

Rosemount™ 3410 series Gas Ultrasonic Flow meter

Models 3415, 3416, and 3417 GUSM



Safety and approval information

This Rosemount product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EU declaration of conformity for directives that apply to this product. The EU declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions are available on the internet at www.emerson.com or through your local Emerson support center.

Information affixed to equipment that complies with the Pressure Equipment Directive, can be found on the internet at www.emerson.com.

For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the user manual. Product data sheets and manuals are available from the Emerson website at www.emerson.com.

Return policy

Follow Emerson procedures when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Emerson employees. Emerson will not accept your returned equipment if you fail to follow Emerson procedures. Return procedures and forms are available on our web support site at www.emerson.com, or by phoning the Emerson Customer Service department.

Emerson Flow customer service

Email:

- Worldwide: flow.support@emerson.com
- Asia-Pacific: APflow.support@emerson.com

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United States	800 522 6277	U.K.	0870 240 1978	Australia	800 158 727
Canada	+1 303 527 5200	The Netherlands	+31 (0) 704 136 666	New Zealand	099 128 804
Mexico	+41 (0) 41 7686 111	France	0800 917 901	India	800 440 1468
Argentina	+54 11 4837 7000	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3413 8000	Italy	8008 77334	China	+86 21 2892 9000
		Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
		Russia/CIS	+7 495 981 9811	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

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1 Startup

1.1 Checklist

During meter startup, have the following equipment and information on hand:

Meter startup checklist	
	Site pipe and ID drawings with elevations
	Site wiring diagrams
	Rosemount Gas Ultrasonic Meter calibration data
	Rosemount Gas Ultrasonic Meter manuals
	Information and manuals for all other flow instrumentation - flow computers, pressure and temperature transmitter data sheets, and wiring
	Shutoff and control valve information, specifications, operation and setup data.
	Ethernet (Cat 5 cables) or serial cables to link the laptop to the meter
	Field service representative's telephone numbers for major components; valves, meter, flow computer, communication gear, transmitters, site designers or integrators.
	Check all ultrasonic meter wiring.
	Check the settings of any bit switches on transmitter I/O cards.
	Start MeterLink™
	Establish flow in the meter (at least 3 feet per second to ensure good thermal mixing)
	Save the meter configuration file - your "As Found" record of the meter. In MeterLink™, select Tools → Edit/Compare Configuration . Click the Read button and select File Save .
	Open File → Program Settings and customize MeterLink™ user preferences.
	Open Meter → Monitor and check the measurement paths or chords and that they agree with each other to approximately 0.2%.
	Check for alarms, open Meter → Monitor and click Check Status .
	Check for good signal strength (usually shown as "SNR") or, Signal to Noise Ratio.
	Check for reasonably correct flow profile
	From the Logs/Reports menu, click Maintenance Logs/Reports , collect and save a Maintenance Log to record the initial performance of your meter (this is your "as Found" record).
	From the Meter → Field Setup Wizard menu. Make any configuration adjustments, such as setting the frequency output variable and frequency full scale.
	Save another Maintenance Log (this is your "As Left" record).

1.2 Cybersecurity and network communications

The 3410 electronics TCP/IP communications should be configured to mitigate cybersecurity risks as follows:

1. MeterLink uses either FTP or HTTP protocols for Archive and Smart Meter Verification log collection. It is recommended to disable the FTP protocol and leave the HTTP protocol enabled using the **Meter** → **Communications Settings** dialog in MeterLink. Both can be disabled for additional security, but log collection will not be possible in this configuration.
2. Telnet port should be left disabled. This port is not required for any communications to field devices or MeterLink. Beginning with Rosemount 3410 Series Firmware v1.60, Telnet is permanently disabled.
3. Enabling the physical Write Protect switch will prevent metrology configuration changes and firmware upgrades. It will also prevent enabling TCP/IP protocols such as FTP, HTTP, and Telnet.
4. Disable unused protocols or set them to read-only if write capability is not required. The Modbus TCP/IP protocol can be set to Read-only or Disabled on the Ethernet port. Modbus protocols can be disabled or made read-only on serial ports while still allowing authenticated MeterLink communications.
5. Rosemount 3410 Series Firmware v1.60 and later require user authentication and has a default administrator password. While the password is unique to each meter, it is highly recommended to be changed at meter startup. For added security, the default username, administrator, can be changed as well.
6. Other users can be added with different privileges and passwords in the Rosemount 3410 Series Firmware v1.60 and later. Only give users privileges to perform their job functions. See Manage users for more details on how to add, change, and delete users.

This transmitter:

1. Is not intended to be directly connected to an enterprise or to an internet facing-network without a compensating control in place.
2. Should be installed following industry best practices for cybersecurity.

2 Communications

2.1 Setup meter communications

After the installation of your Rosemount Ultrasonic Meter, install MeterLink™ on your PC or laptop as described in the *MeterLink Software for Gas and Liquid Ultrasonic Flow Meters Quick Start Manual* (00809-0100-7630) for your operating system, then configure the meter.

The *MeterLink Software for Gas and Liquid Ultrasonic Flow Meters Quick Start Manual* (00809-0100-7630) is made available with the meter.

The MeterLink installation program is available for download from the Emerson website: www.emerson.com/meterlink.

2.1.1 MeterLink utilities

MeterLink™ provides the following utilities to configure the meter's flow measurement units, meter output parameters, communications settings, output tests and logs and reports file management.

- Meter**
 - Connect
 - Disconnect
 - Monitor
 - Field setup wizard
 - Startup
 - General
 - Frequency/Digital output sources
 - Frequency outputs
 - Meter digital outputs
 - Analog outputs
 - Meter corrections
 - Temperature and pressure
 - Gas chromatograph setup
 - Gas chromatograph component data
 - AGA8
 - Continuous flow analysis
 - Alarm limits
 - Local display
 - Communications settings
 - Signal analyzer
 - Meter information
 - Manage users

- Key manager
 - Open data folder
- Tools**
- Edit/Compare configuration
 - Waveform viewer
 - Gas SOS calculator
 - Outputs test
 - Transducer swap-out
 - Set transducer type
 - Reset tracking
 - Reset velocity estimation
 - Override velocity estimation update time
 - Locate meter
 - Set baseline wizard
 - Program download
 - Warm start meter
 - Communications analyzer
- Log/Reports**
- Maintenance Logs and Reports
 - Trend Maintenance Logs
 - Meter Archive Logs
 - Smart Meter Verification
 - Create PDF from XML SMV Report
 - Compare Excel® Meter Configurations
- Calibration**
- Analog Inputs Wizard
 - Meter Factors
 - Flow Calibration
 - Zero Calibration

Setup the meter directory

Setup the connection properties for your meter. By default, the meter directory contains only one record named New Meter, that is defaulted to connect to a Rosemount Gas Ultrasonic meter configured as shipped from the factory.

Create a new meter record

Procedure

1. Select **Insert**, **Insert Duplicate**, or **Add from** the File pull-down menu to create a new record.
2. Setup the record by entering a Meter Name, Short Desc, Meter Type, and select the connection type(s) checkboxes Direct, Ethernet and Ethernet 2.

3. For each connection type selected, a button will be enabled at the bottom of the dialog with the same name. Click these buttons to edit the connection properties for that connection method. After choosing the connection properties, click **OK** accept the changes or click **Cancel** to discard any changes and close the dialog.

- a) **Direct connection** - to connect to the meter directly through one of the serial ports on the meter using one of the serial ports on your computer. Click **Direct** to set the following parameters.

- Protocol: TCP/IP is a read-only field and is the only protocol MeterLink uses.

Note

Rosemount Ultrasonic meters still support Modbus ASCII and Modbus RTU when talking to other applications or devices.

- Comms Address: Enter the communication address that is configured in the meter hardware. The default address for meters from the factory is 32. For Rosemount Ultrasonic meters the valid range is from 1 to 247.
 - Port: Select the available driver from the list of those installed on your machine.
 - Baud Rate: Select the serial port baud rate from the drop-down list for which the meter hardware is configured. The default Baud Rates is 19200.
- b) **Ethernet connection** - Set the following properties to configure the Rosemount ultrasonic meter hardware for Ethernet connectivity.

NOTICE

It is strongly recommended that the meter be configured using an independent (off- network) single host computer. After configuration of the meter, the DHCP option should be disabled.

- IP Address: Enter the IP Address for the meter's Ethernet port. The factory set IP Address is 172.16.17.200 for Rosemount Gas Ultrasonic meters or you can use 192.168.135.100 if DHCP is enabled in the meter (see DHCP below for more details).

Dynamic Host Configuration Protocol (DHCP): Business PCs are usually configured to work in a network environment where a DHCP server assigns an IP address to each computer when they connect to the network.

If a PC is configured to obtain an IP address from a DHCP server and it is going to connect through the Ethernet Cable (1-360-01-596) to a Rosemount meter that is not connected to a network, then the DHCP server in the meter must be enabled so it can assign an IP address to the PC when it connects.

The DHCP server can be enabled on the meter by setting the DHCP switch on the CPU module to the ON position.

When connecting to a meter with DHCP enabled, use the IP address of 192.168.135.100 to connect to the meter. In this mode you can create just one Meter Directory record with this IP address to connect to all your meters with DHCP enabled. When the connection is made, select to use the Meter Name in the meter instead of the Meter Directory Name in order to keep all log files and configurations separate from each meter.

Click **OK** to accept the changes or click **Cancel** to discard any changes and return to the Meter Directory dialog box.

Meter groups

This dialog, available from the Meter Directory dialog, allows you to manage meter groups for filtering the list of meters in the Connect to Meter dialog, exporting to other MeterLink™ users and for filtering the list of meters in MeterLink™ Net Monitor's main window. There is a predefined meter group for "All meters," otherwise meters can be grouped together in any way that is useful to you, e.g. meters for geographic regions, or meters that require daily monitoring.

User-defined meter groups can be added, edited and deleted in the dialog. The left side displays a list of meter groups. The right side displays all available meters (meter directory records) in the currently selected group and allows meters to be added to or removed from the currently selected group using a checkbox next to each meter.

MeterLink communications settings for dual configuration Dual configuration - serial connection

Procedure

To connect to dual configuration meter using serial connection, enter the serial connection properties for Transmitter Head 1. MeterLink will connect to both transmitter heads using the Ethernet settings configured for each Transmitter Head.

- Check Box labeled Route IP packets to connection (recommended for Dual-Configuration meters).
- Transmitter Head 1 and Head 2 IP address and Data Sharing Dual-Configuration Meter IP must be configured properly for each meter and meters must be connected to same network either via Expansion I/O module or local network switch. (See Section for Dual Config Initial Meter Communication Settings Head 1 and Head 2.)

Ethernet initial connection steps

Procedure

1. Power up the meter.
2. Shutdown the PC.
3. Plug the Ethernet adapter cable Phoenix end into the meter Field Connection Board connector J8 and connect the RJ-45 end into the PC Ethernet connector.
4. Enable the Ethernet LAN connector DHCP server on the CPU Module by moving the DHCP (switch-1) to the ON position (see direction arrow on the CPU Module label).
5. Power up (boot) the PC and log in to the initial Windows® logon prompt.
6. Verify the Ethernet connection status by the CPU Module "LINK" LED which should be on solid green.
7. Launch MeterLink and create a new meter record.

Dual configuration - Initial meter communication settings - Transmitter head 1

Procedure

1. Turn on DHCP Switch for Transmitter Head 1.

Note

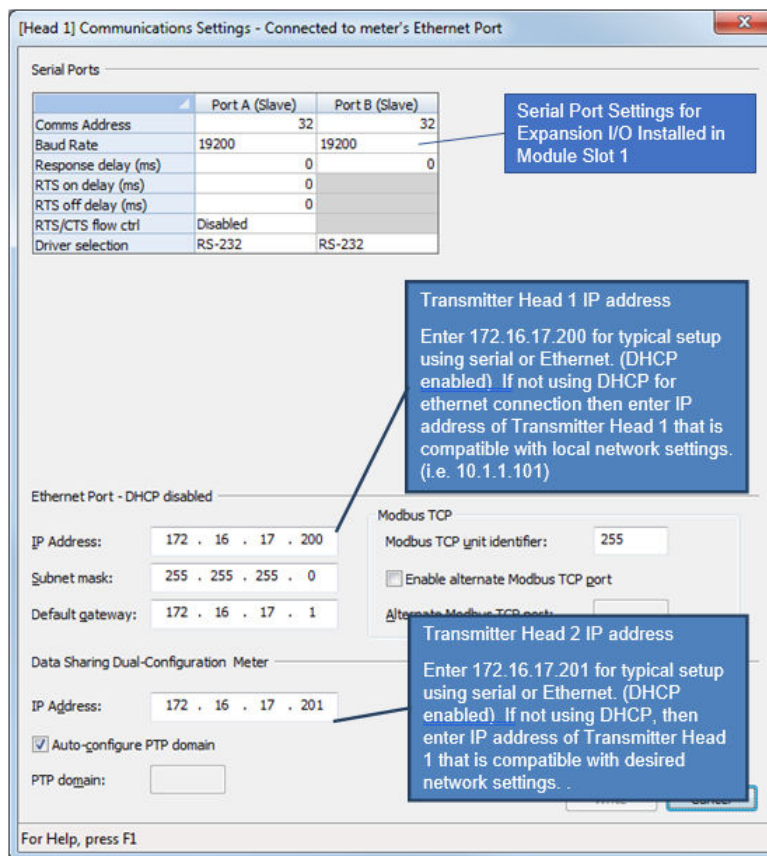
When DHCP is enabled on Head 1, Head 1 and Head 2 IP address settings automatically become 192.168.135.100 and 192.168.135.101, respectively. This allows for simple direct laptop ethernet connection to both heads if meters are connected with Expansion I/O module. This eliminates requirement to connect separately to each meter for initial startup.

