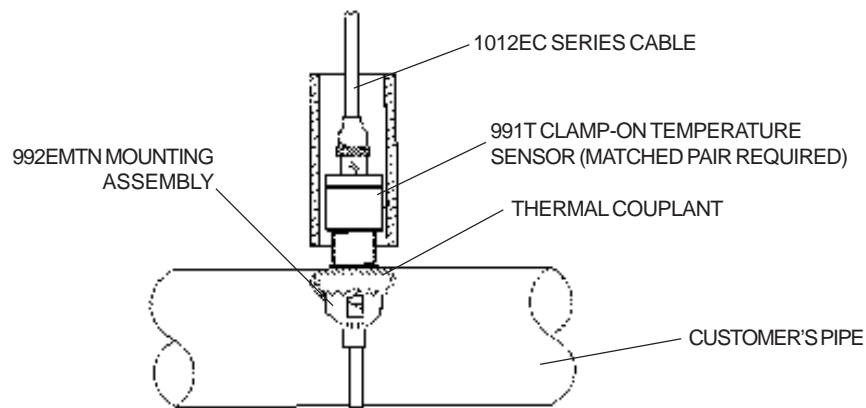
Clamp-on style sensors are mounted on the surface of the monitored pipe using 992EMT series mounting assemblies. Apply a generous quantity of the thermal couplant provided to the tip of the sensor and attach it securely to the cleaned pipe surface with the propermounting assembly. Temperature measurement anomalies resulting from variations in the ambient conditions can be minimized by insulating the pipe and sensor after installation.
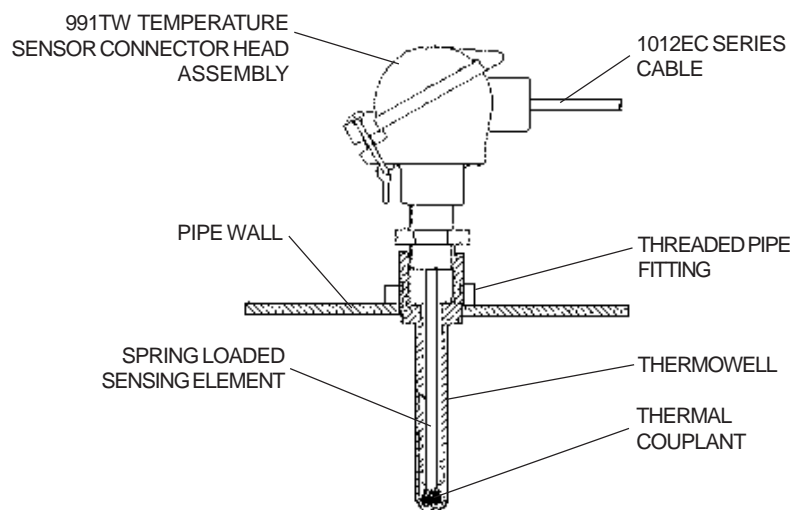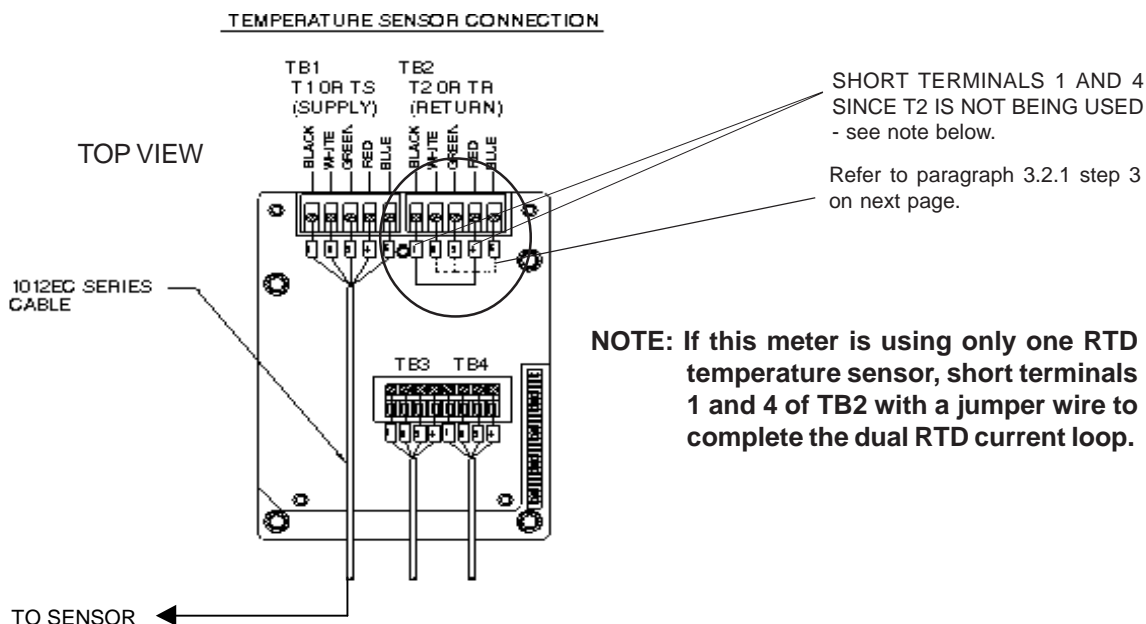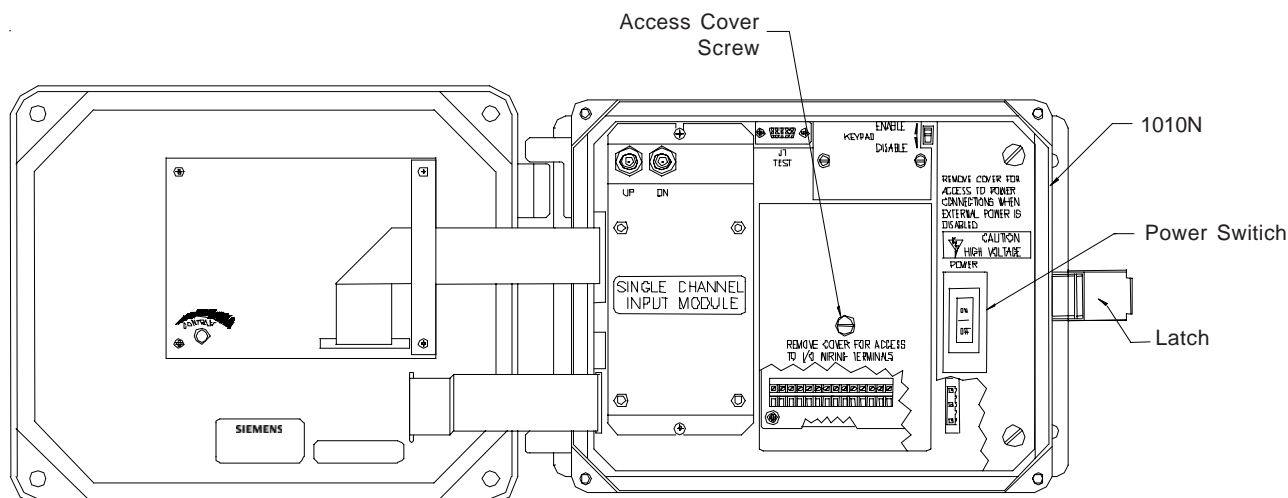
The 991TW insert sensors are designed to be used in pipes equipped with Thermowells. These are spring-loaded, 1/4" diameter sensors with 1/2" NPT integral connection heads, available in several lengths to accommodate a range of pipe sizes. Thermowells for new installations are available from Alloy Engineering Company in Bridgeport, Connecticut.

3.2.1 WIRING TEMPERATURE SENSOR TO THE ANALOG INPUT MODULE

WARNING: Set flowmeter and instrumentation power to OFF when inserting or removing the Analog Input Module, or when making connections to TB1, TB2, TB3, and TB4.

- Open the 1010 NEMA flowmeter top cover by releasing the cover latch.
- Place the power switch to the OFF position.
- Loosen the captive thumbscrew securing the Access Cover and remove Access Cover.
- Using a flat-blade screwdriver, remove four captive screws securing the I/O board.
- Carefully remove the I/O board and set it aside.

NOTE: If this meter is using only one RTD temperature sensor, short terminals 1 and 4 of TB2 with a jumper wire to complete the dual RTD current loop.

1010N Single Channel Temperature Sensor Inputs

● Using a flat-blade screwdriver, loosen Terminal Block TB1 and TB2 screws.

● Connect the wires of the 1012EC Series cable as follows:

1. Connect the RTD liquid temperature cable (1012EC) as shown in the table below:

1012EC SERIES CABLE	TERMINAL TB1
WIRE #1 (Black)	to TB1-1
WIRE #2 (White)	to TB1-2
WIRE #3 (Green	to TB1-3
WIRE #4 (Red)	to TB1-4
WIRE #5 GND/SHLD (Blue)	to TB1-5

2. Complete the temperature sensor current loop by shorting together terminals 1 and 4 of the unused TB2 temperature sensor terminal block.

3. Ground the voltage sensing leads (terminals 2 and 3 of TB2) by connecting them both to terminal 5.

● Tighten all TB1 and TB2 terminal block screws.

● Replace I/O Board and secure with four captive screws.

● Replace Access Cover and finger tighten captive thumbscrew.

3.2.2 1010N SUPPLY AND RETURN CONNECTIONS

Terminals for the supply and return sensor connections are located on the Analog Input Module as previously shown. For other terminal locations on System 1010N Single Channel and Dual Channel units, see drawings 1010N-5-7 or 1010N-5D-7, respectively. For terminal locations on Multi-Channel units, see drawing 1010N-8M-7.

WARNING: Set flowmeter and instrumentation power to OFF when inserting or removing the module, or when making connections to TB1, TB2, TB3, and TB4.

1010N Dual Channel Temperature Sensor Inputs
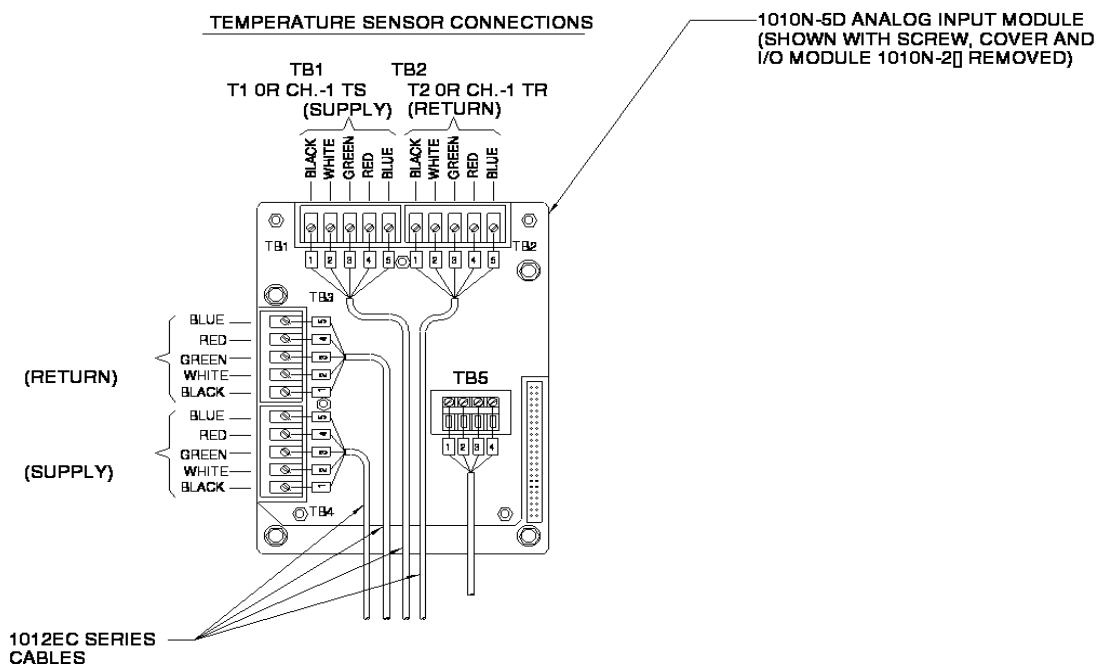
3.2.3   NOTES ON SYSTEM 1010 ANALOG INPUT MODULES

Single Channel Models

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

Dual Path Models

● Dual Channel flowmeters report both T1 and T2 as generic variables for both channels.

● The Dual Channel unit uses T1 for liquid temperature for Channel 1 and T2 as liquid temperature for Channel 2.

● The Dual Path instrument uses T1 to report liquid temperature. (Note that T2 is used to report ambient temperature in some Leak Detector systems.)

● The Analog Input of temperature takes priority over the built-in RTD (Resistive Thermal Device) measurement of temperature.

● If you want both channels of a Dual-Channel meter to sense a single RTD, short TB1/2 to TB2/2 and TB1/3 to TB2/3. This allows the same voltage to be fed to both channels. Once that is complete, you must close the RTD current loop by connecting TB1/4+5 to TB2/4+5. (Note: TB5 is just the cable shield.)

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

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

● Prepare the pipe surface by removing paint to expose bare metal and by smoothing out any remaining rough spots.

● Use the thermal couplant compound (CC#117) between the face of the RTD element and the pipe surface to improve the conductivity of the metal-to-metal contact.

● Keep the RTD out of direct sunlight or other non-pipe sources of heat or cold that may affect their temperature sensing. The foam insulator supplied helps in this regard, but consider using additional pipe insulation for all installations exposed to extreme ambient conditions. Consider mounting the RTD under the pipe in order to keep it out of direct sunlight.

● In installations where RTD elements are exposed to harsh conditions such as condensation, salt spray, etc., use CC#110 couplant compound to coat the connection between the cable and the RTD sensor. Consult Installation Drawing 991TN-7 for details.

● 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 1010 menu; either supply or return.

3.2.5 PARALLELING RTD INPUTS FOR DUAL-CHANNEL ENERGY MEASUREMENT
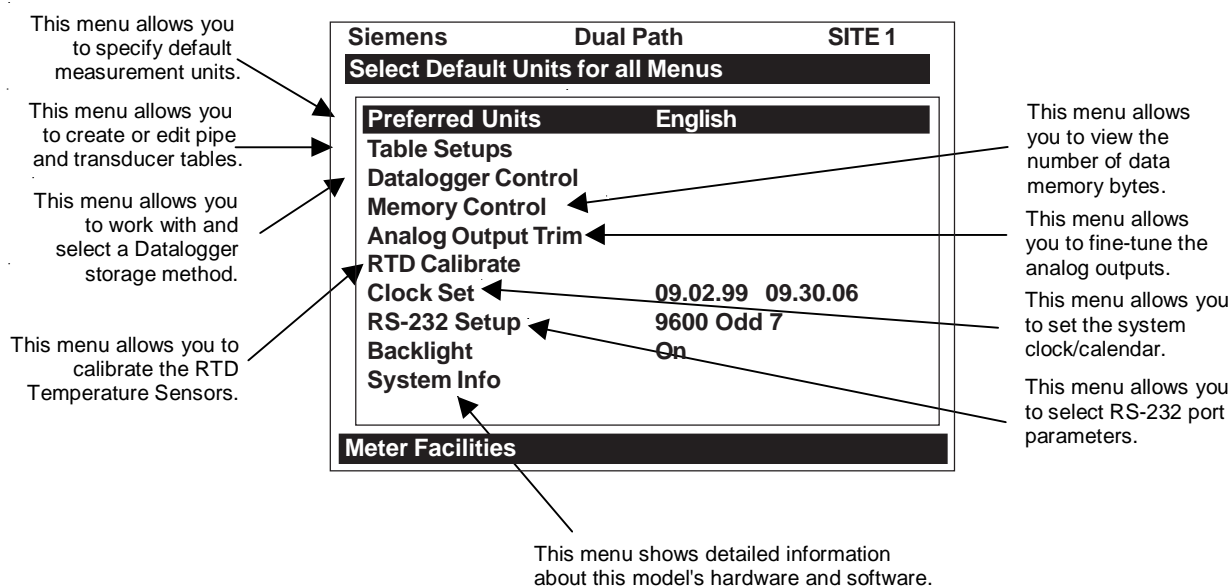
Should you wish to measure liquid flow in the same pipe twice (perhaps at the supply and return location of the line) but not redundantly have to measure the temperature, the following information may prove helpful:

● Connect terminal #2 of terminal blocks TB1 and TB2 together and terminal #3 of TB1 and TB3. You can use any available hookup wire to do this. By doing this, you are not shorting terminals 2 and 3; just interconnecting 2/2 and 3/3 of each terminal block.

● Connect terminal #2 terminal blocks of TB2 and TB4 as well as Terminal #3 of TB2 and TB4. This hookup will result in the same temperature being reported for Tr and Ts for channels 1 and 2 of the meter. It probably is a judicious idea to check the temperature to ensure that they do indeed match. Of course, Td will be similarly identical. These temperatures can be checked in Diagnostics/Energy Data.

● Be sure to accurately indicate where the flow is being measured in the "Location" item of the 1010 menu; either supply or return.

4. THE METER FACILITIES MENU AND GRAPHIC DISPLAY SCREEN

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

- 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.

This menu allows you to specify default measurement units.

This menu allows you to create or edit pipe and transducer tables.

This menu allows you to work with and select a Datalogger storage method.

This menu allows you to calibrate the RTD Temperature Sensors.

Siemens	Dual Path	SITE 1
Select Default Units for all Menus		

Preferred Units	**English**
Table Setups	
Datalogger Control	
Memory Control	
Analog Output Trim	
RTD Calibrate	
Clock Set	**09.02.99 09.30.06**
RS-232 Setup	**9600 Odd 7**
Backlight	On
System Info	

Meter Facilities

This menu allows you to view the number of data memory bytes.

This menu allows you to fine-tune the analog outputs.

This menu allows you to set the system clock/calendar.

This menu allows you to select RS-232 port parameters.

This menu shows detailed information about this model's hardware and software.

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 [ENT]

4.2   THE TABLE SETUPS MENU

The Table Setups menu allows you to pre-condition your pipe table and transducer types. The edits made in Table Setups become the default settings for creating a new site. Transducers "marked" in the Transducer Types menu will be preferentially selected when the meter recommends transducers during the automatic Pick/Install Transducer routine.

To access the Table Setups menu press

| Table Setups | ⇨ ⇕ | Pipe Table |
| | | Transducer Type |

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**	⇕ 1CS40	⇕ 1P40
		2SS10	1CS80	1P80
		3SS10	2CS40	2P40
		4SS10	2CS80	2P80
		6SS10	3CS40	3P40
		8SS10	3CS80	3P80
		Metric DN Steel	4CS40	4P40
		⇕ 50DN	4CS80	4P80

(continued)

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

PIPE TABLE MENU STRUCTURE *(continued)*

Create/Edit Pipe ⇨	Choose Pipe Name ⇨	↕ 100 DN 200 DN 400 DN 800 DN	↕ 6CS40 6CS80 8CS40 8CS80	↕ 6P40 6P80 8P40 8P80
		⇨ Metric SGP Steel	10CS XS	10P XS
		↕ 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	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	10P40 12P STD 12P XS 16P STD 16P XS 18P STD 18P XS 20P STD 20P XS 24P STD 24P XS 30P STD 30P XS 36P STD 36P XS
			⇨ Cast Iron Table ↕ 6" cls C 10" cls C 12" cls C 16" cls C 20" cls C ⇨Ductile Iron Table ↕ 6" cls 52 8" cls 52 10" cls 52 12" cls 56" 16" cls 52 24" cls 52	⇨ 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
	Outer Diameter (in) ⇨	x.xxx *(numeric entry)*		
	Wall Thickness ⇨	x.xxx *(numeric entry)*		
	Liner Material ⇨	↕ None Cement Coal Tar Enamel Glass Plastic HDPE Teflon Rubber		
	Liner Thickness ⇨	x.xxx *(numeric entry)*		
Delete Pipe ⇨	Choose Pipe Class ⇨	*See Create/Edit Pipe		
	Choose Pipe Name ⇨	*See Create/Edit Pipe		

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.

<u>An example of how to use the Create/Edit Function:</u>

To access the Create/Edit menu press [⇨]

To access the Pipe Class option list press [⇨]

Scroll the option list to a class that provides the closest match to your pipe press ⬇️⬆️

To select the Pipe Class press `ENT` . This moves the highlight to Choose Pipe Name.

To access the Pipe Name option list press ➡️

Scroll the option list press ⬇️⬆️ to a pipe name and press `ENT` 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 `ENT` to store the OD. The highlight moves to Wall Thickness.

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

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

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

To use a new name, press ➡️ and then use the appropriate arrow keys to rename the pipe (8 chars. Max.). Press `ENT` . 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 a pipe table. We recommend that you use this function only to delete pipes that you have added so as to preserve the factory presets.

To delete a Pipe from the Pipe Table

To access the Delete Pipe menu press ➡️ . To access the Pipe Class option list press ➡️

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

To select the Pipe Class press `ENT` . This moves the highlight to Choose Pipe Name.

To access the 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 `ENT`

4.3   TRANSDUCER TYPE MENU

During the Transducer Install procedure, System 1010 analyzes the entered pipe and liquid data, then automatically generates a list of the transducer sizes most suited for the application.

The Transducer Type menu allows you to place "marks" next to any transducers that you may want the meter to consider preferentially during its recommendation routine. These transducers will be included on the recommended list, which appears from on the reverse-video prompt line at the top of the display screen. The left-most transducer on the list is the most applicable while the right-most transducer on the list is the least applicable.

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
⇕		B3H
	⇕	C1H
		C2H
		D1H
		D2H
		D3H
		D4H
	991 Universal ⇨	⇕ 0A
		0
		1
		2
		2A
		3
	⇕	3A
		4
		4A
		5
		5A

<u>To mark Transducers:</u>

Access the Transducer Type menu by pressing [⇨]

Scroll the highlight by pressing [⇩][⇧] to a transducer type (e.g., 1011H High Precision) then press [⇨] to access the size option list.

Scroll the option list by pressing [⇩][⇧] and then press [ENT] to "mark"desired transducers. Note that a plus sign (+) appears before each "marked" transducer.

If you want to clear a "marked" transducer, move the highlight to the transducer then press [CLR] 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 due to the data compression scheme employed. Note that this is only available for dual-channel systems. The [Est Log Time Left] menu view-only menu cell shows an estimate of the hours and minutes of logging time remaining. This only applies to non-circular datalogging. Selecting Circular memory blanks this field. For convenience sake, the Display Datalogger command is essentially a duplicate of the menu cell in Datalogger Setup. It sends Datalogger data to the graphic screen with or without line wrapping. For dual-channel systems with logging enabled on both channels, a screen dump from menu will show data from both channels. The Output Datalogger command sends data to an external device via the RS-232 serial port. Data transmitted from this menu will be from both channels of a dual-channel system. The Clear Datalogger command erases the entire Datalogger file. For dual-channel systems, you are cautioned not to use this command if your intention is to clear the logged data of only one channel.

> 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] by pressing [⬇] [⬆]

To view Datalogger contents press ENT

To return to Datalogger Control press MENU

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] (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. Siemens offers the model 996P portable serial printer. You must use the proper cabling between the flow computer and the external device. In addition, you must configure the RS-232 Setup 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.

NOTE: The meter suspends flow measurement while it transmits serial data.

To send Datalogger contents to the RS-232 Serial Port:

Check the flow computer-to-external device connections and your RS-232 Setup parameters (see RS-232 Setup).

To access the Output Datalogger option list press ⇒

Scroll the cursor to [Yes] by pressing ⇓ ⇑

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

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 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 ENT

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 ENT

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.

MEMORY CONTROL MENU

Data Memory Left	⟹	⬇ XXXXX
Memory Map	⟹	⬇ Yes
		No
Defragment	⟹	⬇ No
		Yes

Data Memory Left: This view only menu cell shows the minimum remaining number of characters available for Datalogger and site storage. When the Datalogger is enabled for circular mode, the meter allocates all of memory except for two conventional empty sites worth for datalogger use.

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

Defragment: Selecting YES for this item consolidates memory data blocks into contiguous storage; collapsing the filler regions. You may be able to use an additional block for site or datalogger storage as a result. Use this command if you seem to be out of memory even though the Data Memory Left item indicates free capacity.

To view the amount of data memory bytes available press

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 Convertor (DAC).

To access the Analog Output Trim menu press

ANALOG OUTPUT TRIM MENU STRUCTURE

Analog Output Trim ⇨	Io1 (Io2) ⇨ ⇕	Operate
		Trim @ 4mA ⇨ *Indicated mA = x.xx*
⇕	⇨ Vo1 (Vo2) ⇨ ⇕	Operate
		Trim @ 2V ⇨ *Indicated V = x.xx*
	⇨ Pgen1(Pgen2) ⇕	Operate
		Trim @ 1kHz ⇨ *Indicated Hz = xxxx*

4.5.2 CURRENT OUTPUT TRIM (Io1 & Io2)

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

To calibrate a current output (Io1 or Io2):

Set up the multimeter to read Amps, then connect it to the supply and return terminals of the current output under test.

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.

Re-check the multimeter to make sure that it is now reading 4mA.

4.5.3 VOLTAGE OUTPUT TRIM (Vo1 & 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 supply and return 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 ENT 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.

Re-check the multimeter to make sure that it is now reading 2.00 Volts.

4.5.4 PGEN OUTPUT TRIM (Pgen 1 & 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 supply and return terminals of the pulse rate output under test.

Move the highlight to the port to be tested ⬇️⬆️ , press ➡️ , then press ⬇️ to move the cursor to Trim @ 1kHz.

Press ENT . This triggers a 1 kHz pop-up window. The frequency counter should now be reading 1 kHz.

If the frequency counter reading does not match, use the numeric keys to type in the frequency counter reading.

Press ENT to register setting. This adjusts the meter's DAC (digital-to-analog converter so that a 1 kHz output corresponds with 1 kHz on the frequency counter.

Re-check the frequency counter to make sure that it is now reading 1 kHz.

4.6   THE RTD CALIBRATE MENU (optional)

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

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

To access the RTD Calibrate menu press ➡️

RTD CALIBRATE MENU STRUCTURE (Single Channel 1010)

RTD Calibrate ⇨	RTD 1 ⇨	⇕	Factory User Cal
	RTD 2 ⇨	⇕	Factory User Cal

4.6.1 RTD CALIBRATION BY DATA ENTRY

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

To enter the current RTD temperature

Move the highlight to the RTD you want to calibrate (RTD1 or RTD2).

To access the RTD option list press ⟮→⟯.

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

> **Calib @ deg F**
> **=32.0**

To enable numeric entry press ⟮→⟯, then type in the reading of the reference thermometer (e.g., 72.0).

> **Calib @ deg F**
> **=72.0**

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

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

4.6.2 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 costantly.