2. Turn off DHCP Switch for Transmitter Head 2 or disconnect Ethernet to Head 2.
3. Connect to Transmitter Head 1 (192.168.135.100) using MeterLink.
4. Select **Meter** → **Communication Settings**.
5. Enter IP address of Transmitter Head 1 in Data Sharing Dual-Configuration Meter IP address entry box.
 - DHCP Disabled : 172.16.17.200 or user specified
 - DHCP Enabled : Use Default, no changes required in configuration
6. Enter IP address of Transmitter Head 2 in Data Sharing Dual-Configuration Meter IP address entry box.
 - DHCP Disabled : 172.16.17.201 or user specified
 - DHCP Enabled : Use default

Note

If using DHCP for connection to meter, then use default address 172.16.17.200 for IP address of Head 1 and 172.16.17.201 for IP address of Head 2. DHCP Switch should be enabled on only one head when performing setup and in normal operation. For operation with DHCP, it is recommended to have Head 1 with DHCP enabled. If DHCP is used, dual-configuration meters will use IP address 192.168.135.100 (Head 1) and 192.168.135.101(Head 2) for data sharing regardless of settings for IP address. Meters should not be connected to local network with DHCP enabled.

Figure 2-1: Transmitter Head 1 - Communication settings shown for Dual Configuration Data sharing

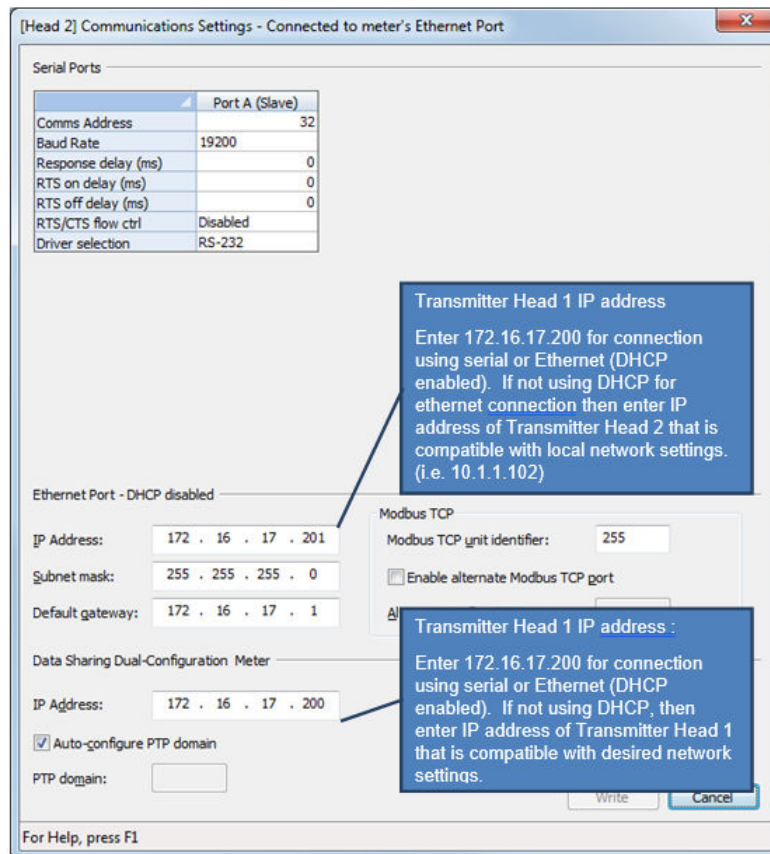


Dual configuration - Initial meter communication settings - Transmitter head 2

Procedure

1. Turn off DHCP Switch for Transmitter Head 1.
2. Turn on DHCP Switch for Transmitter Head 2.
3. Connect to Transmitter Head 2 Using MeterLink.
4. Select **Meter** → **Communication Settings**.
5. Enter IP address of Transmitter Head 2 in Ethernet Port entry box.
 - DHCP Disabled : 172.16.17.201 or user specified
 - DHCP Enabled (Head 2): 172.16.17.201
6. Enter IP address of Transmitter Head 1 in Data Sharing Dual-Configuration Meter entry box.
 - DHCP Disabled : 172.16.17.200 or user specified
 - DHCP Enabled (Head 1): 172.16.17.200

Figure 2-2: Transmitter Head 2 - Communications settings shown for Dual Configuration Data sharing



Import a meter record

Procedure

1. Select **File** → **Import** from the Meter Directory drop-down menu or click **Import**.
2. The Import Meter Directory File dialog which allows you to select a meter directory .DAT file to import the file into the currently used meter directory file. If an identical meter record already exists and a duplicate is trying to be imported, MeterLink inserts the duplicate meter record. The **Import** button performs the same operation.

Export a meter record

Use the Export command to save the current meter directory to file. Select **File** → **Meter Directory** from the Meter Directory drop-down menu or click **Export**.

Procedure

1. Enable the meter directory record checkbox you want to export or click **Select All**.
2. Click **OK** to begin exporting the meter record(s). Use the Export Meter Directory File dialog to save the exported record to the default folder (C:\Ultrasonic Data) or enter another location.


3. Click **Save**. If you have an existing **METER_DIRECTORY_EXPORT.DAT** file, you are prompted to change the file name or replace the file. If changing the file name, keep the .DAT extension to maintain functionality when importing the file to the new machine.
4. Copy the exported file to the new machine.
5. Use the **Import** command to select this file and import it into the Meter directory.

Important

Due to limitations in the Microsoft® Dial-Up Networking, not all of the directory information for Direct and Modem connection can be exported to the METER_DIRECTORY.DAT file for Rosemount Ultrasonic meters. It will be able to export the meter names, Comms Address, Interface, and Telephone numbers. It will still be necessary to recheck the connection properties and verify the communication parameters such as COM port, data bits, and parity are configured correctly.

Connect to the meter

Procedure

1. From the menu bar, select **Meter** → **Connect** or click , the **Connect** icon, on the toolbar.
2. The Connect to Meter dialog box displays a list of meters setup in MeterLink. Click either **Direct** or **Ethernet** next to the Meter Name to establish a connection with your Rosemount Ultrasonic meter.

For Rosemount 3410 Series Firmware v1.60 and later, MeterLink will display a **Meter Login** dialog box and require a valid username and password to be entered to make a connection.

The default username for a meter from the factory or for a meter upgraded from a firmware version prior to v1.60 is administrator. The default password is Administrator-XXXXX where XXXXX is the non-zero padded CPU serial number which can be found on a label on the CPU Module.

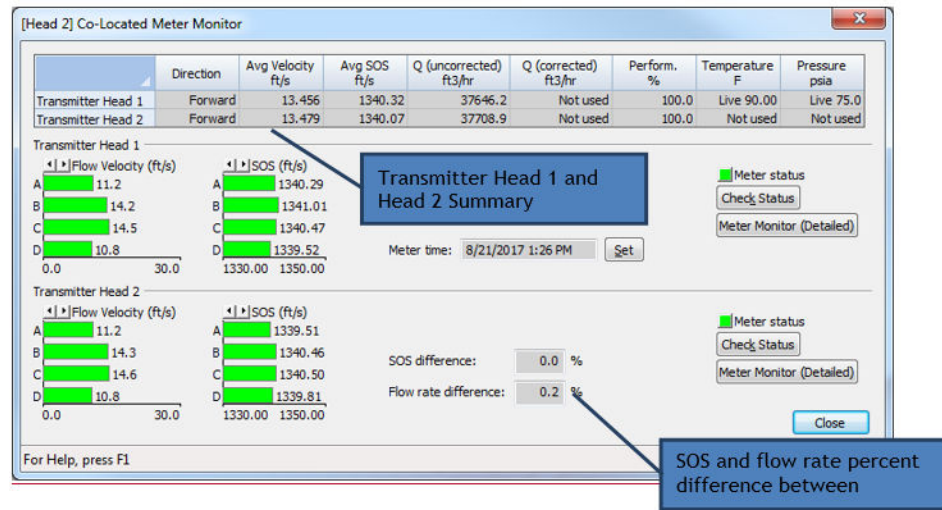
MeterLink v1.90 or later is required to make a connection to a meter requiring user authentication. See **Meter** → **Manage Users** for more details on setting up users, user types and passwords.

Meter monitor Summary page - Dual configuration

Procedure


1. Dual-Configuration meter functionality can be verified by viewing the Summary Page in MeterLink. Summary page will show measurement data and meter status from both transmitter heads. Data sharing communication settings must be properly configured in Meter setup.
2. Select **Meter** → **Monitor** → **Summary**.

Figure 2-3: Transmitter Head 1 and Head 2 Summary



Collect "As Found" logs and reports

Use the MeterLink Logs/Reports menu and collect and save the logs and reports for a historical record of the meter at several velocities within the operating range of the meter. This will establish a baseline to be used for the trending of the meter diagnostics. Save the following logs and reports for the "As Found" settings (factory default).

- Maintenance log
- Event log, including Audit, Alarm and System logs
- Save your meter's configuration file
- Use the **Tools** → **Edit/Compare Configuration** menu to display the dialog. Enable the **View All** or **Metrology** radio button and click **Read**.
The All View displays the meter's extended configuration parameters. Grayed out values are read-only, but help describe the configuration. The Metrology View displays the path dimensions, pipe diameter, transducer delay parameters, zero flow calibration coefficients, and flow calibration coefficients.
— Click the question mark icon, , for the data point to display additional information.
- Click **Save** to save the configuration file. By default, the file is saved to the Data Folder setup in **File** → **Program Settings**.

Customize MeterLink settings

Open MeterLink and access **File** → **Program Settings**, then input the desired settings for your meter. Your user name and company name is included on reports and logs generated with MeterLink.

Figure 2-4: Program Settings

Program Settings

User name: tsharma

Company name: Emerson/EICP

Data folder: C:\Ultrasonic Data Browse...

Use each meter's name to create a subfolder for its data

Meter name for logs, folders, etc.

Meter name from the meter (recommended)
 Prompt if the meter name from the meter is different from the meter directory name

Display units for this program: U.S. Customary Metric

Liquid meter volume units: gal ft3 bbl

Prompt to save meter configuration: Field Setup Wizard Transducer Swap-Out (zero flow) Set Baseline Wizard Meter Factors dialog

Connect to Meter dialog

Automatically open when Daniel MeterLink opens
 Dim non-pingable Ethernet connections

Automatically open Meter Monitor after connecting Prompt to open logs
 Use FTP passive mode Check for updates via the Web
 Allow backup upgrade mode connection Use HTTP for file transfer if available in the meter
 Tab from spreadsheet to next control when editing

TCP/IP meter connection database timeout: 13 s Reset

Override system default printer:
The system default printer will be used Change Clear

Product type preference: Gas ultrasonic meters

Excel workbook format: Excel Binary Workbook (*.xlsb)

OK Cancel

For Help, press F1

- User name
- Company name
- Data folder (where meter's data is stored)
- Select the checkbox to create a subfolder with the meter's name under Data folder for saving and opening files for your meter
- Display units (of measurement); U.S. Customary or Metric for necessary unit conversions read by the meter
- Meter volume units; gal, cubic feet, or bbl
- Prompt to save meter config (configuration) prompts you to save a copy of the meter configuration after writing changes to the meter
- Run Connect dialog automatically after connecting
- Run Meter Monitor automatically after connecting
- Run Meter Monitor summary or detailed view after connecting
- Use FTP passive mode (client - server port communications)
- Tab from spreadsheet to next control instead of next cell
- TCP/IP meter connection database timeout - amount of time MeterLink waits to respond to a request for data from the meter database (default 13 seconds)
- Override system default printer - used to change printer

- Product type preference - meter type you will most often connect, gas or liquid

HTTP file transfer

- Use HTTP for file transfer if available in the meter.
 - A checkbox is enabled when selected.
 - MeterLink uses HTTP protocol for file transfer with meter if it is supported by firmware.
 - Rosemount 3410 Series Firmware v1.50 and later supports HTTP protocol for file transfer for Program Download, Collect Archive Logs, Collect XML SMV Report and cache database configuration XML file when connecting to meter for the first time.
 - Alternatively, Rosemount 3410 Series Firmware also supports FTP protocol for file transfer for Program Download, Collect Archive Logs, Collect XML SMV Report and cache database configuration XML file when connecting to meter for the first time.

2.1.2 Setup Modbus communications

Rosemount 3410 Gas Ultrasonic Flow Meters support RS-232 or RS-485 4-wire or 2-wire half duplex serial interface to an external system (e.g., flow computer) using Modbus ACSII protocol with the following parameters:

Setting	Value
Baud rate	19200
Data bits	7
Stop bits	1
Parity	even
Protocol	Modbus ACSII

Refer to your flow computer user manual to set I/O settings required to allow serial communication with the Rosemount 3410 Gas Ultrasonic Flow Meters.

The Rosemount 3410 Gas Ultrasonic Flow Meters supports ASCII and RTU Modbus communication. For ASCII Modbus, both 7E1 and 7O1 are supported. For RTU Modbus, 8N1 is supported. The communication ports provide automatic protocol detection - only the baud rate and Modbus ID need to be specified. Also, refer to the Rosemount website and select the Product page for the model of your meter:

www.emerson.com/en-us/automation/emerson

2.1.3 Setup HART® communications

Rosemount Ultrasonic Flow Meters are HART-capable devices utilizing the 4-20mA signal Analog Output 1 on the CPU Module, in which the digital signal is sent from the field device (Rosemount Ultrasonic Flow Meter) to the host (PC running AMS™ Device Manager or a Field Communicator). An external 24V power supply is required for the analog signal from the CPU Module.

The HART Device Description application provides dynamic variables, device-specific commands, universal commands and common practice commands in accordance with the HART Communication Foundation. The Device Description defines the communication details from the device to the host (e.g. menus for the Field Communicator, graphical displays for AMS Device Manager and the device parameters - process variables, pressure, temperature, diagnostics and three status alert groups - Failed, Maintenance

and Advisory). Refer to the *Rosemount 3410 Series Gas Ultrasonic Meters HART Field Device Specification*, (00825-0400-3240) for details.

Also see, the HART Communications Foundation, AMS Device Manager and 475/375 Field Communicator websites:

- www.emerson.com/en-us/catalog/asset-reliability/ams-ams-device-manager
- www.emerson.com/documents/automation/user-s-manual-en-104978.pdf

2.1.4 Setup the meter in a DeltaV System

Rosemount 3410 Series Ultrasonic Flow Meters are compatible with DeltaV System communications. The following are optional communications configurations of Rosemount Ultrasonic Flow Meters:

- Serial connection for RS-232 or RS-485
- Ethernet
- HART®
- Modbus TCP/IP (requires a VIM card)

Refer to the *Install Your Digital Automation System* manual for field wiring terminations, I/O interface, power, and DeltaV control Network.

1. Access the DeltaV website hyperlink shown below.
2. Click **Books Online** under **Quick Links**.
3. Setup your user account and access the manual.

www.emerson.com/en-us/automation/deltav

2.2 Manage users

Starting with Rosemount 3410 Series Firmware v1.60, the meter will authenticate any user making a connection to the meter using MeterLink. MeterLink will prompt for a username and password that will be authenticated by the meter before a successful connection is established.

Only users with an Administrator user type can access the **Meter** → **Manage Users** dialog box in MeterLink to add, change, or delete users within the user database. Changes to the user database are not write protected by the **WRITE PROT.** switch. A user with the Administrator user type can also export and import the user database from one meter to another to facilitate the user management function across multiple meters. MeterLink v1.90 or later is required to make a connection to a meter requiring user authentication.

Note

Modbus protocols do not support authentication so meters cannot authenticate communications over these protocols. No changes have been made to how these protocols function.

2.2.1 User setup

Open MeterLink and connect to the meter as user with the Administrator user type. Access **Meter** → **Manage Users**, to bring up the dialog box to add, change or delete users. A maximum of 25 users can be setup in a meter. The following are the rules needed to successfully setup new users in a meter.

Username

Username can be from 1 to 20 characters in length. Usernames are stored in the meter in all lowercase lettering. The user can enter a username in upper or lowercase lettering, but it will be converted to lowercase for authentication. The following characters are allowed:

- Uppercase letters (A to Z)
- Lowercase letters (a to z)
- Numbers (0 to 9)

User type

There are three user types supported:

User Type	
Administrator	Full read/write capability plus privileges for user management
Engineer	Full read/write capability but without user management privileges
Operator	Read only capability. Operator is not allowed to acknowledge alarms.

At least one user with the Administrator user type must be always configured in the meter. The meter will not allow the last user with an Administrator user type from being deleted. Multiple users can have the same user type.

Passwords

Passwords must be 8 to 20 characters long. Only characters from the following groups are allowed.

- Must have at least one uppercase letter [A-Z]
- Must have at least one lowercase letter [a-z]
- Must have at least one number [0-9]
- Must have at least one special character from the following:
 - ! Exclamation mark
 - " Straight double quote
 - # Number
 - \$ Dollar
 - % Percentage
 - ' Straight single quote or Apostrophe
 - (Open parenthesis
 -) Close parenthesis
 - * Asterisk
 - + Plus
 - , Comma
 - - Hyphen
 - . Period
 - & Ampersand
 - / Slash

- : Colon
- ; Semicolon
- = Equals
- > Greater than
- << Less than
- ? Question mark
- @ At symbol
- [Opening bracket
- \ Backslash
-] Closing bracket
- ^ Caret-circumflex
- _ Underscore
- ` Grave accent
- { Opening brace
- | Vertical bar
- } Closing brace
- ~ Tilde

2.2.2 Import/Export user database

To help facilitate managing users across multiple meters, there are options to export and import the user database from one meter to another. This allows user to be setup on one meter and easily transferred to others. These functions are also needed in the event a CPU module in a meter must be cold started to default values or replaced.

To export the user database from the meter to a local file on your computer, click **Export** under **Meter** → **Manage Users** in MeterLink. MeterLink will prompt for a password for the meter to use to encrypt the database to provide some level of security for this file once MeterLink saves it to your computer. This encrypted user database file and the password must be kept in a secure location since it contains sensitive information such as usernames and passwords.

To import an encrypted user database file on your computer to a meter, click **Import** under **Meter** → **Manage Users** in MeterLink. MeterLink will prompt for the password that was used to encrypt the file during export. The file and password will be sent to the meter and if the meter can successfully decrypt the file, the existing user database in the meter will be deleted and replaced with the imported user database.

2.2.3 Reset users

It is important to keep track of the login credentials for at least one user with the Administrator user type to avoid a situation where administration rights are lost to a meter.

If this occurs, there is a user reset mode that can be initiated to delete all users in the user database and restore the default administrator username and password.

Prerequisites

- The default password is Administrator-XXXXX where XXXXX is the non-zero padded CPU serial number which can be found on a label on the CPU Module.
- This operation cannot be done remotely and requires physical access to the CPU module.

Do the following to delete all users and restore back the default administrative user.

Procedure

1. Attach your computer with MeterLink to the meter that requires the user database to be reset using the appropriate cable.
2. To put the meter in reset mode, transition the Port A Override switch on the CPU module from the Off position to the On position three times within five seconds and leave the switch in the On position after the third transition.
The meter will stay in this reset mode for two minutes or until the Port A Override switch is turned off.

Tip

Use a retractable ball point pen with the ball point retracted as a tool to transition the switch.

3. Within the two minutes, connect to the meter with MeterLink. A **Meter Reset Mode is enabled** dialog box will appear.
4. Click the option to **Reset Users**.
MeterLink™ prompts you to confirm that the user database should be reset.
Once the operation is confirmed, the meter will delete the user database and create the default administrator user. MeterLink will disconnect from the meter.
5. Connect to the meter again using the default administrator username and go to **Meter → Manage Users** to setup new users and change the default password for the administrator user.

Note

For added security, the default username for the administrator user can be changed as well.

3 Optional feature keys

3.1 General overview of the Optional feature keys

Rosemount 3410 Series Gas Ultrasonic Flow Meters offer many industry-leading features including Chapter 21-compliant data log access, gas chromatograph (GC) interface, sound velocity calculation (with comparison to measured sound velocity) and Continuous Flow Analysis diagnostics.

With Rosemount 3410 Series Firmware v1.50 and later, features keys will be generated on meter start up automatically and this makes all optional features available in the meter.

For firmware versions older than 1.50, use **Meter** → **Key Manager** in MeterLink to enter keys to enable optional features.

3.1.1 GC interface key

The GC interface feature allows the meter to read gas property data (composition and heating value) from a Rosemount gas chromatograph.

The meter can use the gas composition data to:

1. Calculate AGA8 compressibilities for converting volumetric flow rate and volumes to standard (base) condition. AGA8 Gross Method 1, AGA8 Gross Method 2, AGA8 Detailed Method and GERG-2008 calculations are available.
2. Calculate AGA8 density for calculating mass rate and mass totals
3. Calculate the sound velocity (see [AGA10 key \(sound velocity calculation\)](#)).

The meter uses the GC-reported gas heating value to calculate the energy rate and totalized energy rate values. This feature is enabled/disabled via the **GCKey** data point.

Note

Only Head 1 will require the GC interface key to enable data sharing of T, P and GC composition with Head 2.

3.1.2 AGA10 key (sound velocity calculation)

The sound velocity calculation feature allows the meter to calculate the predicted sound velocity based upon the gas composition and compare this value to the measured average sound velocity. The gas composition can be either specified via data points or optionally read live from a GC (see above). The sound velocity is calculated using AGA10 if **HCHMethod** is set to Detail Method or GERG-2008 (AGA8 Part2) if **HCHMethod** is set to GERG-2008. This feature is enabled or disabled via the **AGA10Key** data point.

3.1.3 Continuous Flow Analysis (CFA) key

The Continuous Flow Analysis key enables all optional features and provides extensive diagnostics for the meter's operational health.

Note

Two Separate CFA keys are required for enabling Continuous Flow Analysis in both transmitter heads. If a CFA key is available for only Head 1, then Head 2 will only support GC interface. AGA10 and CFA functionality will not be available in Head 2.

4 Measurement

4.1 Flow measurement

Rosemount 3410 Gas Ultrasonic Flow Meters measure the transit times of ultrasonic pulses passing through the medium on two parallel planes. The measurement paths (also referred to as "chords") are angled to the pipe axis, and each chord has two transducers acting alternately as transmitter and receiver as shown in [Figure 4-1](#). This permits the transit times to be measured both with and against the flow (upstream and downstream).

The transducers are mounted on the meter body at accurately known locations for each pipe size so the distance L between opposing transducers and the angle are precisely defined for the measurement path.

Models 3415, 3416, and 3417 consist of two meters in one body. Transmitter head 1 for all models controls 4 direct transducer paths. Transmitter head 2 for the 3415 and 3416 controls 1 or 2 reflective paths. Transmitter head 2 for the 3417 controls 4 direct paths that are a mirror image of transmitter head 1.