Move the highlight by pressing ⟮↓⟯⟮↑⟯ 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 ⟮ENT⟯. This triggers the pop-up window.

When you are sure that the RTD Sensor is at 32ºF (0ºC), press ⎹ENT⎸ to recalibrate the RTD 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**

4.7   THE CLOCK SET MENU

The Clock Set menu allows you to set the time and date. The meter uses its internal clock/calendar to record the real-time when certain data and diagnostic events occur. In addition, the clock/calendar provides the Datalogger and Stripchart date and time stamps.

CLOCK SET MENU STRUCTURE

Clock Set	Date	xx.xx.xx *(date entry)*
	Time	xx.xx *(time entry)*

> **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's datalogger reports are Y2K complaint using an industry standard algorithm to form a 4 digit year field.

4.7.1 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, 1997 by typing 12.07.97. You can use the <Right Arrow> to move the cursor back to a number if you need to re-type it. Press the <CLR> key to remove the current setting.

To set the Date:

To enable numeric entry press ⟶

Use the Numeric keys to type the date (MM.DD.YY).

To store the date press ⎹ENT⎸ . This moves the cursor to [Time].

4.7.2 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 the <Right Arrow> to move the cursor back to a number if you need to re-type it. Press the <CLR> key to remove the current setting.

To set the clock:

To enable numeric entry press ⊡

Use the numeric keys to type the time (HH.MM).

To store the time press ⊡**ENT**⊡ . This moves the cursor to RS-232 Setup.

4.8   RS-232 SETUP

Use the RS-232 Setup menu to set the operating parameters of the serial I/O port. Settings include baud rate, parity, data bits, line feed, network ID number and waiting period before a RTS time-out. Only activate the RS-232 output if you intend to transmit serial data. This will avoid burdening the system with unnecessary data transferals while it is performing flow computations.

**NOTE: The RS-232 stop bit implementation is fixed. If you are using a communication pro-
gram, such as Windows 3.xx Terminal or Windows 95/98/NT/2000/XP HyperTerminal,
that includes a field for stop bits, select 1 stop bit.**

RS-232 SETUP MENU STRUCTURE

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

4.8.1 BAUD RATE

The Baud Rate menu cell sets the asynchronous serial transmission data transfer rate of the RS-232 port. It provides a selection of standard baud rates up to 38,400 baud. The selected baud rate must match the baud rate setting of the receiving external device. The factory-set baud rate is 9600.

To change the Baud Rate:

To access the Baud Rate option list press ⊡

Move the cursor to the required baud rate by pressing ⬇️⬆️

To store selection press ⏹ENT⏹. This moves the cursor to [Parity].

4.8.2 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 by pressing ⬇️⬆️

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

4.8.3 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 ⏹ENT⏹ to store data. This moves the cursor to [Line Feed].

4.8.4 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 the Line Feed to [OFF]. This instructs the flow computer to send a carriage return character without adding a line feed to avoid creating an additional blank line after each carriage return. Setting the Line Feed to [ON] tells the flow computer to insert a line feed character after each carriage return that it transmits. This may be necessary to avoid the constant "wrapping" of transmitted data onto a single line. The factory setting is [NO] (line feed disabled). Note that the 996P portable printer requires [NO].

To enable (or disable) Line Feed:

To access the Line Feed option list press ➡️

Press ⬇️⬆️ to move the asterisk to [Yes] Line feed enabled, or [No] Line feed disabled.

To store the data press `ENT` . This moves the cursor to Network ID.

4.8.5 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 `ENT` . This moves the cursor to RTS Key Time.

4.8.6 RTS KEY TIME

During a serial transmission session, you can select how long the flow computer holds its *request-to-send* line high until it receives a *clear-to-send* signal. If the RTS time expires, the 1010 will return its RTS line low and abort the transmission attempt. Data entry units are *seconds.* The default RTS key time is 0.2 seconds.

NOTE: The RTS Key Time function is only provided when the meter's network ID number is non-zero.

To set the RTS Key Time:

To access the RTS Key Time option list press ⇨

To move the asterisk to the required RTS time press ⬇ ⬆

To store the data press `ENT`

4.9 BACKLIGHT

This menu cell allows you to specify how long you want to maintain the backlighting for the LCD Graphic Display. Select [On] for continuous illumination. Press the <Right Arrow> to access the option list and then scroll to desired time delay (before turn-off).

Press `ENT` to store your setting.

4.10 SYSTEM INFO

This menu provides general information about the flowmeter.

System Info Menu Structure

Version	This is the meter's operating system version number. The Technical Services Group may request this number during consultations.
Reset Date/Time	Shows the date and time of this meter's last <F4> reset.
Op System P/N	Meter's operating system part number.
Checksum	Operating System verifying code. The Technical Services Group may request this number during consultations.
Code	Software Compile Date/Time. Operating System identifier. The Technical Services Group may request this number during consultations.
System Time	Use to set system time and date. Format: xx.xx.xx xx.xx.xx

4.11   THE 1010 GRAPHIC DISPLAY SCREENS

The 1010 family Graphic Display Sub-System is a versatile resource which provides visual access to all system variables and conditions. Depending upon your selection, details of the display my vary, but all elements are always clearly labeled with units and variable names. You're always free to move through the displays by using the arrow keys. The meter will hold the last display selected indefinitely or until the menu is selected by pressing the <Menu> key. When you again leave the menu, the last selected display will be shown upon your return.

After completing the Site Setup, Check your local display screen to ensure that everything is operating properly. The meter begins to measure flow as soon as you complete the transducer installation.

When you press |MENU| to leave the menu, you will see the hybrid digital display screen (see page 4-17). Note that it includes a <u>digital flow, total numeric display and a Stripchart.</u>

<u>The StripChart Contains a number of special elements that deserve mention:</u>

● *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 dis-played 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.*

Selected
Measurement
Channel

Measured Sonic
Velocity (in m/s)

Signal Strength

Select Meter Type
(Dual Channel Flow)

Site Name

Digital Average
Volumetric Flow

Percent of
Aeration
Detected

Siemens   2 Channel   [1]   Unit #1

FLOW: GAL/MIN   **Vs   ALS   AER**

Active Alarm

HI/LO

68.10

1286   63   2

Totalizer Mode (NTOTAL)

NTOTAL: GAL

112.38

Digital Flow Total

30.0

Vs

G/M

-30.0

11.40

9/26   12:45

Strip Chart
Data (Vfo)
Volumetric
Flow Rate

Date & Time

Instantaneous
Flow Rate

Stripchart
Alarm Cursors

Stripchart
(Flow History)

To switch the screen to the "big digits" display press

Selected Meter Type
(Dual Channel Flow)

Selected
Measurement
Channel

Site Setup Name

Siemens   2 Channel   [1]   Unit#1

FLOW GAL/MIN   100.0

14.35

Percent of
Span Bar
Graph Display

Vfo
(Volumetric Average
Flow Output)

Flow Total

TOTAL   GAL   Vs
                1427
354.6597

Vf

0.0
31.74

Instantaneous
Volumetric
Flow Rate (%)

Measured Sonic
Velocity

You can press   to scroll between the available display screens.

4-17

UNIT #1	0.65	
FLOW GAL/MIN		FLOW GAL/MIN
9.73		11.01
TOTAL GAL		TOTAL GAL
75.30		97.04
- - - - - - - - - 17.12		09/28

Dual Display Screen

Siemens	2 Channel [1]	Channel 1
FLOW GAL/MIN		89.68
	0.20	
TOTAL KGAL	Vs	Vfo
0.12	1474	G/M
		0.00

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 1010 APPLICATION NOTES

System 1010 is an extremely versatile transit-time flowmeter that operates with either non-intrusive clamp-on or in-line (non-wetted) flow transducers. Please review the following application guidelines to obtain the best service from this equipment.

System 1010 provides a simple menu-driven interface for site programming. During the installation procedure, you tell the system what you need it to do. It will then verify the pipe and liquid conditions, and based on your selections, optimize its operation automatically. However, the system cannot protect itself from critical data entry errors that you input. Its performance depends on the accuracy of the information that you provide it.

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

5.1   TO OBTAIN TECHNICAL ASSISTANCE

Our Technical Service Group provides assistance upon request. You can obtain toll-free assistance from 8:30 until 5:00 o'clock EST by calling 800-275-8480. In addition, you can request help via e-mail by contacting the Siemens Technical Service Group at TSG.ultrasonicflow@siemens.com. The meter's computer provides comprehensive diagnostics data. Using this data, our Engineers can analyze the system in relation to the application in detail. Proper analysis will provide solutions to virtually any application problem.

5.2   CONSIDERATIONS FOR CRITICAL APPLICATIONS

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

System 1010 flowmeters automatically compensates for adverse flow conditions to achieve extremely high accuracy. This requires following the instructions for proper equipment selection, use of the correct clamp-on transducer or flow tube configuration, and paying close attention to installation instructions. Such judicious use implies expert equipment knowledge and experience, plus a thorough understanding of flow conditions.

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

5.3   PIPE CONSIDERATIONS FOR CLAMP-ON TRANSDUCER

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

5.3.1 PIPE DIMENSIONS

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

5.3.2 PICKING THE APPROPRIATE TRANSDUCER

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

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

NOTE: Transducer pairs must have matching serial numbers.

5.3.3 FLOW VELOCITY RANGE

System 1010's flow velocity range with clamp-on transducers is at least ±40 ft/sec regardless of the diameter of the pipe. Depending on application conditions, this range can extend to over 100 ft/sec. This measurement range is greater than needed for virtually any application. For optimum accuracy at very low flow rates and for small line sizes, consider using our 992DFT or 1011FT flow tubes.

5.3.4 OVERVIEW OF SYSTEM PERFORMANCE

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

within specifications depends primarily on the receive signal's signal-to-noise ratio and amplitude. The information 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 (Vs) errors will usually reveal this problem and by simply returning to the appropriate menu cells, entering the correct values, and 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 Drift.*

Data Scatter

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

System 1010 does not exhibit inertia since it has no moving parts. In addition, it takes readings ten times per second. Therefore, it can detect and track very brief flow fluctuations that are beyond the response capability of some conventional meters. This performance level is required for detecting very fast and short flow transients or for a fast-response servo control loop application. However, you can use the damping and slewing controls to smooth the output response if you want the system to ignore rapid flow fluctuations or data scatter.

Data Drift

Drift is a defined as a long-term cyclical flow deviation resulting from the variation of liquid temperature or liquid sonic velocity. Drift may be more noticeable when combined with a poor signal-to-noise ratio. System 1010 is carefully designed to minimize the effects of drift. There are no drift-prone analog phase-locked loop devices in the primary detection circuits. In addition, we use only the most stable plastics or steel to construct our transducers.

5.4 FLOW CONDITIONS

Very rarely are real-world flow conditions uniform and predictable. Therefore, the 1010 operating system provides a considerable degree of control over the stability/agility of the flow rate output. System 1010 is significantly more agile in tracking pressure wave induced Vs transients, and will recover from mistracking more quickly and smoothly than any other competing transit-time flowmeter.

5.4.1 LOW FLOW RATES

Our 1010 Systems provide a flow resolution and measurement range that surpasses any other type of flowmeter. Therefore, it operates superbly for low or high flow rate applications. However, with our clamp-on systems, using the highest resolution when measuring a low flow rate may cause natural data scatter to become a high percentage of the reading. Since it is data scatter, it will not contribute any error to a totalizer reading accumulating for at least several minutes. However, if the flow rate is extremely low (e.g., under 0.25 ft/sec) the minute zero drift retained by the system may cause an observable performance decline. Therefore, if your application involves extremely low flow velocities, and your line size is 2" or under, our 992DFT or 1011FT Flow Tubes might serve you best.

5.4.2 FLOW DATA SCATTER & DAMPING

The transit-time flowmeter's ability to respond to the extremely fast flow fluctuations that characterize "real" flow may surprise you. Most conventional flowmeters cannot detect these rapid flow fluctuations since they are subject to unavoidable mechanical inertia. System 1010's response speed is ideal for tracking fast flow transients. However, if this performance is unnecessary, you can smooth the System 1010's response time to suit any application.

System 1010 Damping and Slewing Controls

System 1010 can detect and display minute flow fluctuations that are always present, though not usually detectable by typical flowmeters. This rapid response accommodates applications that require the tracking of fast flow transients.

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

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

5.4.3 NOTES ON LIQUID CONDITIONS

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

Most liquids are excellent sonic conductors, regardless of their electrical or optical properties. Although highly viscous liquids exhibit a greater degree of sonic attenuation, System 1010 operates perfectly with the vast majority of these liquids. The *Valc %* (signal strength) item on the Diagnostic Menu is a good indicator of this condition. A low value (under 30) indicates a possible low liquid sonic conductivity, or improper transducer installation.

5.4.4 ERRONEOUS LIQUID PARAMETER SPECIFICATION

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

5.4.5 LIQUID COMPATIBILITY

Since our clamp-on transducer systems never contact liquid, the issue of liquid compatibility only applies to entrained gases or mineral solid content that might impair sonic signals Since System 1010 is designed to measure flow using both transit-time and Reflexor™ techniques, we can safely say that it will operate most successfully on virtually all liquids.

5.4.6 AERATION

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

System 1010 can operate successfully with a larger amount of aeration than any other transit-time flowmeter. It measures and reports the aeration level as the analog output, *Vaer %.* This represents the relative degree of aeration detected within the flow stream. Its computer reports the Vaer level until it impedes operation and forces a Fault Alarm. The Vaer output accommodates applications requiring an aeration indicator. The Vaer also appears on the display screen. The aeration percentage can be used as an alarm relay set-point. You can set the aeration alarm setpoint such that it trips before aeration reaches a level that impairs flow measurement.

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

5.4.7 SLURRIES

High-density undissolved solids (e.g., sand slurry) may cause application problems if present in suffi-cient 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 conduc-tivity.

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 1010N MEMORY RESOURCES

System 1010N's memory resources include both Read-Only-Memory (ROM) and battery-backed Ran-dom Access Memory (RAM). The ROM memory contains the system operating instructions, on-line help text, default data, and the pipe, transducer and liquid tables.

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

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

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

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

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

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

The 1010 also offers a Memory Map and Defragmenting command in the Meter Facilities area of the menu as an aid in visualizing and maximizing the efficient utilization of your meter's memory resources.

5.6   REFERENCE TABLES

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

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

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

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

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

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

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

(continued)

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 FACTOR

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

TERMINOLOGY CHART

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

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

(continued)

TERM	EXPLANATION
Local Display	Refers to the 1010N'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 retreive a particular Site by selecting its name from a site name list.
Site Setup	A collection of parameters used by the meter to service a specific site (or location).1010 allows you to store several independent Site Setups.
Site Storage Memory	Section of RAM allocated for permanent data storage. This memory segment stores inactive site setups (including a backup of active site). The meter's Site Setup storage capacity depends on the dynamic memory allocation as dictated by each application. In addition, the 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 NEMA DUAL-CHANNEL MENU CHART

This section shows the 1010 Permanent Dual Channel Menu Chart. The Dual Beam Flow, Ch 1+2 Flow, Ch 1-2 Flow Channel Setup menus are virtually identical. The Reflexor and Flow Tube menus repeat the Clamp-On menu, except for the exclusion of menu cells only appropriate for clamp-on transducers.

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

THE METER TYPE MENU

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

THE METER FACILITIES MENU

Meter Facilities ⇨	⇨ Preferred Units	⇨ English Metric		
	⇨ Table Setups ⇕	⇨ Pipe Table ⇕	⇨ Create/Edit Pipe ⇕	⇨ Choose Pipe Class Choose Pipe Name ⇕ Outer Diameter (in) Wall Thickness (in) Liner Material Liner Thickness
			⇨ Delete Pipe	⇨ Choose Pipe Class ⇕ Pick Pipe Name
		⇨ Transducer Type ⇕	⇨ 1011 Universal ⇕ 1011H High 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		
	⇨ Analog Output Trim ⇕	⇨ Trim Io1 ⇨ Trim Io2 ⇨ Trim Vo1 ⇨ Trim Vo2 ⇨ Trim Pgen 1	⇨ Operate Trim @ 4mA ⇨ Operate Trim @ 4mA ⇨ Operate Trim @ 2V ⇨ Operate Trim @ 2V ⇨ Operate Trim @ 1Khz	

(continued)

METER FACILITIES MENU *(continued)*

Meter Facilities ⇨	Analog Output Trim ⇨	Trim Pgen 2 ⇨	Operate
			Trim @ 1Khz
⇨	RTD Calibrate ⇨	RTD-1 ⇨	User Cal. / Factory
	⇨	RTD-2 ⇨	User Cal. / Factory
	⇨ Clock Set ⇨	⇕ Date	
		Time	
	⇨ RS-232 Setup ⇨	⇕ Baud Rate	
		Parity	
⇕	⇕	Data Bits	
		Line Feed	
		Network ID	
		Rts Key Time	
	⇨ Backlight ⇨	ON, 30 sec, 1 min, 2 min, 3 min, 5 min, 10 min	
	⇨ System Info ⇨	⇕ Version	
		Reset Date/Time	
	⇕	Op System P/N	
		Checksum	
		Code	

THE CLAMP-ON MENU

⇨Clamp-On	⇨ Channel Setup	⇨⇕ Recall Site Setup				
		Channel Enable				
	⇕	Create/Name Site				
		Site Security				
		Delete Site Setup				
		Save/Rename Site				
	⇨ Pipe Data	⇨⇕ Select Pipe Class				
		Select Pipe Size				
		Pipe OD (in)				
	⇕	Pipe Material				
		Wall Thickness				
		Liner Material				
		Liner Thickness				
	⇨ Application Data	⇨Liquid Class	⇨Select Liquid			
			⇕ Estimated Vs m/s			
		⇕	Viscosity cS			
			Density S.G.			
		⇨UniMass Table	⇨Disabled			
			⇨Constant Temp	Create/Edit Table	Table Point	New
					Vs	xx.xxx
⇕					Temperature	xx.xx
				⇕	S.G.	xx.xx
					Viscosity (cS)	xx.xx
			⇕		Accept ⇨	Yes
						Clear Pt.
	⇕			Clear Table	No/Yes	
			⇕	Table Active	Yes/No	
			⇨Constant Vs	Create/Edit Table	Table Point	New
					Vs	xx.xxx
					Temperature	xx.xx
				⇕	S.G.	xx.xx
			⇕		Viscosity (cS)	xx.xx
					Accept ⇨	Yes
						Clear Pt.
				Clear Table	No/Yes	
				Table Active	Yes/No	
			⇨ Changing Temp & Vs	Table Active	Yes/No	

(continued)

THE CLAMP-ON MENU *(continued)*

➪Clamp-On	➪ Application Data	➪ Temp Range ⇕	➪⇕ -40F to 250F -40F to 375F -40F to 450F	
		➪ Pipe Config (Change to Up- stream Piping) ⇕	➪⇕ Fully Developed 1 Elbow Dbl Elbow + Dbl Elbow - Valve Expander Reducer Norm Entry Header Inlet Intrusions	
		➪ Anomaly Diams	xxxx (numeric entry)	
		➪ 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
			➪ Deadband Control	➪ x.xx (numeric entry)
			➪ Memory/Fault Set	➪ Fault/Memory
			➪ Memory Delay <sec>	➪ xxx (numeric entry)
			➪ 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 Totalizer Mode Batch/Sample Total	
		➪ Data Span/Set/Cal	➪ Span Data ⇕ ⇕	➪⇕ Max Flow (Units) Min Flow (Units) Max Vs m/s Min Vs m/s Max S.G. Min S. G. Max Viscosity cS Min Viscosity cS Max Temperature Min Temperature
			➪ Set Alarm Levels ⇕	➪⇕ High Flow (Units) Low Flow (Units) High S.G. Low S.G. High Viscosity cS Low Viscosity cS High Temperature Low Temperature

(continued)

THE CLAMP-ON MENU *(continued)*

⇨Clamp-On	⇨Data Span/Set/Cal	⇨ Set Alarm Levels ⇕	⇨⇕	Interface Vs m/s Aeration % Makeup Latch
	⇕	⇨Calibrate Flow Rate ⇕	⇨⇕	Intrinsic Kc MultiPoint
	⇨ Stripchart Setup ⇕	⇨ Select Data ⇕Data Display Time Base Stripchart Clear		
	⇨ Application Data ⇕	⇨ Datalogger Setup ⇕	⇨⇕	Datalogger Mode Datalogger Data Log Time Interval Datalogger Events Display Datalogger
	⇨ I/O Data Control ⇕	⇨ Analog Out Setup ⇕	⇨⇕	Io1/2 Vo1/2 Pgen1/2
		⇨ Relay Setup ⇕	⇨⇕	Relay 1 Relay 2/3/4
		⇨ Analog Input Setup	⇨	Iin1 / Iin2 (Optional Function)
	⇨ Diagnostic Data	⇨ Flow Data ⇕	⇨⇕	Flow Flow Vel F/S Total Vs m/s Signal mV Valc % Vaer % Alarm Status AnCal HiFlow LoFlow
⇕		⇨ Application Info ⇕	⇨⇕	TN uSec TL uSec DeltaT nSec Burst/Sec % Accepted Last Makeup Makeup Status
		⇨ Liquid Data ⇕	⇨⇕	Temp 1/2 Reynolds # Specific Gravity Viscosity cP Pressure Viscosity cS
	⇕	⇨ Site Setup Data ⇕	⇨⇕	fx (drive) N (burst length) Ltn in Vfmax Vs max m/s Vs min m/s Empty % Samples/Cycle Max Damping Min Damping HF
		⇨ Test Facilities ⇕	⇨⇕	Makeup Graph Tx Up Tx Dn

(continued)

THE CLAMP-ON MENU *(continued)*

⇨ Clamp-On	⇨ Diagnostic Data	⇨ Test Facilities	⇨ ⇕ 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

This extremely versatile in-line transit-time flowmeter system has proven to be a valuable tool for servicing the following applications listed below. Be aware though that only the models 1010FTN and 1010AN meters are equipped to utilize flow tubes.

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 COMPATIBILITY

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

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

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

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.

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

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

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

   ·   A throttling valve or other source of cavitation.

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

   ·   The discharge of a positive displacement pump.

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

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

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

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).

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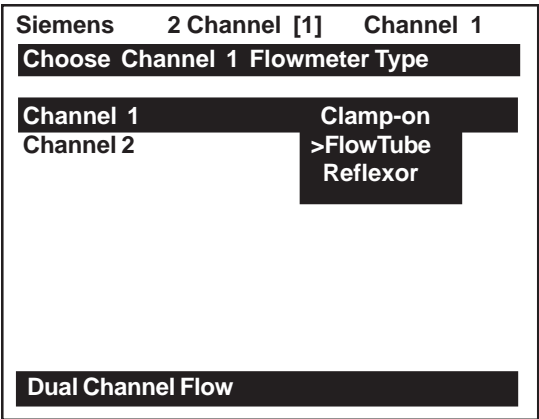
To select Flow Tube press [ENT]. This enables the Flow Tube menu. Press [→] to access Channel Setup menu.

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

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



Channel Setup
```

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 Security           Off
 Delete Site Setup       No Sites
 Save/Rename Site



Channel Setup
```

To create a new site and register the site name press ENT : 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         1S
 Install Completed?      No
 Empty FlowTube Set      Chan Not Setup
 Zero Flow Adjust        Chan Not Setup




Install FlowTube
```
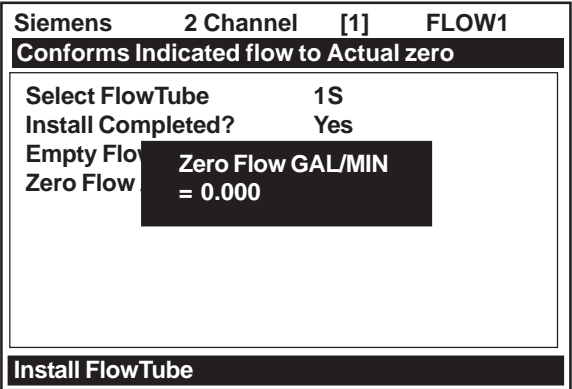
To access the Flow Tube option list press ➡ . Note that this list shows the currently available flow tube sizes. The number is the size (e.g., 1). The letter represents the material (e.g., S = Steel, P = PVC, T = Teflon, K = Kynar). In this example, we will install a size 1S Flow Tube. This 1011FTP-1S (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 ENT . This moves the highlight to [Install Completed?].

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

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 ENT . 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 DE-SIRED OFFSET.***

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

  Select FlowTube          1S
  Install Completed?        Yes
  Empty Flo┌─────────────────────────┐
  Zero Flow│ Zero Flow GAL/MIN       │
           │ = 0.000                 │
           └─────────────────────────┘




Install FlowTube
```

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

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

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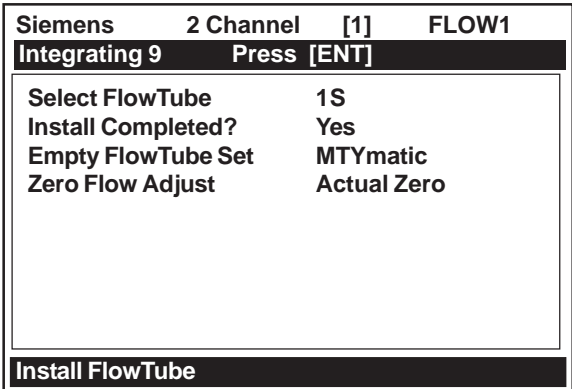
When this routine is finished, the cursor moves to [Operation Adjust]. The flowmeter will be measuring flow. Press `MENU` to leave the menu.

A pop-up window prompts you to save the site. Do so by pressing ➡, then `ENT`. 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	¾" FPT

6.5   SPECIFICATIONS – KYNAR PVDF FLOW TUBE

Typical values, subject to change without notice.