Figure 4-1: Direct path transit-time measurement principle

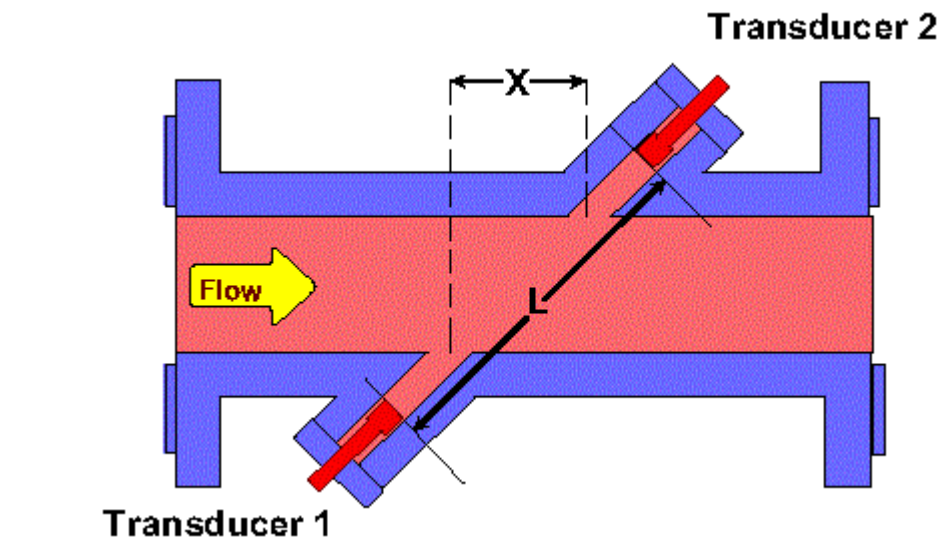
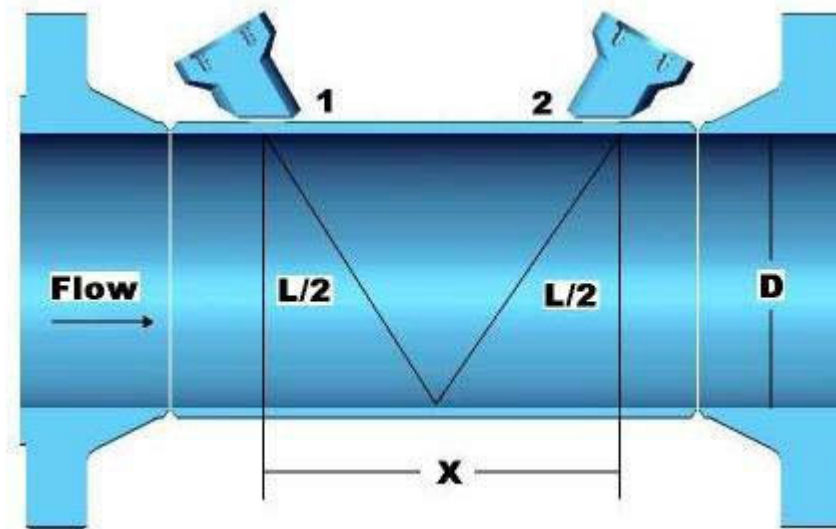


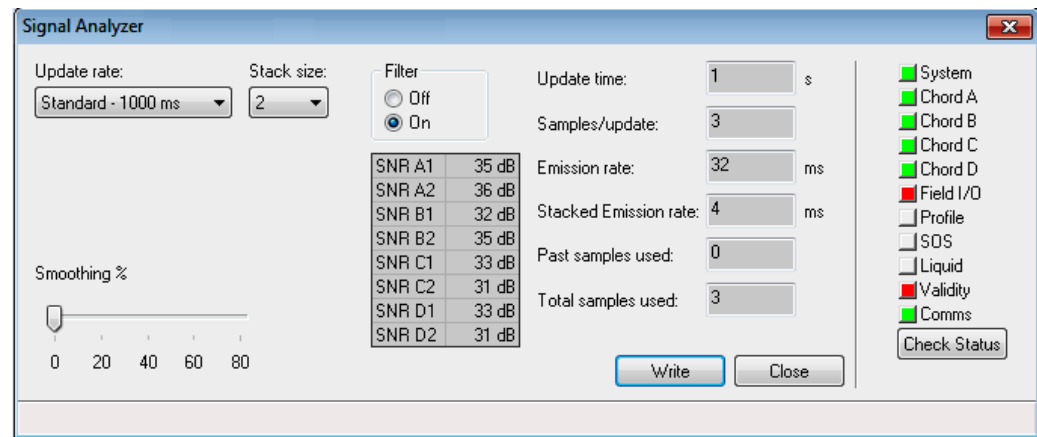
Figure 4-2: Reflective path measurement principle



4.1.1 Transducer timing control

The following terms are used in explaining the effects of transducer timing control, the performance of batch data collection and calculation updates in Rosemount 3410 Gas Ultrasonic Flow Meters.

Figure 4-3: Signal Analyzer - update rate, stack size, filter and emission rate



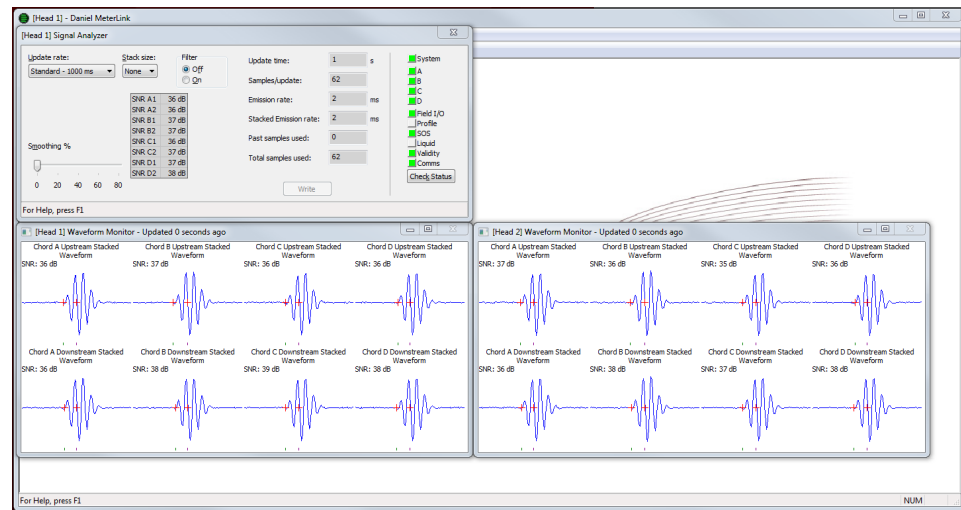
4.1.2 Signal analyzer for dual configuration

MeterLink Signal Analyzer page allows for simultaneous viewing of transducer signals from both meters, in addition to allow for change of meter update rates, stack size, and filtering.

Procedure

1. Modification to update rate parameters will only be written to the Meter shown in upper right hand corner of Signal Analyzer. Other meter can be selected by closing window and typing Ctrl+Shift+1 or 2 for Head 1 or Head 2 respectively.
2. Or alternately select **Meter** → **Head 1 meter name** or **Meter** → **Head 2 meter name**. Co-located communication settings must be properly set in each meter.
3. Select **Meter** → **Signal Analyzer**.

Figure 4-4: Signal analyzer for Dual configuration



Terminology

- **Sequence** - a complete cycle of firing all enabled transducers in a single round of transducer operation.
- **Stacking** - the process of modifying a sequence so that each individual transducer is fired "x" times (where x equals the stack size) before the next transducer in the sequence is fired.
- **Stack size** - the multiple of times each transducer is fired before the next transducer within the sequence is fired. (When stacking is absent or disabled, the stack size is actually 1, because each enabled transducer is fired once during the sequence. When stacking is applied or enabled, it is applied in increments of 2, 4, 8, and 16 and are the only stack size choices, so that each enabled transducer is fired 2, 4, 8, or 16 times before the next transducer in the sequence is fired.)
- **Emission rate** - the time elapsed before the next transducer in a sequence is fired, regardless of stack size (minimum emission rate is 2 milliseconds with the Filter **ON** or **OFF**). We recommend the default Filter setting, which is the **OFF** position.
- **Stack emission rate** - the time elapsed before a single transducer is re-fired when stacking is enabled (minimum stack emission rate is 2 milliseconds with the Filter **OFF**).
- **Chords inactive or active** - the exclusion or inclusion of a chord-forming pair of transducers in the sequence of transducer operation.
- **Update time** - the time elapsed, in seconds, between each processing, or recalculation of data that is collected from sequences of transducer firings.
- **Batch period, or batch cycle** - synonymous with Update time, as defined above.

- **Sample** - refers to one point on the waveform as in samples per cycle. The data that is collected from one Sequence of transducer operation. (This term is displayed in the MeterLink™ Signal Analyzer screen, and is nearly synonymous with Sequence, as defined above. That is, Samples/update, as displayed in the MeterLink™ Signal Analyzer Wizard, could be interpreted as Sequences/update.) This shows the average number of new samples collected during an update period.

4.2 Signal processing

The signal at the receiving transducer is amplified, digitized and processed digitally to provide accurate transit time measurement.

A measure of the signal "quality" is the signal-to-noise ratio (SNR). The higher the SNR, the better the signal. In general there are two types of noise: "white" noise and "colored" noise. White noise is noise that occurs across the frequency spectrum and is asynchronous to the transmitted signal. Colored noise is concentrated around a particular frequency and can be synchronous with the transmitted signal. The meter provides two methods for improving the received signal waveform SNR by reducing the noise energy: Stacking and Filtering.

When making changes to these parameters in dual-configuration meters such as the 3415, 3416, 3417, it is generally necessary to make the same changes in both transmitter heads in order to maintain compatible transducer firing sequence durations. The meter will generate an alarm if the two transmitter heads are not in synchronization which may be an indication that they are not configured the same.

4.2.1 Stacking

Stacking is a method of firing a transducer multiple times and averaging the received signals on a point-by-point basis.

Stacking is effective on asynchronous noise such as is typically seen with valve noise. This method is not useful for removing synchronous noise and should not be used when there is a great deal of signal "jitter." Meters are configured by default with a stack size of 1 (no stacking).

Care should be taken when turning on stacking and it is recommended to consult with Rosemount Customer Service if you are unsure of how stacking a signal can affect the meter's operation. Refer to Technical Support under the Help menu of MeterLink for contact information.

The number of consecutive times to fire each transducer is specified via the StackSize data point. Available stack sizes are 1 (None), 2, 4, 8, and 16. A stack size of 1 selects no stacking (i.e., stacking disabled). Stacking is only available when the standard update rate is selected (see [Batch update period](#)).

4.2.2 Filtering

Filtering applies a bandpass filter that removes noise that is above and below the transducer frequency.

Filtering is effective on noise outside of the frequency passband of the filter (e.g., filtering works on any noise outside of the passband of the filter).

Filtering is enabled/disabled via the Filter data point (TRUE=enable filtering, FALSE=disable filtering). Meters are configured by default with filtering disabled. The minimum emission rate for the gas meter is 2 milliseconds with the filter ON or OFF. We recommend the default Filter setting, which is the OFF position.

Care should be taken when enabling/disabling filtering and it is recommended to consult with Flow Lifecycle Services for Rosemount products if you are unsure of how this change can affect the meter's operation. Refer to Technical Support under the Help menu of MeterLink™ for contact information.

4.2.3 Batch cycle processing

Batch update period

Calculation updates performed by the meter, for deriving volume and velocity, are based on batches of data samples collected from sequences of transducer firings. The batch update period is dependent upon the user specified batch update period (**SpecBatchUpdtPeriod**) and the stack size (**StackSize**) as shown in Table 4-1. The Standard batch update period is the default. The actual batch update period is readable via the **BatchUpdatePeriod** data point.

Table 4-1: Actual meter update period

		Stack size				
		1 (None)	2	4	8	16
SpecBatchUpdtPeriod	Rapid (250 ms)	0.25 sec	N/A	N/A	N/A	N/A
	Standard (1000 ms)	1 sec	1 sec	1.5 sec	3 sec	5 sec

Emission rates

The emission rate is the period between firing two different transducers. The stacked emission rate is the period between consecutive firings of a single transducer when stacking is used (i.e., the stack size is not set to **None**).

The actual emission rates used (readable via the **EmRateActual** and **StackEmRateActual** data points) are functions of the desired emission rates, meter type, firing sequence, stack size, and pipe diameter.

4.2.4 Smoothing

The Rosemount 3410 Series Gas Ultrasonic Flow Meter applies a method for smoothing the output (particularly the frequency output) by averaging times collected from past batch periods with new times for the current batch period.

Smoothing can be applied in the following increments: 0 (i.e., smoothing is disabled), 20, 40, 60, or 80%.

For example, setting Smoothing to 20% means that of the samples used for the current update, 20% will be from previously collected samples and 80% will be from the newly collected samples. Thus, if eight new samples are collected, then those eight samples along with the last two previous samples would be used together for the current update period calculations.

Meters are configured by default for Smoothing of 0% (only new samples are used for the **Current Update period**).

4.3 Acquisition mode

Rosemount 3410 Gas Ultrasonic Flow Meters have two modes of normal operation: Acquisition and Measurement. The Acquisition mode is used to acquire the ultrasonic signals. This mode is entered when power is applied to the meter.

Once the ultrasonic signals are acquired, the Measurement mode is entered and the flow velocity is measured. The meter remains in the Measurement mode as long as at least one chord is operational.

If while in the Measurement mode all chords fail, then the meter re-enters the Acquisition mode. If the VelHold data point is set to a value greater than zero, then, while in the Acquisition mode, the meter holds the average weighted flow velocity to the last good value for up to the VelHold number of batches before setting the velocity to zero. The VelHold default value is 0.

The Acquisition mode uses the chords' "L" dimensions (**LA...LD** as appropriate to the meter type) and the specified minimum and maximum sound velocities (**SSMin** and **SSMax**) determines the signal search range. **MinHoldTime** and **MaxHoldTime** are also used to determine the signal search range. The meter uses the more restrictive of **SSMin/MaxHoldTime** and **SSMax/MinHold** time.

4.3.1 Re-acquisition

When fewer than **MinChord** (default 1) chords are good, then the meter re-enters the Acquisition mode. If **MinChord** is set to the number of active chords, the meter will reacquire on the first time a chord is failed for a batch.

Note that failed for a batch is different from hard failed. A chord fails for a batch when Pct-Good[A1..D2] is less than **MinPctGood**.

Hard fails occur after **AlarmDef** number of batches in a row.

4.4 Chord gas and sound velocity measurements

At each batch update period, each firing path's transit time measurements are averaged. The average (mean) value for each path is available via data points **MeanTmA1...** **MeanTmD2** (as appropriate for the meter type).

NOTICE

The data point names often use a "short-hand" way of identifying the receiving transducer. The last two characters identify the chord (A...D) and the transducer (1=upstream, 2=downstream). For example, **MeanTmA1** is the mean transit time for the chord A upstream transducer.

The difference between a chord's average upstream transit time and average downstream transit time is the average delta time. The chord's average times and the chord "X" and "L" dimensions are used to calculate the gas velocity and sound velocity measured by the chord as shown in [Equation 4-1](#) and [Equation 4-2](#).

Equation 4-1: Chord Gas Velocity

$$V_{\text{chord}} = \frac{L_{\text{chord}}^2}{2X_{\text{chord}}} \left[\frac{t_1 - t_2}{t_1 t_2} \right]$$

and

Equation 4-2: Chord Sound Velocity

$$C_{\text{chord,classic}} = \frac{L_{\text{chord}}}{2} \left[\frac{t_1 + t_2}{t_1 t_2} \right]$$

$$C_{\text{chord}} = C_{\text{chord,classic}} \times \text{PortAngleFactor}$$

where the *PortAngleFactor* is a dimensionless factor that is dependent upon the chord port angle with respect to the direction of flow. The *PortAngleFactor* is calculated based on chord "X" dimension, chord length "L", chordal configuration, port angle, transducer type, speed of sound, and fluid velocity. The factor is one for Dual-X Chordal configuration meters and for BG Chordal configuration meters with 45 degree port angles and Transducer type is not set.

4.4.1 Average sound velocity

The Average Sound Velocity is calculated as the average of the active chord sound velocity measurements as shown in the equation below:

Equation 4-3: Average sound velocity

$$C_{\text{Avg}} = \frac{\sum \text{ActiveChords } C_{\text{chord}}}{\text{NumActiveChords}}$$

where

- C_{Avg} = average sound velocity (m/s) (**AvgSndVel**)
- C_{chord} = chord average sound velocity (m/s) (**SndVelA... SndVelD**)
- NumActiveChords = number of active chords

4.4.2 Sound velocity calculation and comparison

The Rosemount 3410 Series Gas Ultrasonic Flow Meter offers an option to calculate the sound velocity and compare the result to the meter- measured sound velocity on an hourly basis.

This feature is enabled via the AGA10 Key (see [AGA10 key \(sound velocity calculation\)](#)). The gas property data required for using this feature can be specified via data points or optionally read from a Rosemount GC ([Configure Gas Chromatograph parameters](#)). The AGA8 Detail Method or GERG-2008 must be selected (via the **HCH_Method** data point, [Configure Gas Chromatograph parameters](#)) in order for the sound velocity calculations to be performed.

Every five seconds the meter updates the calculated sound velocity. This value is readable via the **AGA10SndVel** data point and the calculation status value is readable via the **AGA10SndVelStatus** data point. The status values are as listed in the table below:

Table 4-2: Status of AGA speed of sound calculation

AGA10SndVelStatus value	Description
0	Calculation OK (no errors)
1	Calculation not performed as the feature is not enabled. AGA10SndVel is set to zero.
2	Calculations not performed as the AGA8 method (HCH_Method) is not the Detail Method or GERG-2008. AGA10SndVel is set to zero.

Table 4-2: Status of AGA speed of sound calculation (continued)

AGA10SndVelStatus value	Description
3	Calculations not performed as the AGA8 calculations are invalid. AGA10SndVel is set to zero.
4	Calculations not performed due to encountered division by zero. AGA10SndVel is set to zero.

Over the course of an hour (starting from the top of the hour), the meter calculates the average measured sound velocity (the average of the average weighted sound velocity) and the average calculated sound velocity. At the end of the hour, the two averages are compared; the comparison error (%) is readable via the **SndVelCompErr** data point.

Note that the comparison error is only calculated at the end of the hour when there is at least 75% of a log hour worth of valid flow data during the hour. A valid flow data means that all of the following are true:

- no sound velocity calculation errors occurred (i.e., **AGA10SndVelStatus** always equal to 0),
- the measured average flow velocity (**AvgFlow**) is between the diagnostic flow analysis limits (**FlowAnalysisLowFlowLmt** and **FlowAnalysisHighFlowLmt**), and
- the measured sound velocity was always valid (as indicated by the **QMeterValidity** data point).

4.4.3 Average weighted gas flow velocity

When all active chords are non-failed, the average weighted gas flow velocity is a weighted sum of the chord velocity measurements as shown in Equation 4-4 where the chord weights are determined by the meter geometry.

Equation 4-4: Average weighted gas flow velocity

$$V_{AvgWtd} = \sum_{ActiveChords} Wt_{chord} V_{chord}$$

where

V_{AvgWtd} = average weighted gas flow velocity (m/s) (**AvgWtdFlowVel**)

Wt_{chord} = chord weight (dimensionless) (**WtA ... WtD**)

V_{chord} = chord average gas velocity (m/s) (**FlowVelA ... FlowVelD**)

4.4.4 Average weighted flow velocity using chord proportions

In the event of one or more chord failure(s), the meter operation is dependent upon the number of non-failed chords. If there is at least one operating chord, then the meter uses a velocity estimation method described in the following paragraphs.

If all chords fail, then the meter re-enters the Acquisition mode as described in the [Re-acquisition](#) section.

The meter partitions the velocity range (for forward and reverse flow) into ten consecutive, non-overlapping "bins" (where the velocity range is as specified via the **MeterMaxVel** data point).

The meter maintains a set of bins for each active chord where each bin contain three data values: (1) the chord's average velocity (within the bin's velocity range), (2) the chord's average proportion value, and (3) an indicator that the value is still the default (**Is[Fwd/**

Rev]Prop[A..D]DfltBin[1..10]). A chord proportion value is the ratio of the chord velocity to the average weighted flow velocity as shown in Equation 4-5 below. The default indicator is used to determine if a bin's velocity and proportion data values have been updated from their initialized values. The bins are initialized with the average velocity over the bin's range and meter-geometry-dependent proportion values. All default indicators are initialized to **TRUE**. The bin data is stored in non-volatile memory.

Equation 4-5: Chord proportion calculation

$$\text{Prop}_{\text{chord}} = \frac{V_{\text{chord}}}{V_{\text{AvgWtd}}}$$

where

$\text{Prop}_{\text{chord}}$ = chord proportion (dimensionless)
 V_{chord} = chord velocity (m/s) (**FlowVelA ... FlowVelD**)
 V_{AvgWtd} = (**AvgWtdFlowVel**)

When the meter has operated for a user-specified number of consecutive batches without any chord failures, the meter updates each chord's data values for the bin containing the chord velocity as shown in Equation 4-6 and sets the bin's default indicator to **FALSE**. The **PropUpdtBatches** data point, configurable via the MeterLink **Edit/Compare Configuration** screen, specifies the number of consecutive failure-free batches required for updating the bin data (range: [1, 1000], default: 24). The **NumVals** data point (that determines how quickly an average value changes) is also configurable via the **Edit/Compare Configuration** screen (range: [1, 1000], default: 10).

Equation 4-6: Updating chord proportion bin data values

$$\text{AvgVel}_{\text{ChordBin}_{n+1}} = \frac{(\text{AvgVel}_{\text{ChordBin}_n} \cdot (\text{NumVals} - 1)) + V_{\text{chord}}}{\text{NumVals}}$$

$$\text{AvgProp}_{\text{ChordBin}_{n+1}} = \frac{(\text{AvgProp}_{\text{ChordBin}_n} \cdot (\text{NumVals} - 1)) + \text{Prop}_{\text{chord}}}{\text{NumVals}}$$

where

$\text{AvgVel}_{\text{ChordBin}_{n+1}}$ = chord bin (n+1)st average velocity (m/s)
 $\text{AvgVel}_{\text{ChordBin}_n}$ = chord bin nth average velocity (m/s)
 NumVals = update factor data point (dimensionless) (**NumVals**)
 V_{chord} = chord velocity (m/s) (**FlowVelA ... FlowVelD**)
 $\text{AvgProp}_{\text{ChordBin}_{n+1}}$ = chord bin (n+1)st average proportion value (dimensionless)
 $\text{AvgProp}_{\text{ChordBin}_n}$ = chord bin nth average proportion value (dimensionless)
 $\text{Prop}_{\text{chord}}$ = chord proportion (dimensionless)

In the event of a chord failure with at least one operating chord, the meter's average weighted flow velocity is estimated as shown in Equation 4-7.

Equation 4-7: Estimating average flow velocity using proportion values

$$V_{\text{AvgWtd}_{\text{est}}} = \frac{\sum \text{Non-Failed Chord}(s) \cdot V_{\text{chord}}}{\sum \text{Non-Failed Chord}(s) \cdot \text{InterpProp}_{\text{chord}}}$$

where

$V_{\text{AvgWtd}_{\text{est}}}$ = estimated average weighted flow velocity (m/s) (**AvgWtdFlowVel**)
 V_{Chord} = (non-failed) chord velocity (m/s) (**FlowVelA ... FlowVelD**)
 $\text{InterpProp}_{\text{chord}}$ = (non-failed) chord interpolated proportion value (dimensionless)

For each non-failed chord, the interpolated proportion value used in [Equation 4-7](#) is calculated as follows:

- If the chord's velocity is surrounded by non-default (average velocity, average proportion) data pairs, then the interpolated proportion is the linear interpolation between the two data pairs.
- If the chord's velocity has a non-default (average velocity, average proportion) data pair on one side of it but not the other, then the interpolated proportion is the data pair average proportion.
- If there are only default (average velocity, average proportion) data pairs, then the interpolated proportion is the corresponding bin's default average proportion value.

4.5 Volumetric flow rate values

The Rosemount 3410 Series Gas Ultrasonic Flow Meter meter provides three volumetric flow rate values: raw, (expansion-corrected and/or profile-effect corrected) flow-condition, and base-condition. Note that a positive volumetric flow rate indicates flow in the forward direction whereas a negative volumetric flow rate indicates flow in the reverse direction.

4.5.1 Raw volumetric flow rate

The "raw" volumetric flow rate is calculated from the average gas flow velocity (wet-calibration gas flow velocity) as shown in [Equation 4-8](#).

Equation 4-8: Raw volumetric flow rate

$$Q_{Raw} = V_{WetCal} \cdot \left[\frac{\pi D^2}{4} \right] \cdot 3600(s/h)$$

where

- Q_{Raw} = "raw" volumetric flow rate (m³/h) (**QMeter**)
- V_{WetCal} = wet-calibration gas flow velocity (m/s) (**AvgFlow**)
- π = geometric constant, pi (dimensionless) (3.14159...)
- D = pipe inside diameter (m) (**PipeDiam**)

4.5.2 Flow-condition volumetric flow rate

The flow-condition volumetric flow rate is the result of applying expansion correction and flow- profile correction to the raw volumetric flow rate as shown in [Equation 4-9](#) subject to the low- flow cut-off. If the resulting value is below the low-flow cut-off value, it is set to zero. The low-flow cut-off volumetric flow rate (**QCutOff**) is the specified low-flow velocity threshold (**ZeroCut**) converted to a volumetric flow rate.

Equation 4-9: Flow-condition volumetric flow rate

$$Q_{Flow} = (Q_{Raw})(ExpCorr_P)(ExpCorr_T)(CorrFctr)$$

where

- Q_{Flow} = flow-condition volumetric flow rate (m³/h) (**QFlow**)
- Q_{Raw} = "raw" volumetric flow rate (m³/h) (**QMeter**)
- $ExpCorr_P$ = expansion correction factor due to pressure (dimensionless) (**ExpCorrPressure**) calculated as shown in [Equation 4-10](#).

ExpCorr_T = expansion correction factor due to temperature (dimensionless) (**ExpCorrTemperature**) calculated as shown in [Equation 4-12](#).
CorrFctr = profile-effect correction factor (**CorrectionFactor**) calculated as shown in [Equation 4-11](#).