	Size 1	Size 2
Liquid	Must be compatible with PVDF under operating conditions and free of suspended gasses or solids.	Must be compatible with PVDF under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.28 psi @ 1.5 GPM (5.7 LPM) flowing water at 68°F	0.24 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.006 LPM)
Linearity	1% of flow for rates above 0.09 GPM (0.34 LPM)	1% of flow for rates above 0.27 GPM (1.0 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.0013 GPM (0.005 LPM)	±0.003 GPM (0.011 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 5 GPM (95 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Connection	$3/8$" FPT	$3/4$" FPT

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

Typical values, subject to change without notice

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

ADDITIONAL INSTALLATION NOTES

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

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

INLET (Use Swagelok Tube Fitting)

OUTLET (Use Swagelok Tube Fitting)

Mounting Bracket

Flow Direction Indicator
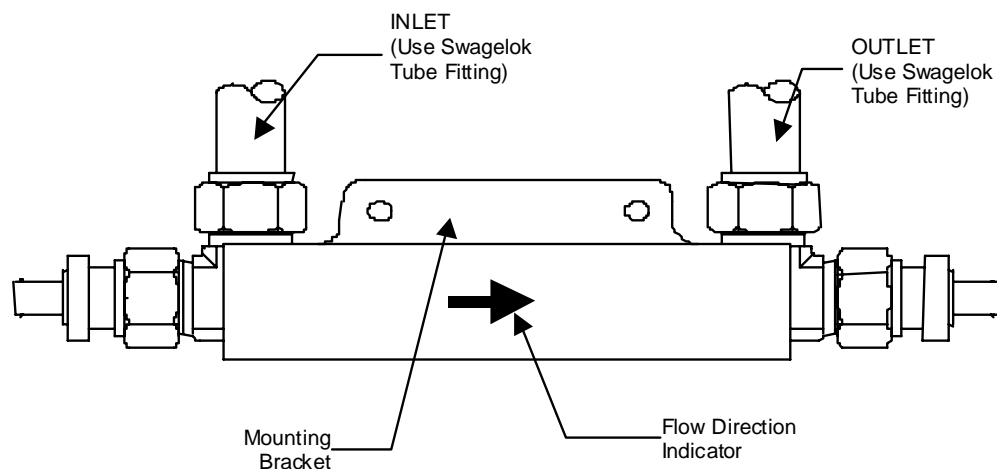
992DFT Series CPVC or Kynar PDFA Flow Tube
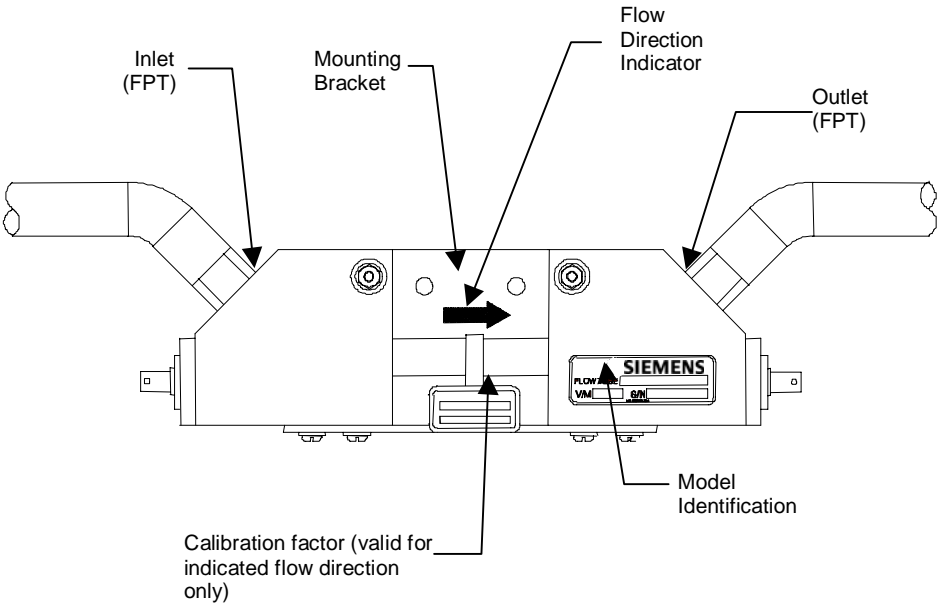
992DFT Series Teflon PFA Flow Tube
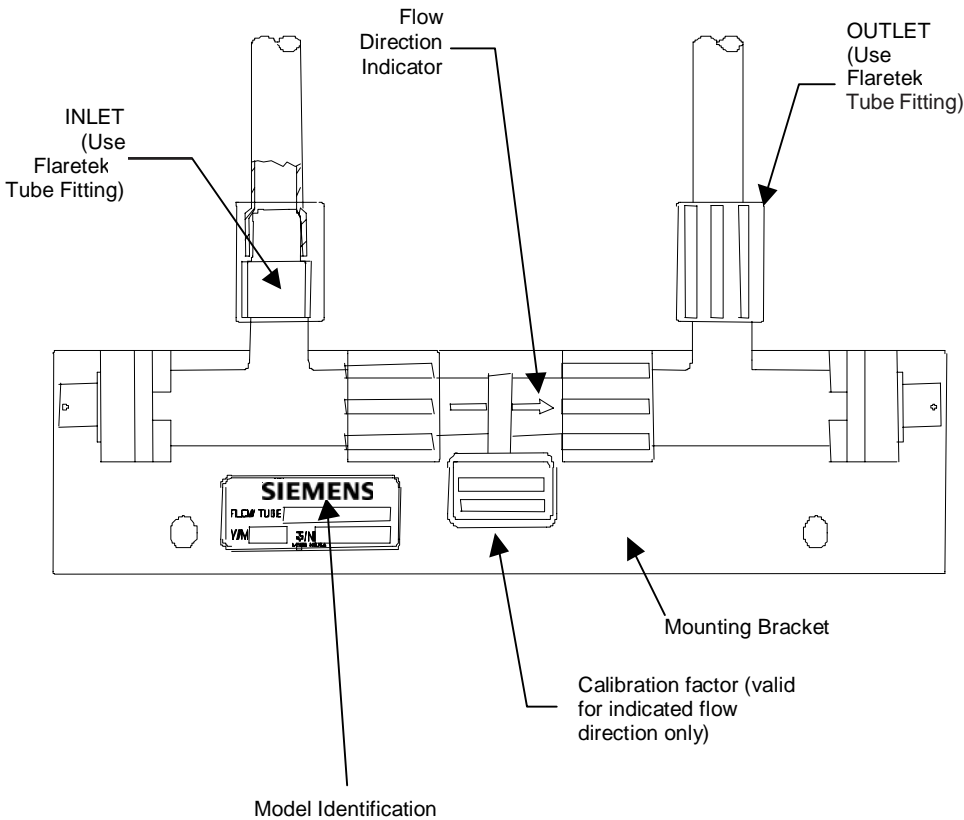
7.   THE SYSTEM 1010 REFLEXOR FLOWMETER

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.

Incorrect Transducer Placement   **Correct Transducer Placement**

ELBOW

EXPANSION
OR
CONTRACTION

VALVE

ORIFICE PLATE
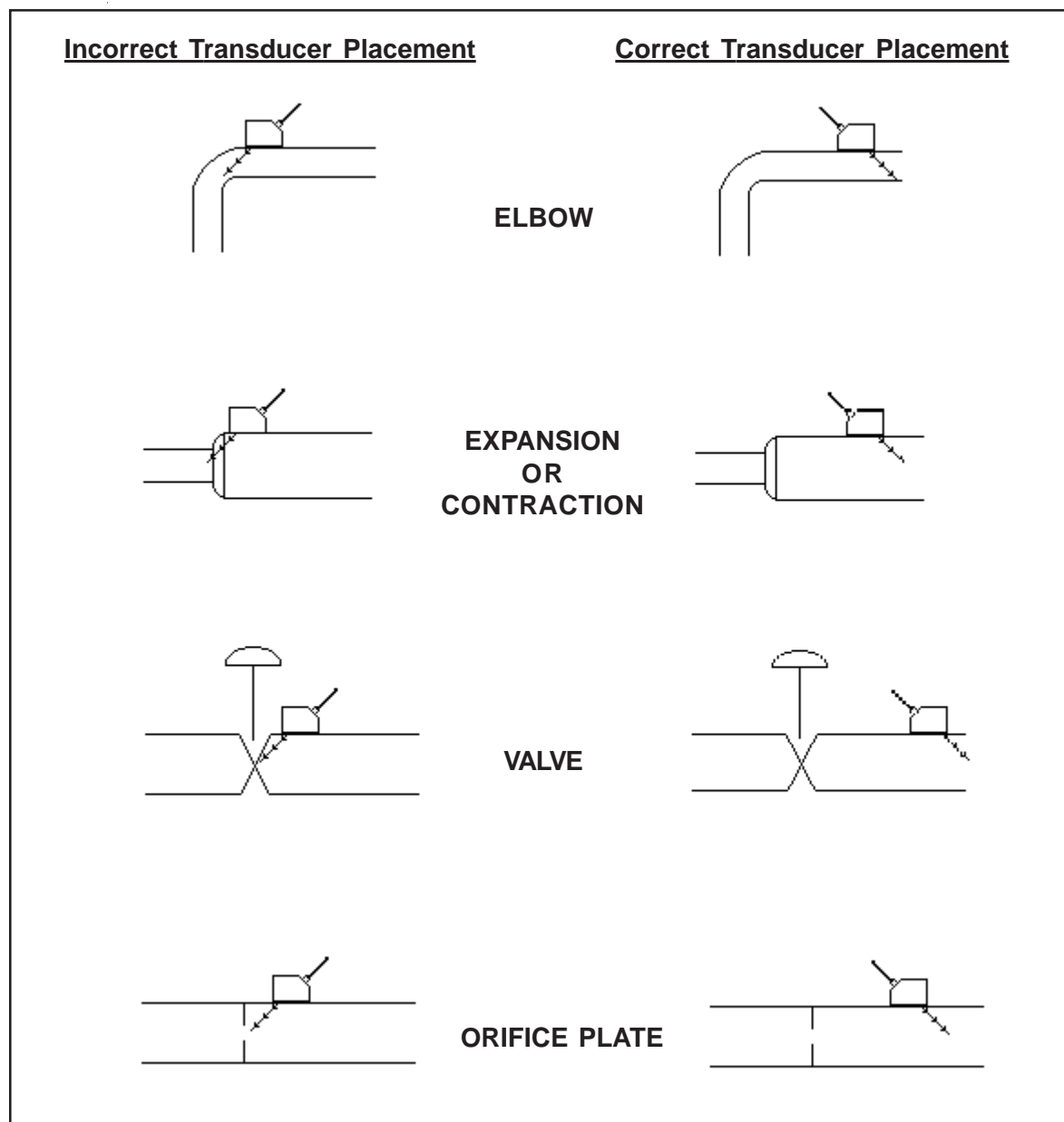
7.4   MOUNTING THE TRANSDUCERS

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).
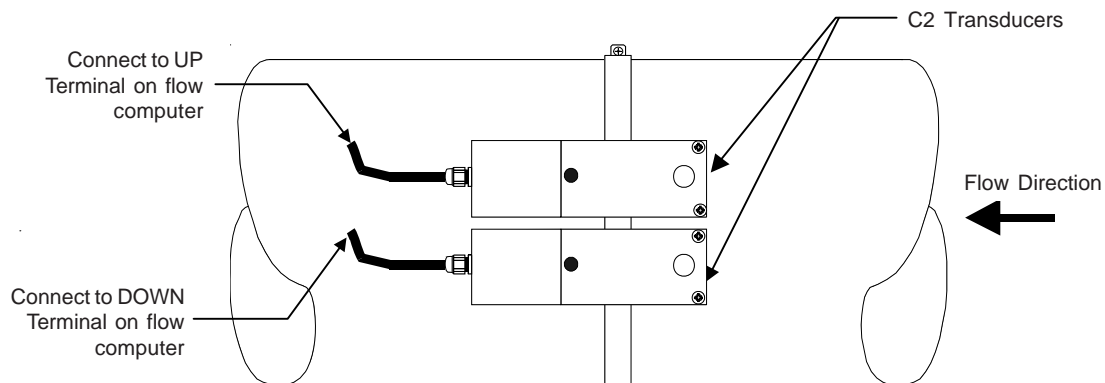
REFLEXOR MODE - ADJACENT TRANSDUCER MOUNTING
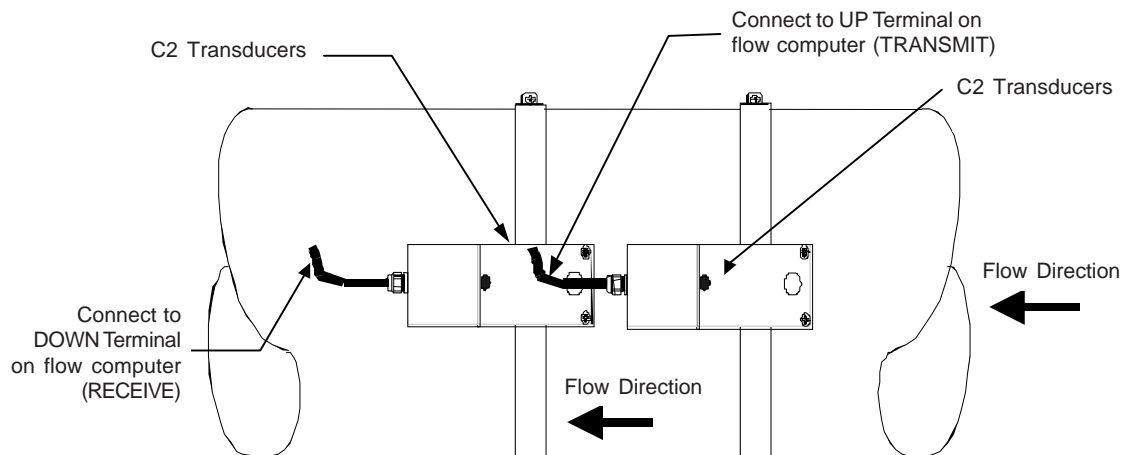
NOTE: Transducer position shown is for metal pipes.