4.5.3 Pressure-effect expansion correction

The meter is capable of correcting the raw volumetric flow rate for the effect of pipe expansion due to pressure changes.

Note that for the pressure-effect expansion correction factor to be calculated, the correction must be enabled (via the **EnableExpCorrPress** data point) and the flow-condition pressure must be available (i.e., the **EnablePressureInput** data point must be set to 'Live'(1) or 'Fixed'(2), see [Configure the pressure parameters for the meter](#). The pressure-effect calculation is shown in [Equation 4-10](#). If the pressure-effect expansion correction factor is not calculated, it is set to 1.0.

Equation 4-10: Pressure-effect expansion correction

$$ExpCorr_p = 1 + [3 \times \beta \times (P_{abs,f} - P_{ref})]$$

where

ExpCorr_p = expansion correction factor due to pressure (dimensionless) (**ExpCorrPressure**)
 β = pipe linear expansion coefficient due to temperature (**MPaas-1**) (**StrainPerUnitStress**) calculated as shown in [Equation 4-8](#).
 $P_{abs,f}$ = flow-condition absolute pressure (**MPaa**) (**AbsFlowPressure**) calculated as shown in [Equation 4-15](#)
 P_{ref} = reference absolute pressure (**MPaa**) (0.101325MPaa) reference temperature for the pipe linear expansion coefficient (K)

Equation 4-11: Pressure-effect strain per unit stress

$$\beta = \frac{[D_{out}^2(1+\nu)] + [D_{in}^2(1-2\nu)]}{E \times (D_{out}^2 - D_{in}^2)}$$

where

β = pipe strain per unit stress (MPaa-1) (**StrainPerUnitStress**)
 D_{out} = outside diameter of the meter or pipe (m) (**PipeOutsideDiameter**)
 D_{in} = inside diameter of the meter or pipe (m) (**PipeDiam**)
 ν = Poisson's Ratio (dimensionless) (**PoissonsRatio**)
 E = Young's Modulus of elasticity (MPaa) (**YoungsModulus**)

4.5.4 Temperature-effect expansion correction

The meter is capable of correcting the raw volumetric flow rate for the effect of pipe expansion due to temperature changes.

Note that for the temperature-effect expansion correction factor to be calculated, the correction must be enabled (via the **EnableExpCorrTemp** data point) and the flow-condition temperature must be available (i.e., the **EnableTemperatureInput** data point must be set to 'Live'(1) or 'Fixed'(2), see [Temperature expansion correction](#). The temperature-effect calculation is shown in [Equation 4-12](#). If the temperature-effect expansion correction factor is not calculated, it is set to 1.0.

Equation 4-12: Temperature-effect expansion correction

$$ExpCorr_T = 1 + [3 \times \alpha \times (T_f - T_{ref})]$$

where

ExpCorr_T = expansion correction factor due to temperature (dimensionless)

(ExpCorrTemperature)

α = pipe linear expansion coefficient due to temperature (K-1) **(LinearExpansionCoef)**

T_f = flow-condition temperature (K) **(FlowTemperature)**

T_{ref} = reference temperature for the pipe linear expansion coefficient (K)

(RefTempLinearExpCoef)

4.5.5 Profile-effect correction

For meter types that require profile-effect correction, the correction factor can be either user- specified or meter-calculated depending upon the value of the **SpecCorrectionFactor** data point: if set to 0.0, then the correction factor is meter-calculated; if set within [0.90, 1.05], then the specified value is used.

Calculating the meter factor requires that the flow-condition pressure and temperature be live or fixed and that the AGA8 calculations are performed either internally or externally. If the profile-effect correction factor is to be meter-calculated but either the flow-condition pressure and/or temperature are/is disabled or the AGA8 calculations are not performed, then the flow- condition correction factor is set to the default value of 0.95. Otherwise, it is calculated as shown in [Equation 4-13](#).

Equation 4-13: Profile-effect correction factor

$$CorrFctr = 1 + \frac{0.242}{\log\left(0.2703 \frac{WR}{D_{in}} + \frac{0.835}{Re^{0.8}}\right)}$$

where

CorrFctr = flow-profile correction factor **(CorrectionFactor)**

WR = pipe wall roughness (m) **(WallRoughness)**

D_{in} = pipe inside diameter (m) **(PipeDiam)**

Re = Reynolds number (dimensionless) **(ReynoldsNumber)** calculated as shown in [Equation 4-14](#).

4.5.6 Reynolds number

Reynolds Number is a dimensionless value that represents the nature of the gas flow within the pipe. Although the primary reason for calculating Reynolds Number is for reflective path meters (transmitter head 2 for 3415 and 3416) profile-effect correction, the value is calculated for all meter types.

Reynolds Number is calculated as shown in [Equation 4-14](#).

Equation 4-14: Reynolds number

$$Re = \text{Max} \left[(\text{PathFactor}) \left(\frac{4}{\pi} \right) \left(\frac{Q_{Raw} \rho (P_f, T_f)}{3600 * D_{in} \mu} \right), 10^4 \right]$$

where

Re = Reynolds Number (dimensionless) **(ReynoldsNumber)**

MAX = maximum function that takes the maximum of the values within the brackets
 PathFactor = factor to (approximately) correct for velocity profile effects (0.94 for JuniorSonic™ meters, 1.00 for SeniorSonic™ meters) (dimensionless)
 π = geometric constant, pi (dimensionless) (3.14159...)
 Q_{Raw} = "raw" volumetric flow rate (m³/h) (**QMeter**)
 $\rho(P_f, T_f)$ = natural gas mixture mass density at the flow condition (either calculated as part of internal AGA8 calculations or specified via (**SpecRhoMixFlow**) (kg/m³) (**RhoMixFlow**)
 D_{in} = pipe inside diameter (m) (**PipeDiam**)
 μ = dynamic viscosity (Pa•s) (**Viscosity**)

4.5.7 Base-condition volumetric flow rate

The base-condition volumetric flow rate is the result converting the flow-condition volumetric flow rate to the base pressure-temperature condition.

This conversion requires (1) AGA8 calculations to be either performed internally (i.e., by the meter) or externally (with the resulting compressibilities specified to the meter via the **SpecZFlow** and **SpecZBase** data points), and (2) the flow-condition temperature and pressure to be live or fixed. If AGA8 calculations are not performed (i.e., neither internally nor externally) or the flow-condition temperature and/or pressure are/is not enabled, then the base-condition volumetric flow rate is set to zero. The base-condition volumetric flow rate is calculated as shown in [Equation 4-15](#).

Equation 4-15: Base-condition volumetric flow rate

$$Q_{Base} = Q_{Flow} \left(\frac{P_{abs,f}}{P_{abs,b}} \right) \left(\frac{T_b}{T_f} \right) \left(\frac{Z_b}{Z_f} \right)$$

where

Q_{Base} = "raw" volumetric flow rate (m³/h) (**QMeter**)
 Q_{Flow} = flow-condition volumetric flow rate (m³/h) (**QFlow**)
 $P_{abs,b}$ = flow-condition absolute pressure (MPaa) (**AbsFlowPressure**) calculated as shown in [Equation 4-10](#).
 T_b = base-condition temperature (K) (**TBase**)
 T_f = flow-condition temperature (K) (**FlowTemperature**)
 Z_b = base-condition compressibility factor (**ZBase**)
 Z_f = flow-condition compressibility factor (**ZFlow**)

4.5.8 Volume

The Rosemount 3410 Series Gas Ultrasonic Flow Meter provides forward and reverse volume accumulators for each of the three volumetric flow rate values: raw, flow-condition (raw with expansion and/or profile correction), and base-condition.

Each volume accumulator is actually stored as a data pair: (64-bit unsigned integer portion, 32-bit floating point fractional portion). For example, a volume of 12345.750 m³ is stored as 12345 m³ for the integer portion and 0.750 m³ as the fractional portion. Note that while a volumetric flow rate can be positive (indicating forward flow) or negative (indicating reverse flow), the volume accumulators are always positive values.

The non-volatile volume accumulator data points are as listed in the table below:

Table 4-3: Volume accumulation data points

Volumetric flow rate type	Forward Direction		Reverse direction	
	Integer	Fraction	Integer	Fraction
Raw	PosVolUncorr	PosVolUncorrFrac	NegVolUncorr	NegVolUncorrFrac
Flow-condition	PosVolFlow	PosVolFlowFrac	NegVolFlow	NegVolFlowUncorr
Base-condition	PosVolBase	PosVolBaseFrac	NegVolBase	NegVolBaseUncorr

4.5.9 Energy rate and totals

These calculations require that the flow-condition pressure and temperature are available (either fixed or optional analog inputs, [Flow-condition pressure and temperature](#), the gas property data (composition and heating value) are available (either fixed or optionally read from a GC, [Flow-condition pressure and temperature](#)), and the AGA8 calculations are performed (internally by the meter or externally with the results written to the meter, [Flow-condition pressure and temperature](#)).

The energy rate is calculated as shown in [Equation 4-16](#).

Equation 4-16: Energy rate

$$Q_E = Q_{Base} \times HV \times \frac{1MJ}{1000kJ} \times \frac{1000dm^3}{1m^3}$$

where

Q_E = energy rate (MJ/h) (**EnergyRate**)

Q_{Base} = base-condition volumetric flow rate (m³/h) (**QBase**)

HV = "in-use" heating value (kJ/dm³) (**HeatingValueInUse**)

The sign of the energy rate indicates the flow direction: a positive value indicates flow in the forward direction, a negative value indicates flow in the reverse direction.

The energy rate validity is indicated by the **EnergyRateValidity** data point (TRUE(1) indicates valid). The energy rate is valid if the base-condition volumetric flow rate is valid (indicated by **QBaseValidity** where TRUE(1) indicates valid) and if the in-use gas properties are valid (indicated by **AreGasPropertiesInvalidInUse** where FALSE(0) indicates valid).

The energy rate is accumulated into the corresponding direction energy total regardless of the energy rate validity.

The forward and reverse direction energy totals are each stored in non-volatile memory as a data pair: a 64-bit unsigned integer portion and a 32-bit floating point fractional portion. For example, an energy total of 12345.750 MJ is stored as 12345 MJ for the integer portion and 0.750 MJ as the fractional portion. Note that while the energy rate can be positive (indicating forward flow) or negative (indicating reverse flow), the energy totals are always positive values.

The non-volatile energy total data points are as listed in the table below:

Table 4-4: Energy total data points

Forward direction		Reverse direction	
Integer	Fraction	Integer	Fraction
PosEnergy	PosEnergyfrac	NegEnergy	NegEnergyFrac

4.5.10 Mass rate and totals

The Rosemount 3410 Series Gas Ultrasonic Flow Meter meter calculates the mass rate and mass totals (forward and reverse).

These calculations requires that the flow-condition pressure and temperature are available (either fixed or optional analog inputs, [Gas properties](#)), the gas composition is available (either fixed or optionally read from a GC, [Gas property data](#)), and the AGA8 calculations are performed (internally by the meter or externally with the results written to the meter, [Configure Gas Chromatograph parameters](#)).

The mass rate is calculated as shown in [Equation 4-17](#).

Equation 4-17: Mass rate

$$MassRate = Q_{Flow} \times \rho_{Flow}$$

MassRate = mass rate (kg/h) (**MassRate**)

Q_{Flow} = flow-condition volumetric flow rate (m³/h) (**QFlow**)

ρ_{Flow} = "in-use" flow-condition gas mass density (kg/m³) (**RhoMixFlow**)

The sign of the mass rate indicates the flow direction: a positive value indicates flow in the forward direction, a negative value indicates flow in the reverse direction.

The mass rate validity is indicated by the **MassRateValidity** data point (TRUE(1) indicates valid). The mass rate is valid if the flow-condition volumetric flow rate is valid (indicated by **QFlowValidity** where TRUE(1) indicates valid) and if the AGA8 flow-condition calculation is valid (indicated by **AGA8FlowCalcValidity** where TRUE(1) indicates valid).

The mass rate is accumulated into the corresponding direction mass total regardless of the mass rate validity.

The forward and reverse direction mass totals are each stored in non-volatile memory as a data pair: a 64-bit unsigned integer portion and a 32-bit floating point fractional portion. For example, a mass total of 12345.750 kg is stored as 12345 kg for the integer portion and 750 kg as the fractional portion. Note that while the mass rate can be positive (indicating forward flow) or negative (indicating reverse flow), the mass totals are always positive values.

The non-volatile mass total data points are as listed in the table below:

Table 4-5: Mass total data points

Forward direction		Reverse direction	
Integer	Fraction	Integer	Fraction
PosMass	PosMassFrac	NegMass	NegMassFrac

4.6 Rosemount 3410 Series gas flow meter characterizations

For Rosemount 3410 Series Gas Ultrasonic Flow Meter SeniorSonic meters only, the following flow characterizations are calculated/estimated: symmetry, cross-flow, chord turbulence, profile factor, and swirl angle. Alarm limits are provided for the chord turbulence and swirl angle values.

Symmetry

Symmetry is a dimensionless measure of the flow symmetry comparing the upper chords to the lower chords and is readable via the Symmetry data point. Ideally, the **Symmetry** should be 1.0.

Cross-flow

Cross-flow is a dimensionless measure of the flow symmetry comparing the chords on one side of the meter to the chords on the other side. It is readable via the **CrossFlow** data point. Ideally, the Cross-flow should be 1.0.

Chord turbulence

Chord Turbulence is an estimate of the turbulence (percentage) at a chord location. A value is calculated for each active chord and is readable via the **TurbulenceA**, **TurbulenceB**, **TurbulenceC**, or **TurbulenceD** data points. A value of 0% indicates no appreciable turbulence.

Profile Factor

The profile factor is a dimensionless ratio of the inner chord velocities to the outer chord velocities. It is readable via the **ProfileFactor** data point. Ideally, the Profile Factor should be 1.17 for a 4-path transmitter head. It is not possible to calculate Profile Factor for a reflective path transmitter head.

Swirl angle

The swirl angle is an estimate of the swirl (to the nearest degree) and is readable via the **SwirlAngle** data point. It is calculated as a function of the meter body style and Profile Factor (see above). A value of 0 degrees indicates no appreciable swirl. Swirl is only calculated for a 4-path transmitter head.

5 Configurations

5.1 Calibrate and configure the meter

Use MeterLink™ to calibrate and configure the meter parameters: Analog (current), Meter Factors, Flow Calibration, Frequency/Digital Output Sources, Frequency and Digital inputs and outputs, HART output, Meter corrections(for transmitter head 2 of Model 3415 and 3416), Temperature and Pressure, AGA8 calculations, and Local Display parameters.

5.1.1 Calibration methods

The Rosemount 3410 Series Gas Ultrasonic Flow meter uses two calibration steps: "dry" calibration and "wet" calibration.

In this methodology, the "dry-calibration" values are set by Rosemount at the factory and are not expected to be modified; the "wet-calibration" values are expected to be set as the result of a user flow calibration (if desired). These two calibration methods are explained in further detail below.

Important

The **WRITE PROT.** switch on the CPU Module must be disabled (**OFF**) before writing calibration factors to the meter.

After the meter is configured, enable the **WRITE PROT.** switch (**ON**) to write-protect the configuration.

Collect a Maintenance Log and configuration file the meter's "As left" configuration settings.

Gas flow velocity for dry calibration

The dry-calibration gas flow velocity is the result of applying a third-order polynomial equation to the average weighted gas flow velocity as shown in [Equation 5-1](#).

Equation 5-1: Dry-calibration gas flow velocity

$$V_{DryCal} = A_0 + A_1V_{AvgWtd} + A_2V_{AvgWtd}^2 + A_3V_{AvgWtd}^3$$

where

V_{DryCal} = dry-calibration gas flow velocity (m/s) (**DryCalVel**)

V_{AvgWtd} = average weighted gas flow velocity (m/s) (**AvgWtdFlowVel**)

A_0 = dry-calibration 0th order coefficient (m/s) (**FwdA0 or RevA0**)

A_1 = dry-calibration 1st order coefficient (dimensionless) (**FwdA1 or RevA1**)

A_2 = dry-calibration 2nd order coefficient (s/m) (**FwdA2 or RevA2**)

A_3 = dry-calibration 3rd order coefficient (s²/m²) (**FwdA3 or RevA3**)

Note

Note that the meter provides two sets of dry calibration coefficients - one set for each flow direction.

Dry calibration procedure

Prerequisites

NOTICE

Modification of dry calibration parameters is not recommended. The dry calibration parameters should not be modified unless directed by Emerson representative.

Procedure

1. Select the **Calibration** → **Meter Factors** menu.

Figure 5-1: Calibration - Meter factors page

2. Click the **Advanced View** button to display the zero flow calibration polynomial coefficients. Regardless of what flow calibration method is selected, the zero flow calibration polynomial coefficients will be applied first.
3. Set the flow calibration method to **None**.
4. Enter the appropriate forward and reverse meter factors and click **Write** to send the factors to the meter.
5. Click the **Cancel** button to cancel any changes and close the dialog box.

The meter provides separate dry calibration coefficients for each flow direction as listed in the table below.

Table 5-1: Data Points for dry calibration

MeterLink™ Display Name	Data points, options and guidelines
Forward A0	<p>Data points affected:</p> <ul style="list-style-type: none"> • FwdA <p>0 Options:</p> <ul style="list-style-type: none"> • Enter a value (m/s or ft/s) within the range [-1,1 m/s]. <p>Guidelines:</p> <ul style="list-style-type: none"> • This value should only be modified under direction of Emerson representative.
Forward A1	<p>Data points affected:</p> <ul style="list-style-type: none"> • FwdA <p>1 Options:</p> <ul style="list-style-type: none"> • Enter a value (dimensionless) within the range [0.95, 1.05]. <p>Guidelines:</p> <ul style="list-style-type: none"> • This value should only be modified under direction of Emerson representative.
Forward A2	<p>Data points affected:</p> <ul style="list-style-type: none"> • FwdA2 <p>2 Options:</p> <ul style="list-style-type: none"> • Enter a value (s/m or s/ft) within the range [-0.1, 0.1]. <p>Guidelines:</p> <ul style="list-style-type: none"> • This value should only be modified under direction of Emerson representative.
Forward A3	<p>Data points affected:</p> <ul style="list-style-type: none"> • FwdA <p>3 Options:</p> <ul style="list-style-type: none"> • Enter a value (s²/m² or s²/ft²) within the range [-0.1, 0.1 s²/m²]. <p>Guidelines:</p> <ul style="list-style-type: none"> • This value should only be modified under direction of Emerson representative.
Reverse A0	<p>Data points affected:</p> <ul style="list-style-type: none"> • RevA <p>0 Options:</p> <ul style="list-style-type: none"> • Enter a value (s/m or s/ft) within the range [-1, 1]. <p>Guidelines:</p> <ul style="list-style-type: none"> • This value should only be modified under direction of Emerson representative.
Reverse A1	<p>Data points affected:</p> <ul style="list-style-type: none"> • RevA <p>1 Options:</p> <ul style="list-style-type: none"> • Enter a value (dimensionless) within the range [0.95, 1.05]. <p>Guidelines:</p> <ul style="list-style-type: none"> • This value should only be modified under direction of Emerson representative.

Table 5-1: Data Points for dry calibration (continued)

MeterLink™ Display Name	Data points, options and guidelines
Reverse A2	<p>Data points affected:</p> <ul style="list-style-type: none"> RevA <p>2 Options:</p> <ul style="list-style-type: none"> Enter a value (s/m or s/ft) within the range [-0.1, 0.1]. <p>Guidelines:</p> <ul style="list-style-type: none"> This value should only be modified under direction of Emerson representative.
Reverse A3	<p>Data points affected:</p> <ul style="list-style-type: none"> RevA <p>3 Options:</p> <ul style="list-style-type: none"> Enter a value s²/m² or s²/ft² within the range [-0.1, 0.1 s²/m²]. <p>Guidelines:</p> <ul style="list-style-type: none"> This value should only be modified under direction of Emerson representative.

Gas flow velocity for wet calibration

The Rosemount 3410 Series Gas Ultrasonic Flow meter offers three selections for wet calibration: 12-point piece-wise linearization, a third-order polynomial, or none. The wet calibration method is selected via the **CalMethod** data point with "None" being the default value. The wet calibration gas flow velocity is calculated from the dry calibration gas flow velocity as shown in [Equation 5-2](#).

Equation 5-2: Wet-calibration gas flow velocity

$$V_{WetCal} = WetCalFunction(V_{DryCal})$$

where

V_{WetCal} = wet-calibration gas flow velocity (m/s) (**AvgFlow**)

V_{DryCal} = dry-calibration gas flow velocity (m/s) (**DryCalVel**)

WetCalFunction(x) = selected wet-calibration function

Wet calibration procedure using gas flow velocity

Configure the data points listed below from the MeterLink **Calibration** → **Meter Factors** menu:

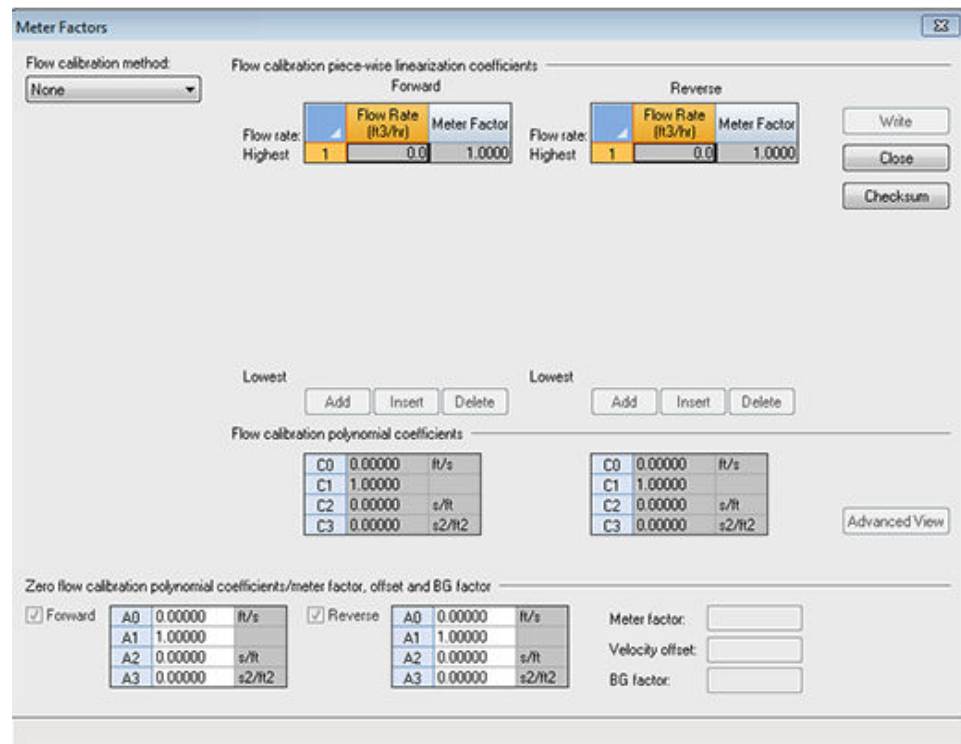
Table 5-2: Data Points for wet calibration

MeterLink™ Display Name	Data points, options and guidelines
Flow calibration method	<p>Data points affected:</p> <ul style="list-style-type: none"> CalMethod <p>Options:</p> <ul style="list-style-type: none"> Piece-wise (2) Polynomial (1) None (0) <p>Guidelines:</p> <ul style="list-style-type: none"> This value should only be modified under direction of Emerson representative.

Procedure

- Choose a Flow Calibration Method:
 - Polynomial
 - Piece-wise linear
 - None (If set to **None** then the wet calibration has the same value as the dry calibration.)
- Select the **Calibration** → **Meter Factors** menu.

Figure 5-2: Calibration - Meter Factor: None



Piece-wise linearization for wet calibration

If the 12-point piece-wise linearization (PWL) wet calibration method is selected, then the dry-calibration gas flow velocity is calculated as shown in Equation 5-3.

The inputs to the 12-point piece-wise linearization are the (up to) 12 pairs of volumetric flow rates and meter factors for each flow direction ([FwdFlwRt1, FwdMtrFctr1], ..., [FwdFlwRt12, FwdMtrFctr12] for forward flow; [RevFlwRt1, RevMtrFctr1], ..., [RevFlwRt12, RevMtrFctr12] for reverse flow). Refer to [Calibrate meter factors](#) to configuring these data points using MeterLink.

NOTICE

The input flow rates should be entered in descending order (highest first) with their corresponding meter factors. If these are entered in the wrong order, the meter will still work but the accuracy may be affected. The meter will not accept negative values, so only positive values should be entered for both forward and reverse flow rates. If fewer than 12 points are to be used, the unused flow rate and meter factor pairs should be set to 0 and 1 respectively.

Equation 5-3: Wet calibration - 12-point piece-wise linearization

$$V_{WetCal} = V_{DryCal}^{LinearMeterFctr}$$

where

V_{WetCal} = wet-calibration gas flow velocity (m/s) (**AvgFlow**)

V_{DryCal} = dry-calibration gas flow velocity (m/s) (**DryCalVel**)

LinearMeterFctr = linear meter factor (dimensionless) (**LinearMeterFctr**)

Wet calibration procedure using piece-wise linearization

The linear meter factor is determined by the PWL inputs, the flow direction, and the dry-calibration gas flow velocity. If set to "Piece-wise Linear" then the piece-wise linearization flow rate and meter factor parameters are used to calculate the meter factor to be applied.