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.

```
Siemens        2 Channel   [1]          Channel 1
Choose Channel 1 Flowmeter Type

   Channel 1                    Clamp-on
   Channel 2                    >Reflexor




Dual Channel Flow
```
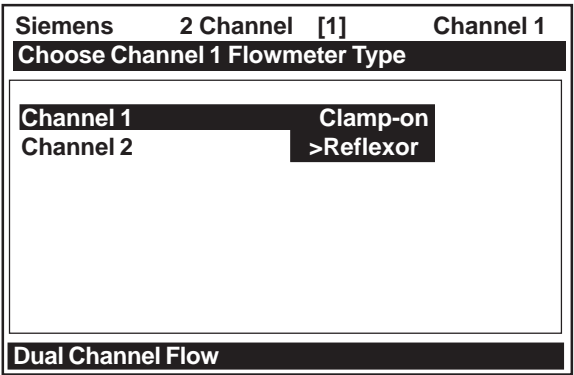
7.8   ACCESS THE INSTALL XDCR (TRANSDUCER) MENU

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 Completed?], for new installations, press the <Right Arrow>, select [Install], and then select [Yes]. Press the <ENT> 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.
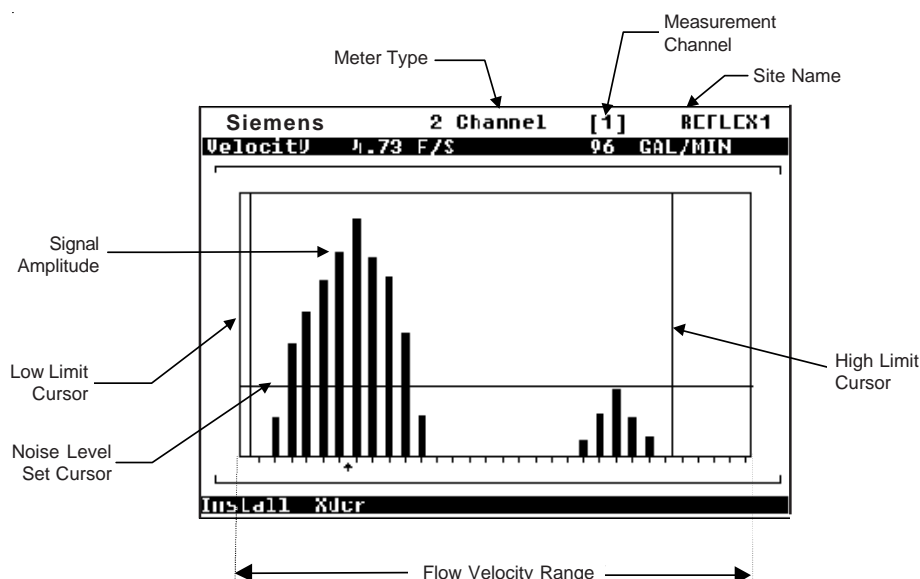
EXAMPLE OF A SPECTRA DISPLAY SCREEN

7-5

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 <-> keys are active in this position.

Press the <Down Arrow> from Carrier FX to advance to the Diagnostic Data Display. The <+> and <-> 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	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. 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.
Signal Peak-to-Peak mV	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.
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 rates 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.

APPENDIX A

Couplant Installation Instructions

FOR TECHNICAL ASSISTANCE
Call: (800) 275-8480
(631) 231-3600
Fax: (631) 231-3334
E-mail: TSG.ultrasonicflow@siemens.com

FOR GENERAL INFORMATION
Website: www.controlotron.com
E-mail: info.ultrasonicflow@siemens.com
Or: sales.ultrasonicflow@siemens.com

NOTE

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

APPENDIX B

SITE SETUP CONSIDERATIONS FOR 1010/1020N BLIND SYSTEMS

Siemens offers an economical "blind" 1010/1020 NEMA system (without a local keypad and graphic display screen). This supplement describes the hardware and software requirements for programming these models. Site setup for a blind unit requires a PC connected to the RS-232 serial port. These models include a serial interface cable for this purpose. The serial interface cable includes 9-pin and 25-pin connectors to accommodate both types of IBM-compatible serial ports. A PC communication program such as Terminal (Windows 3.x) or HyperTerminal (Windows 95/98/NT/2000/XP) serves as the data entry interface. These programs reproduce the menu screens that would appear on the system's graphic screen. In fact, the example screens in this manual are actual HyperTerminal screen captures. Once the serial interface is established, the site setup procedure for blind and graphic display systems are identical. You could choose to program a graphic display system using a PC and a communications program. However, note that *for models with a local display screen, the serial interface cable is an option.*

NOTE: You can use a DOS-based communications program also. Make sure that your PC is loading the ANSI.SYS driver via your Config.sys file. Set the program's RS-232 parameters to match those of the flowmeter (see HyperTerminal example screen on the following pages).

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

THE RS-232 INTERFACE CABLE

The physical connection between the flow computer and your PC is accomplished using a serial interface cable, part number: 1015CPC-N. The schematic below shows the configuration of the cable. The wire ends for the flow computer termination are tinned for easy insertion into TB1 on the flow computer. Each wire is labeled to identify the correct terminal pin on TB1. In addition, both connectors have their CTS pin shorted to the RTS pin (pins 4 - 5 on 25-pin connector and pins 7 - 8 on 9-pin connector). This eliminates the need for hardware "handshaking."
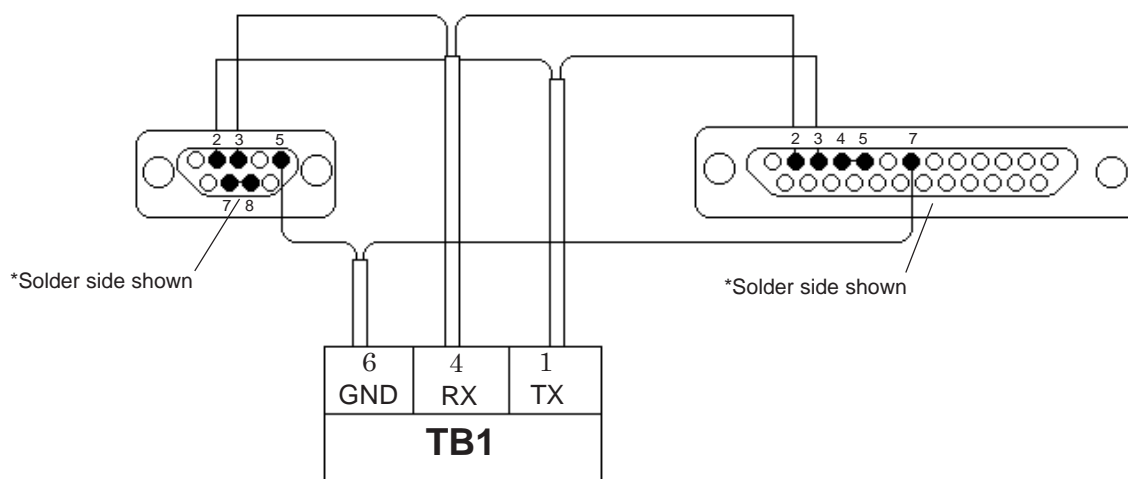
1015CPC-N SERIAL INTERFACE CABLE

Due to the different System 1010/1020 meter configurations, there are 3 types of RS-232 communication cables employed. You can determine which cable is required for the your model flowmeter from the table below. Be sure you have the appropriate cable available for use.

Meter Type	Cable Type	Controlotron Part Number	Notes
Weatherproof Portable	DB-9F – Amphenol	1015CPC-WP	Except Energy
1010P/1020N	DB-9F – DB-9F	1015CPC-P	Use for Energy WP
All NEMA4X	DB-9F – 3 Wire	1015CPC-N	
NEMA 4X with Expanded I/O Module	DB-9F - DB-9F	1015CPC-P	For 1010N with "A1" option (1010N-7 module)
All 1010X	DB-9F – 3 Wire	1015CPC-N	

For those who would prefer to make the cables themselves, the required parts (except for the RS-232 connector for the 1010WP meter types) should be available at most computer or electronics stores. You will find drawings of the terminations for these cables with the reference table below. It provides the signal names, PC termination and 1010/1020 meter termination for each type of flowmeter.

Also, in most computer stores or online, you will be able to find or you may already have a serial "LapLink" cable or "Null Modem" cable. These cables can be used to communicate with the 1010P/ DP and 1020N systems.

If you purchased a 1010W model, you may have received the special connector used for the RS-232 terminal in a packet included with your 1010W. This will enable you to construct the appropriate cable for this meter type.

If you prefer to construct your own cable, the following conventions apply in the table:

PC: Refers to an IBM compatible, DB-9 serial Com port.

1010N: Includes all models (N, DN, MN, E, EXCEPT those with "A1" option). Termination is made to the 1010N-2 I/O Data Module. Flowmeter end of cable is unterminated wire.

1010N With "A1" Option: Meters that carry "A1" option have 1010N-7 module installed that houses a DB-9 connector for RS-232 communication.

1010P/1020N: Includes all models (P/DP). Termination is made to the RS-232 port DB-9 connector. A DB-9 Female connector is needed to mate with the meter connector.

1010WP: Includes all models (WP, WDP except energy meters). Termination is made to the RS-232 port on the connector panel. A special cable terminal is required and can be obtained from Controlotron (Part #1015XWP).

1010X: Includes all models (X, DX). Termination is made to the 1010X-8 I/O module Terminal TB2. Flowmeter end of cable is unterminated wire.

Signal Name	PC DB-9 Terminal	1010P/1020N Terminal	1010WP Terminal	1010N Terminal	1010X Terminal
Ground	Pin 5	Pin 5	Pin E	TB1- pin 6	TB2-pin 16
Tx	Pin 2	Pin 3	Pin C	TB1- pin 1	TB2-pin 11
Rx	Pin 3	Pin 2	Pin B	TB1- pin 4	TB2-pin 14

PC DB-9 Connector
1010P/1020N/990P Connector
(Wiring Side View)

1010WP/WDP Connector
(Wiring Side View)
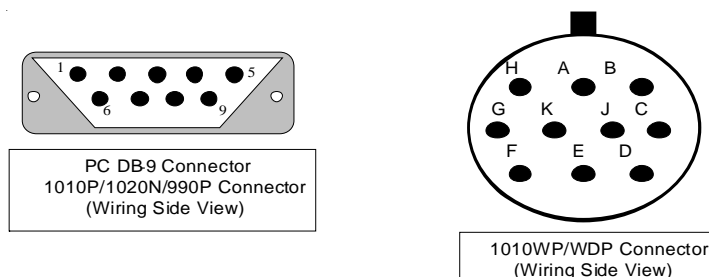
COMMUNICATING WITH SYSTEM 1010/1020 VIA THE RS-232 INTERFACE

The following sections assume that you are familiar with the basics of using a Windows 3.x or Windows 95/98/NT/2000/XP based communications program. All PC computers provide at least one serial port using either a 9-pin or 25-pin D-type connector. The port designation can be either COM 1 or COM 2. Usually, when a computer includes two serial ports, COM 1 will be the 9-pin connector and COM 2 will be the 25-pin connector. However, port designations can vary from manufacturer to manufacturer, so you will have to positively identify the COM port you wish to use for the flowmeter interface. Connect the cable between the flowmeter and your PC using either the 25-pin, 9-pin or USB to RS-232 adapter connector, depending upon the port's architecture.

HOW TO USE THE Windows HyperTerminal PROGRAM

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

1. From the Windows desktop, left-click on the [START] button.

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

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

4. This selects the [Connection Description] dialog box. Enter a name for your connection (e.g., 1010N). You can optionally select an icon for this connection by clicking on one of the icons displayed in the scrolling frame at the bottom of the window. Click [OK].

5. This selects the [Phone Number] dialog box. Move the cursor to the arrow at the right of the [Connect Using] field. Left click on the arrow to expand the field and then move the highlight down to [Direct to Com 1 (or 2)] depending on the port connected to the interface cable. Click [OK] to select the [Com 1 (or 2) Properties] Dialog box. Set up your RS-232 parameters as shown in the example below. Left-click on the [OK] button.
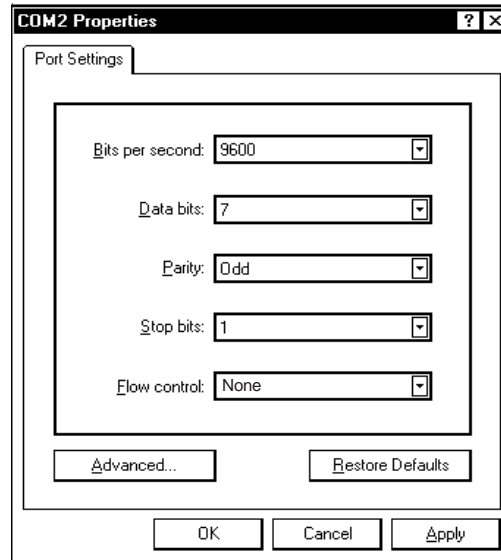
6. You will now see a blank terminal screen. Next left-click [File] on the top menu bar. Drag the highlight down to [Properties] and then left-click.

7. Left-click the [Settings] tab. Expand the [Emulation] box by left-clicking the <Down Arrow> on the right-hand side. Drag the highlight down to [VT-100] and then left-click to select it (as shown below).
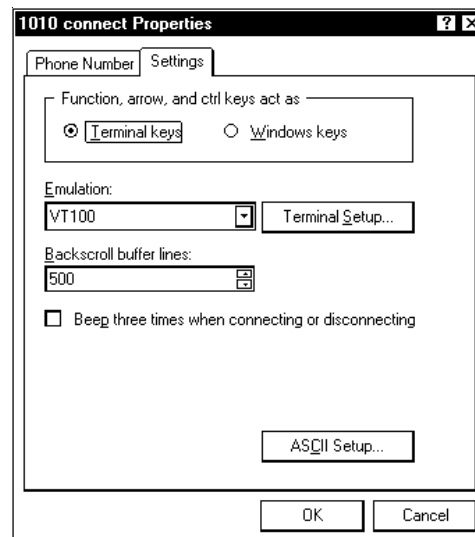
8. Next, left-click on the [ASCII Setup] button (see screen above). In the [ASCII Sending] dialog box, make sure that both [send line ends with line feeds] and [Echo Typed characters locally] are <u>UNCHECKED</u>. In the [ASCII Receiving] dialog box, left-click to place a check mark before the [Append line feeds to incoming line ends] dialog. When your screen looks like the example below, left-click the [OK] button.
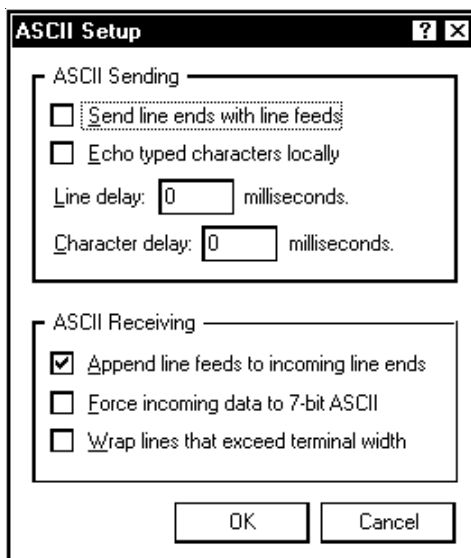
9. You are now ready to communicate with the 1010 flowmeter. But first, save your settings by moving the mouse cursor to [File], sliding the cursor to [Save], then clicking [OK] on the Save dialog box.

10. The next time you want to use HyperTerminal:

    Click on *Start*.

    Drag to *Programs*.

    Drag to *Accessories*. Drag to *HyperTerminal,* and click.

    Double-click the icon you selected for the connection.

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

Accessing the Installation Menu

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

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

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

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

```
 Siemens                Site        [1]
 Select Meter Type

     Meter Type          Single Channel
     Meter Facilities




```

NOTE: To facilitate connecting through modems, the [Menu] command times out after three minutes of inactivity. To maintain a longer connection type: Menu 1000 and press <ENT>. The optional number is the amount in minutes that the connection will be maintained. Typing [Menu 1000] essentially keeps the interface alive until you cancel it.

Data Display Mode

After you complete the installation, you can toggle between Installation Menu mode to Data Display mode. This is the same as using the <MENU> key on the 1010 keypad (see manual). The PC keyboard equivalent to the <MENU> key is <CNTRL> + <L>. Note that the 1010 RS-232 interface does not support graphics. Therefore, when you use HyperTerminal to view the data display screens, you will see the same data in alphanumeric form only (as shown below). You can still use the <Up Arrow> and <Down Arrow> to switch between available display screens.

```
 1010 connect - HyperTerminal
 File  Edit  View  Call  Transfer  Help

 Controlotron        Site    [1]    ABC
           FLOW GAL/MIN
           -7.8




           TOTAL   KGAL    Vs
           -1.32           1481_



 Connected 10:46:36    VT100      9600 7-0-1    SCROLL
```

This is the current flow reading and flow units. (This would be a large graphic character on the 1010 screen)

This is the flow Total display

This is the name of the current active site setup. The [1] indicates that the measurement channel is currently active.

This is the current measured liquid sonic velocity (Vs).

<u>**Navigating Through the Installation Menu**</u>

After accessing the Installation Menu, you can begin to setup your flowmeter according to the instructions in this manual. The chart below shows the PC keyboard equivalents to the 1010 keypad keys while you are in the menu.

1010 Keyboard	PC Keyboard	Description
<Up Arrow>	<Up Arrow>	Move up 1 menu cell (or Flow Display screen)
<Down Arrow>	<Down Arrow>	Move down 1 menu cell (or Flow Display screen)
<Right Arrow>	<Right Arrow>	Move right 1 menu cell (or Flow Display screen)
<Left Arrow>	<Left Arrow>	Move left 1 menu cell (or Flow Display screen)
<Menu>	^L (Cntrl L)	Toggle between Menu and Flow Display
<Datalog>	^D (Cntrl D)	Generate Datalogger report
<CLR>	<Backspace> or <DEL>	Deselect list selection
<ALT+Up Arrow>	^U (Cntrl U)	Logger Display Page Advance
<+/-> (chg sign)	| (bar, shift + backslash)	Change numeric sign. Can also type (-) key.
<ENT>	<Carriage Return>	Enter Key
Digits	Digits	Numerals zero through 9
/	/	Divide by
X	* (upper case 8)	Multiply by
+	+	Plus
-	-	Minus
=	=	Equals
.	.	Decimal Point

<u>**Terminal Mode Menu Commands**</u>

In addition to Menu, the following commands (followed by the <ENT> key) can be used to control the flowmeter while in Terminal Mode.

Note that "n" refers to the flowmeter Channel number. For a dual channel Arithmetic site (Ch1 + Ch2 or Ch1 – Ch2) the virtual Channel is number 3.

Logger – Invokes the download of all data stored in the datalogger.   Note that the datalogger data is not erased from the flowmeter memory when it is downloaded. It is recommended to capture this information into a file with a "csv" extension, which can be easily imported into MS EXCEL.

SITE – Invokes a full site download for a single channel or multi-path 1010 flowmeter.

SITE "n" – Invokes a site download for channel "n", where "n" = the Channel # (1, 2, 3, 4, etc.).

DP "n" – Commands the flowmeter to download the digitized receive signal data for Channel or Path "n".

CLRTOT – Clears the Totalizer for a single channel or multi-path 1010 flowmeter.

CLRTOT "n" – Clears the Totalizer for Channel "n" of a multi-channel flowmeter.

Lf on – Turns on the Line Feed at the end of any text string sent by the flowmeter.

Lf off – Turns off the Line Feed at the end of any text string sent by the flowmeter.

? – Provides a list of available Terminal Mode meter commands.

Transfer of Information from a 1010/1020 Flowmeter to the PC

With HyperTerminal active:

1. Point to *Transfers,* and click.

2. Select *Capture Text.*

3. Select desired drive path or directory, enter a file name, and click the *Start* button.

4. Use the following conventions for data file names:

> For site data or Waveshape data: *filename.txt*
> For Datalogger data: *filename.csv*

5. On PC type the proper command for the data desired (*Logger, Site, or DP)* and then [Enter].

6. The data should begin streaming on the HyperTerminal screen.

7. Wait for EOT (End OF Transmission) to be displayed.

8. Close the file by pointing to *Transfer,* drag to *Capture Text* and click *Stop* button.

Close the Terminal or HyperTerminal Program.

You may now close the Terminal program. The file(s) you have downloaded are now saved in the location you selected. You may now import the file you have saved into the appropriate program (i.e., MS word for site data, or MS Excel for Datalogger or Waveshape data for graphing or analysis).

The datalogger contains data that has its fields separated by commas. By using the file extension ".csv" (comma separated values) suggested earlier, the data will import directly into MS Excel without any further modification. For the waveshape data, the fields are separated by spaces, therefore, it is best to save those files as .txt, then use the MS Excel Import Wizard to select "Space Delimiters" for importation of the data.

Site data is downloaded in plain text and can be imported directly into MS Word.

RESET PROCEDURE FOR BLIND SYSTEMS

1010N Blind systems allow you to perform a system reset via the RS-232 interface. The following instructions require the flowmeter to be connected serially to a PC.

NOTE: Custom RS-232 settings for baud rate, parity and data bits may not be preserved. Therefore, be prepared to set your communications program back to the default (9600, Odd, 7) settings.

To Clear Active Memory Using the RS-232 Interface

1. Turn off power (if it is currently on). Turn power on. As soon as you apply power, immediately type the @ character three times. The prompt: **[Clr Active Memory?   No]** appears at the top of the screen.

2. Press the <Right Arrow> and then the <Down Arrow> to switch the option list to: **[Clr Active Memory? Yes]** Press <ENT> to clear all Active Site Data (but not saved site setups).

3. To restore operation, press <MENU> to access the Installation Menu. Create a new site setup or recall a stored site setup. Re-select any Meter Facilities items (e.g., RS-232 setup parameters).

To Clear All Dynamic Memory Using the RS-232 Interface:

CAUTION: Before proceeding further , it is essential to understand that this function eliminates all data stored in RAM. This means that all saved site setups, including the site data of a flow-calibrated site will be erased! Also, the entire Datalogger file plus any custom factory or user-created pipe or transducer tables will be eliminated. The impact of this is such that we strongly recommend that you consult our technical service department before continuing with this procedure. If you choose to continue, be aware that you will have to create a new site setup, re-enter all site specific parameters including pipe or transducer tables, plus all desired Meter Facilities entries.

1. Turn off power (if it is currently on).

2. Turn the power on. As soon as you apply power, type the @ character three times.

The prompt: **[Clr Active Memory?]** appears at the top of the screen. Press the <Down Arrow>.

Note that the prompt switches to **[Clr Saved Data? No]** .

3. Press the <Right Arrow> and then the <Down Arrow> to switch the option list to: **[Clr Saved Data? Yes]**

4. Press <ENT> to clear all Saved Site Data, Datalogger Data, user created Pipe Data and Transducer Data.

5. To restore operation, press <MENU> to access the Installation Menu. Create a new site setup or recall a stored site setup. Reselect any Meter Facilities items (e.g., RS-232 setup parameters).

APPENDIX C
ENGINEERING DRAWINGS

Flow Computer Drawings

1010N-7   Installation Drawing, 1010 Series Single Channel Flow Computer
1010N-8   Outline Dimensions, 1010 Series Single Channel Flow Computer
1010DN-7   Installation Drawing, 1010 Series Dual Channel Flow Computer
1010DN-8   Outline Dimensions, 1010 Series Dual Channel Flow Computer
1010N-5-7   Installation Drawing, Analog Input Module
1010WX-7   Installation Drawing, 1010 Series Single/Dual Channel Flow Computer
1010WX-8   Outline Dimensions, 1010 Series Flow Computer
1010WXC5-8   Outline Dimensions, 1010 Series Flow Computer
1010N-5D-7   Installation Drawing, Analog Input Module
1010N-2-7   Installation Drawing, I/O Module
1010N-7-7   Installation Wiring, Expanded I/O Module

4-Channel Drawings

1010MN-7   Installation Drawing, 1010 Series Multi-Channel Flow Computer
1010MN-8   Outline Dimensions, 1010 Series Multi-Channel Flow Computer
1010MWX-7   Installation Drawing, 1010 Series Multi-Channel Flow Computer
1010N-8M-7   Installation Drawing, Multi-Channel I/O Module

Transducer and Accessory Drawings

1011HNFS-7   Installation, 1011HNFS Series Dedicated Plastic Body Transducer
1011HNFS-8   Outline Dimension, 1011HNFS Series Dedicated Plastic Body Transducer
1011NFPS-7   Installation, 1011NFPS Series Dedicated Plastic Body Transducer
1011NFPS-8   Outline Dimensions, 1011NFPS Series Dedicated Plastic Body Transducer
1012BN-8   Outline Dimensions, 1010 Series Spacer Bar
1012FN-8   Outline Dimensions, 1011 Series Dedicated Transducer Mounting Frames
1012FNH-8   Outline Dimensions, 1011HN Series Dedicated Transducer Mounting Frames
1012TP-7   Installation Drawing, 1010 Series Transducers and Mounting Tracks
1012THP-7   Installation Drawing, 1010 Series Transducers and Mounting Tracks
1012MS-8   Installation/Outline, Adjustable Mounting Strap
1012TB-8   Installation/Outline, 1011 Series Test Block
1012TN-7   Installation Drawing, 1010 Series Transducer & Mounting Tracks
1012TN-8   Outline Dimensions, 1012 Series Mounting Tracks
1012TNH-7   Installation Drawing, 1010 Series Transducer & Mounting Tracks
1012TNH-8   Outline Dimensions, 1012 Series Mounting Tracks
1011FTNF-8   Outline Dimensions, 1010 Series Flow Tube
992DFTN-8   Installation/Outline 992 Series Extended Flow Tube
992DFTP-T-8   Installation Outline PFA-DFT Flow Tube
1012F-DB-7   Installation Drawing, Dual Path Transducer Set w/Mounting Frames
990TDMVH-7A   Installation Drawing, 990 Series Transducer & Tracks, Very High Temp.,
                    Direct Mode
990TDMVH-7B   Installation Drawing, 990 Series Transducer & Assembly, Very High Temp.,
                    Direct Mode
990TRMVH-7A   Installation Drawing, 990 Series Transducers & Tracks, Very High Temp.,
                    Reflect Mode

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C

D

E

TRADEMARKS

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Reflexor
ReversaMatic
SmartSlew
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SIEMENS

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DUCTILE IRON PIPE
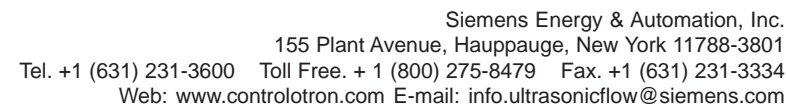
Nominal Diameter	Actual O.D.	CLASS 50 Wall	CLASS 50 I.D.	CLASS 51 Wall	CLASS 51 I.D.	CLASS 52 Wall	CLASS 52 I.D.	CLASS 53 Wall	CLASS 53 I.D.	CLASS 54 Wall	CLASS 54 I.D.	CLASS 55 Wall	CLASS 55 I.D.	CLASS 56 Wall	CLASS 56 I.D.	Liner (Cement) Single	Liner (Cement) Double
3	3.96	N/A	N/A	0.25	3.46	0.28	3.40	0.31	3.34	0.34	3.28	0.37	3.22	0.40	3.16	0.125	0.250
4	4.80	N/A	N/A	0.26	4.28	0.29	4.22	0.32	4.16	0.35	4.10	0.38	4.04	0.41	3.98	0.125	0.250
6	6.90	0.25	6.40	0.28	6.34	0.31	6.28	0.34	6.22	0.37	6.16	0.40	6.10	0.43	6.04	0.125	0.250
8	9.05	0.27	8.51	0.30	8.45	0.33	8.39	0.36	8.33	0.39	8.27	0.42	8.21	0.45	8.15	0.125	0.250
10	11.10	0.29	10.52	0.32	10.46	0.35	10.40	0.38	10.34	0.41	10.28	0.44	10.22	0.47	10.16	0.125	0.250
12	13.20	0.31	12.58	0.34	12.52	0.37	12.46	0.40	12.40	0.43	12.34	0.46	12.28	0.49	12.22	0.125	0.250
14	15.30	0.33	14.64	0.36	14.58	0.39	14.52	0.42	14.46	0.45	14.40	0.48	14.34	0.51	14.28	0.1875	0.375
16	17.40	0.34	16.72	0.37	16.66	0.40	16.60	0.43	16.54	0.46	16.48	0.49	16.42	0.52	16.36	0.1875	0.375
18	19.50	0.35	18.80	0.38	18.74	0.41	18.68	0.44	18.62	0.47	18.56	0.50	18.50	0.53	18.44	0.1875	0.375
20	21.60	0.36	20.88	0.39	20.82	0.42	20.76	0.45	20.70	0.48	20.64	0.51	20.58	0.54	20.52	0.1875	0.375
24	25.80	0.38	25.04	0.41	24.98	0.44	24.92	0.47	24.86	0.50	24.80	0.53	24.74	0.56	24.68	0.1875	0.375
30	32.00	0.39	31.22	0.43	31.14	0.47	31.06	0.51	30.99	0.55	30.90	0.59	30.82	0.63	30.74	0.250	0.500
36	38.30	0.43	37.44	0.48	37.34	0.53	37.24	0.58	37.14	0.63	37.04	0.68	36.94	0.73	36.84	0.250	0.500
42	44.50	0.47	43.56	0.53	43.44	0.59	43.32	0.65	43.20	0.71	43.08	0.77	42.96	0.83	42.84	0.250	0.500
48	50.80	0.51	49.78	0.58	49.64	0.65	49.50	0.72	49.36	0.79	49.22	0.86	49.08	0.93	48.94	0.250	0.500
54	57.56	0.57	56.42	0.65	56.26	0.73	56.10	0.81	55.94	0.89	55.78	0.97	55.62	1.05	55.46	0.250	0.500

CAST IRON PIPE - AWWA STANDARD

Pipe Size	CLASS A O.D	CLASS A Wall	CLASS A I.D.	CLASS B O.D	CLASS B Wall	CLASS B I.D.	CLASS C O.D	CLASS C Wall	CLASS C I.D.	CLASS D O.D	CLASS D Wall	CLASS D I.D.	CLASS E O.D	CLASS E Wall	CLASS E I.D.	CLASS F O.D	CLASS F Wall	CLASS F I.D.	CLASS G O.D	CLASS G Wall	CLASS G I.D.	CLASS H O.D	CLASS H Wall	CLASS H I.D.
3	3.80	0.39	3.02	3.96	0.42	3.12	3.96	0.45	3.06	3.96	0.48	3.00												
4	4.80	0.42	3.96	5.00	0.45	4.10	5.00	0.48	4.04	5.00	0.52	3.96												
6	6.90	0.44	6.02	7.10	0.48	6.14	7.10	0.51	6.08	7.10	0.55	6.00	7.22	0.58	6.06	7.22	0.61	6.00	7.38	0.65	6.08	7.38	0.69	6.00
8	9.05	0.46	8.13	9.05	0.51	8.03	9.30	0.56	8.18	9.30	0.60	8.10	9.42	0.66	8.10	9.42	0.71	8.00	9.60	0.75	8.10	9.60	0.80	8.00
10	11.10	0.50	10.10	11.10	0.57	9.96	11.40	0.62	10.16	11.40	0.68	10.04	11.60	0.74	10.12	11.60	0.80	10.00	11.84	0.86	10.12	11.84	0.92	10.00
12	13.20	0.54	12.12	13.20	0.62	11.96	13.50	0.68	12.14	13.50	0.75	12.00	13.78	0.82	12.14	13.78	0.89	12.00	14.08	0.97	12.14	14.08	1.04	12.00
14	15.30	0.57	14.16	15.30	0.66	13.96	15.65	0.74	14.17	15.65	0.82	14.01	15.98	0.90	14.18	15.98	0.99	14.00	16.32	1.07	14.18	16.32	1.16	14.00
16	17.40	0.60	16.20	17.40	0.70	16.00	17.80	0.80	16.20	17.80	0.89	16.02	18.16	0.98	16.20	18.16	1.08	16.00	18.54	1.18	16.18	18.54	1.27	16.00
18	19.50	0.64	18.22	19.50	0.75	18.00	19.92	0.87	18.18	19.92	0.96	18.00	20.34	1.07	18.20	20.34	1.17	18.00	20.78	1.28	18.22	20.78	1.39	18.00
20	21.60	0.67	20.26	21.60	0.80	20.00	22.06	0.92	20.22	22.06	1.03	20.00	22.54	1.15	20.24	22.54	1.27	20.00	23.02	1.39	20.24	23.02	1.51	20.00
24	25.80	0.76	24.28	25.80	0.89	24.02	26.32	1.04	24.22	26.32	1.16	24.00	26.90	1.31	24.28	26.90	1.45	24.00	27.76	1.75	24.26	27.76	1.88	24.00
30	31.74	0.88	29.98	32.00	1.03	29.94	32.40	1.20	30.00	32.74	1.37	30.00	33.10	1.55	30.00	33.46	1.73	30.00						
36	37.96	0.99	35.98	38.30	1.15	36.00	38.70	1.36	39.98	39.16	1.58	36.00	39.60	1.80	36.00	40.04	2.02	36.00						
42	44.20	1.10	42.00	44.50	1.28	41.94	45.10	1.54	42.02	45.58	1.78	42.02												
48	50.50	1.26	47.98	50.80	1.42	47.96	51.40	1.71	47.98	51.98	1.96	48.06												
54	56.66	1.35	53.96	57.10	1.55	54.00	57.80	1.90	54.00	58.40	2.23	53.94												
60	62.80	1.39	60.02	64.40	1.67	60.06	64.20	2.00	60.20	64.82	2.38	60.06												
72	75.34	1.62	72.10	76.00	1.95	72.10	76.88	2.39	72.10															
84	87.54	1.72	84.10	88.54	2.22	84.10																		

STAINLESS STEEL, HASTELLOY "C" & TITANIUM△ PIPE

Sched.	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24
5S◇	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000
	I.D.	0.710	0.920	1.185	1.530	1.770	2.245	2.709	3.334	3.834	4.334	5.345	6.407	8.407	10.482	12.438	13.688	15.670	17.670	19.634	21.624	23.563
	Wall	0.065	0.065	0.065	0.065	0.065	0.065	0.083	0.083	0.083	0.083	0.109	0.109	0.109	0.134	0.156	0.156	0.165	0.165	0.188	0.188	0.218
10S◇	I.D.	0.674	0.884	1.097	1.442	1.682	2.157	2.635	3.260	3.760	4.260	5.295	6.357	8.329	10.420	12.390	13.624	15.624	17.624	19.564	21.564	23.500
	Wall	0.083	0.083	0.109	0.109	0.109	0.109	0.120	0.120	0.120	0.120	0.134	0.134	0.148	0.165	0.180	0.188	0.188	0.188	0.218	0.218	0.250
40S	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000						
	Wall	0.109⊗	0.113⊗	0.133⊗	0.140⊗	0.145⊗	0.154⊗	0.203⊗	0.216⊗	0.226⊗	0.237⊗	0.258⊗	0.280⊗	0.322⊗	0.365⊗	* .375						
80S	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750						
	Wall	^.147	^.154	^.179	^.191	^.200	^.218	^.276	^.300	^.318	^.337	^.375	^.432	^.500	^.500	* .500						

CARBON STEEL and PVC△ PIPE

Pipe	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	42
Standard	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	30.000	32.000	34.000	36.000	42.000
	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000	13.250	15.250	17.250	19.250	21.250	23.250	25.250	27.250	29.250	31.250	33.250	35.250	41.250
	Wall	0.109	0.113	0.133	0.140	0.145	0.154	0.203	0.216	0.226	0.237	0.258	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	* .375
Extra Strong (XS)	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750	13.000	15.000	17.000	19.000	21.000	23.000	25.000	27.000	29.000	31.000	33.000	35.000	41.000
	Wall	0.147	0.154	0.179	0.191	0.200	0.218	0.276	0.300	0.318	0.337	0.375	0.432	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	* .500
Double Extra Strong (XXS)	I.D	0.252	0.434	0.599	0.896	1.100	1.503	1.771	2.300	2.728	3.152	4.063	4.897	6.875	8.750	10.750													
	Wall	0.294	0.308	0.358	0.382	0.400	0.436	0.552	0.600	0.636	0.674	0.750	0.864	0.875	1.000	1.000													
Sched. 10	I.D.																13.500	15.500	17.500	19.500	21.500	23.500	25.376	27.376	29.376	31.376	33.376	35.376	
	Wall																0.250	0.250	0.250	0.250	0.250	0.250	0.312	0.312	0.312	0.312	0.312	0.312	
Sched. 20	I.D.													8.125	10.250	12.250	13.376	15.376	17.376	19.250	21.250	23.250	25.000	27.000	29.000	31.000	33.000	35.000	41.000
	Wall													0.250	0.250	0.250	0.312	0.312	0.312	0.375⊗	0.375⊗	0.375⊗	^.500	^.500	^.500	^.500	^.500	^.500	^.500
Sched. 30	I.D.													8.071	10.136	12.090	13.250	15.250	17.124	19.000	21.000	22.876		26.750	28.750	30.750	32.750	34.750	40.750
	Wall													0.277	0.307	0.330	0.375⊗	0.375⊗	0.375⊗	0.438	^.500	^.500	0.562	0.625	0.625	0.625	0.625	0.625	* .625
Sched. 40	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	11.938	13.124	15.000	16.876	18.814		22.626							
	Wall	0.109⊗	0.113⊗	0.133⊗	0.140⊗	0.145⊗	0.154⊗	0.203⊗	0.216⊗	0.226⊗	0.237⊗	0.258⊗	0.280⊗	0.322⊗	0.365⊗	0.406	0.438	^.500	0.562	0.593		0.687							
Sched. 60	I.D.													7.813	9.750	11.626	12.814	14.688	16.500	18.376	20.250	22.064							
	Wall													0.406	^.500	0.562	0.593	0.656	0.750	0.812	0.875	0.968							
Sched. 80	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.564	11.376	12.500	14.314	16.126	17.938	19.750	21.564							
	Wall	^.147	^.154	^.179	^.191	^.200	^.218	^.276	^.300	^.318	^.337	^.375	^.432	^.500	0.593	0.687	0.750	0.843	0.937	1.031	1.125	1.218							
Sched. 100	I.D.													7.439	9.314	11.064	12.126	13.938	15.688	17.438	19.250	20.938							
	Wall													0.593	0.718	0.843	0.937	1.031	1.156	1.281	1.375	1.531							
Sched. 120	I.D.										3.624	4.563	5.501	7.189	9.064	10.750	11.814	13.564	15.250	17.000	18.750	20.376							
	Wall										0.438	0.500	0.562	0.718	0.843	1.000	1.093	1.218	1.375	1.625	1.812	2.062							
Sched. 140	I.D.													7.001	8.750	10.500	11.500	13.124	14.876	16.500	18.250	19.876							
	Wall													0.812	1.000	1.125	1.250	1.438	1.562	1.750	1.875	2.062							
Sched. 160	I.D.	0.466	0.614	0.815	1.160	1.338	1.689	2.125	2.624		3.438	4.313	5.189	6.813	8.500	10.126	11.188	12.814	14.438	16.064	17.750	19.314							
	Wall	0.187	0.218	0.250	0.250	0.281	0.343	0.375	0.438		0.531	0.625	0.718	0.906	1.125	1.312	1.406	1.593	1.781	1.968	2.125	2.343							

NON-STANDARD CARBON

Size	10	20	24	24
O.D.	10.750	20.000	24.000	24.000
I.D.	10.192	19.375	23.375	22.126
Wall	0.279	0.312	0.312	0.937

The above sizes are produced by pipe mills but dimensions do not conform to any regular standard or schedule.

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

◇ Wall Thickness of Schedule 5S & 10S does not permit threading in accordance with the American Standard for Pipe Threads (ASA No. B2.1)

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

^ Wall Thickness identical with thickness of "Extra-Heavy" pipe.

* These do not conform to American Standard B36. 10.

PIPE WEIGHT FORMULA FOR STEEL PIPE (lbs per foot)

10.68 (D-t) t, where D=Outside Diameter and t=Wall Thickness

SIEMENS