Figure 5-3: Calibration - Meter Factor: Piece-wise linearization

The screenshot shows the 'Meter Factors' configuration window. The 'Flow calibration method' is set to 'Piece-wise linear'. The window is divided into two main sections: 'Flow calibration piece-wise linearization coefficients' and 'Flow calibration polynomial coefficients'.

Flow calibration piece-wise linearization coefficients:

- Forward:** A table with 12 rows. The first row (Highest) has Flow Rate (ft³/hr) = 0.0 and Meter Factor = 1.0000. Rows 2-11 have Flow Rate = 0 and Meter Factor = 1.0000. The last row (Lowest) has Flow Rate = 0 and Meter Factor = 1.0000. Buttons: Add, Insert, Delete.
- Reverse:** A table with 12 rows. The first row (Highest) has Flow Rate (ft³/hr) = 0.0 and Meter Factor = 1.0000. Rows 2-11 have Flow Rate = 0 and Meter Factor = 1.0000. The last row (Lowest) has Flow Rate = 0 and Meter Factor = 1.0000. Buttons: Add, Insert, Delete.

Flow calibration polynomial coefficients:

- Forward:** C0: 0.00000 ft/s, C1: 1.00000, C2: 0.00000 s/ft, C3: 0.00000 s²/ft².
- Reverse:** C0: 0.00000 ft/s, C1: 1.00000, C2: 0.00000 s/ft, C3: 0.00000 s²/ft².

Buttons on the right: Write, Close, Checksum. A 'Line Number' field is at the bottom right.

Table 5-3: Data points for Piece-wise linearization calibration

Meterlink™ Display Name	Data points, options and guidelines
Forward Flow Rate	Data points affected <ul style="list-style-type: none"> FwdFlwRate1...FwdFltRate12 Options: <ul style="list-style-type: none"> Enter a value (m³/h or ft³/h) within the range [0.200000 m³/h]. Guidelines: <ul style="list-style-type: none"> The flow rates must be entered from highest to lowest.
Forward Meter Factor	Data points affected <ul style="list-style-type: none"> FwdMtrFctr1...FwdMtrFctr12 Options: <ul style="list-style-type: none"> Enter a value (dimensionless) within the range [0.95, 1.05].
Reverse Flow Rate	Data points affected <ul style="list-style-type: none"> RevFlwRate1...RevFltRate12 Options: <ul style="list-style-type: none"> Enter a value (m³/h or ft³/h) within the range [0.200000 m³/h] Guidelines: <ul style="list-style-type: none"> The flow rates must be entered from highest to lowest.
Reverse Meter Factor	Data points affected <ul style="list-style-type: none"> RevMtrFctr1...RevMtrFctr12 Options: <ul style="list-style-type: none"> Enter a value (dimensionless) within the range [0.95, 1.05]

Procedure

1. Select **Piece-wise linear** from the **Calibration** → **Meter Factors** menu.
2. Click the **Add** button below the table to add a new calibration point to the bottom of the table. You can add a maximum of 12 points. The calibration points must be entered from the highest flow rate to the lowest flow rate.
3. Click **Write** to apply the calibration parameters to the meter.

Third-order polynomial for wet calibration

When the Polynomial wet calibration method is selected, the meter uses a third-order polynomial on the dry-calibration velocity, as shown in [Equation 5-4](#).

Equation 5-4: Wet calibration - third order polynomial

$$V_{WetCal} = C_0 + C_1V_{DryCal} + C_2V_{DryCal}^2 + C_3V_{DryCal}^3$$

Where

- V_{WetCal} = wet-calibration gas flow velocity (m/s) (**AvgFlow**)
- V_{DryCal} = dry-calibration gas flow velocity (m/s) (**ADryCalVel**)
- C_0 = wet-calibration 0thorder coefficient (m/s) (**FwdC0** or **RevC0**)
- C_1 = wet-calibration 1storder coefficient (dimensionless) (**FwdC1** or **RevC1**)
- C_2 = wet-calibration 2ndorder coefficient (s/m) (**FwdC2** or **RevC2**)
- C_3 = wet-calibration 3rdorder coefficient (s²/m²) (**FwdC3** or **RevC3**)

Wet calibration procedure using Third-order polynomial

If selecting "Polynomial Coefficients", the "C" calibration coefficients are applied.

Figure 5-4: Calibration - Meter Factor: Polynomial



Three coefficients are specified for each flow direction from the MeterLink **Calibration** → **Meter Factors** page as shown in the table below:

Table 5-4: Data points for Polynomial wet calibration

Meterlink™ Display Name	Data points, options and guidelines
Forward C0	Data points affected <ul style="list-style-type: none"> FwdC0 Options: <ul style="list-style-type: none"> Enter a value (m/s or ft/s) within the range [-1, 1 m/s].
Forward C1	Data points affected <ul style="list-style-type: none"> FwdC1 Options: <ul style="list-style-type: none"> Enter a value (dimensionless) within the range [0.95, 1.05].
Forward C2	Data points affected <ul style="list-style-type: none"> FwdC2 Options: <ul style="list-style-type: none"> Enter a value (s/m or s/ft) within the range [-0.1, 0.1 s/m].
Forward C3	Data points affected <ul style="list-style-type: none"> FwdC3 Options: <ul style="list-style-type: none"> Enter a value (m/s or ft/s) within the range (s²/m² or s²/ft²) within the range [-0.1, 0.1 s²/m²].

Table 5-4: Data points for Polynomial wet calibration (continued)

Meterlink™ Display Name	Data points, options and guidelines
Reverse C0	Data points affected <ul style="list-style-type: none"> RevC0 Options: <ul style="list-style-type: none"> Enter a value (m/s or ft/s) within the range [-1, 1 m/s].
Reverse C1	Data points affected <ul style="list-style-type: none"> RevC1 Options: <ul style="list-style-type: none"> Enter a value (dimensionless) within the range [0.95, 1.05].
Reverse C2	Data points affected <ul style="list-style-type: none"> RevC2 Options: <ul style="list-style-type: none"> Enter a value (m/s or ft/s) within the range [-0.1, 0.1 s/m].
Reverse C3	Data points affected <ul style="list-style-type: none"> RevC3 Options: <ul style="list-style-type: none"> Enter a value (s²/m² or s²/ft²) within the range [-0.1, 0.1 s²/m²].

Procedure

1. Select **Polynomial** from the **Calibration** → **Meter Factors** menu.
2. Add the value for the forward and reverse coefficients.
3. Click **Write** to apply the parameters to the meter.

No wet calibration

If no wet calibration is selected, then the wet calibration gas flow velocity is equal to the dry calibration gas flow velocity.

Triggered delta volumes

The "triggered delta volume" feature provides the ability to measure total gas flow volume (flow- and base-condition) between two successive external event triggers.

To trigger an event, set the **DoUpdtTrigDeltaVols** data point to TRUE. This causes the meter to save the current accumulated flow- and base-condition volume values (forward and reverse). The meter then calculates the difference between these values and the corresponding values saved from the previous event trigger. Finally, the meter writes the delta volume values to the appropriate data points (**TrigDeltaPosVolFlow**, **TrigDeltaNegVolFlow**, **TrigDeltaPosVolBase**, and **TrigDeltaNegVolBase**) and sets the **DoUpdtTrigDeltaVols** data point to FALSE to clear the trigger and indicate the calculation completion.

The triggered delta volume functionality is retained across power cycles as the accumulated volumes values at the last event trigger are saved in non-volatile memory.

The delta volume data points are stored internally in non-volatile memory as double-precision floating point numbers. The delta volume data points can be read via Modbus as either 32-bit floating point values or as integer values (using the [overflow,lower] LONG register pair in a manner similar to reading the accumulated volumes).

Suggested user access logic

The following pseudo-code demonstrates the logic to access the triggered delta volume functionality:

- **INITIAL SET-UP:**
Ensure Modbus units are set-up as desired: set Modbus register 10026 (**UnitsSystem**) to 0 for U.S. Customary units or to 1 for metric units.
- **Periodic Loop:**
Wait for external event for synchronizing the start of the meter delta volumes.
Send trigger Modbus message: set Modbus register 12199 (**DoUpdtTrigDeltaVols**) to 1 (TRUE).
Read trigger Modbus register 12199 (**DoUpdtTrigDeltaVols**) in a loop until it is read as 0 (FALSE) indicating that the delta volumes have been updated.

Read delta volume registers (either the FLOAT registers or the LONG register pairs) in a single Modbus read. If the delta volume registers are read as LONG register pairs, calculate each delta volume as follows:

Equation 5-5: Triggered delta volume

$$\text{DeltaVolume} = (\text{Overflow} \times 1e9) + \text{Lower}$$

where

DeltaVolume = triggered delta volume (forward or reverse, flow-condition or base-condition) (m³ or ft³) (**TrigDeltaPosVolFlow**, **TrigDeltaNegVolFlow**, **TrigDeltaPosVolBase**, **TrigDeltaNegVolBase**)

Overflow = triggered delta volume overflow integer value (forward or reverse, flow-condition or base-condition) (1e⁹m³ or 1e⁹ft³)

Lower = triggered delta volume lower integer value (forward or reverse, flow-condition or base-condition) (m³ or ft³)

Repeat "PERIODIC LOOP"

5.1.2 Configure operational parameters

Table 5-5: Configure Operational parameters

Calibration selection	Description
Analog inputs and outputs (Calibrate analog inputs and outputs)	Calibration settings for the pressure and temperature analog inputs.
Meter factors (Calibrate meter factors)	Calibration settings for the pressure and temperature analog inputs.
Flow calibration (Flow calibration)	Calibrate the meter during flowing conditions.
Frequency/Digital output sources (Configure Frequency/Digital output sources)	Outputs that can be configured as either a frequency output or a digital status.
Frequency output (Configure frequency outputs)	Configure the available frequency outputs.

Table 5-5: Configure Operational parameters (continued)

Calibration selection	Description
Meter Digital outputs (Configure digital input/ outputs)	Configure the digital outputs.
HART outputs (Configure HART outputs)	Configure the HART outputs.
Meter corrections (Configure meter corrections)	Configure meter corrections that include: <ul style="list-style-type: none"> • Profile factor for the reflective path transmitter head of 3415 and 3416 meters • Temperature expansion correction (if Live or Fixed), Linear expansion coefficient • Linear expansion coefficient reference temperature • Pressure expansion correction • Pipe outside diameter • Young's modulus value (ratio of tensile stress to tensile strain) • Poisson's Ratio value (the absolute ratio of the pipe material lateral strain over axial strain)
Temperature and pressure (Configure temperature and pressure)	Temperature and Pressure - to set the scaling for analog inputs, enter fixed values, and set alarm limits for both temperature
Gas Chromatograph setup (Configure Gas Chromatograph parameters)	Configure a serial port as a Modbus master for polling a GC. Selections include: <ul style="list-style-type: none"> • Port • GC protocol • GC baud rate • GC comms address • GC stream number • GC heating value units • GC IP address • GC port number
AGA8 calculations (Configure AGA8 parameters)	Configure the properties necessary for the AGA8 calculations. Selections include: <ul style="list-style-type: none"> • Gross Method 1 • Gross Method 2 • Detail Method • Externally • GERG-2008

Table 5-5: Configure Operational parameters (continued)

Calibration selection	Description
Continuous flow analysis (Configure Continuous Flow Analysis parameters)	Configure the Continuous Flow Analysis features. Selections include: <ul style="list-style-type: none"> • Flow limits • SOS comparison • Liquid detection • Abnormal profile • Blockage Internal bore buildup
Local Display (Configure the Local Display)	Configure the local display settings. Selections include: <ul style="list-style-type: none"> • Display Units • Display Items • Scroll Delay

5.2 Calibrate analog inputs and outputs

NOTICE

The **WRITE PROT.** switch on the CPU Module must be disabled or the calibration values will not be updated for a meter.

An analog input can be calibrated regardless of the corresponding input type, pressure or temperature. However, if the corresponding input type is selected as Live, then the input being calibrated is considered to be invalid and the in-use value depends upon the **FlowPOrTsrcUponAlarm** selection (see above). In this case, the appropriate data point (**FlowPressureWhileCal**, **FlowTemperatureWhileCal**) is set to the in-use value so that it can be logged in the optional log.

The offset and gain can be reset to the default values (0 and 1, respectively) by clicking the **Reset Defaults** button.

NOTICE

Clicking the **Reset Defaults** button writes the offset and gain immediately - the previous values cannot be restored.

Click the **Edit Scaling** button to modify the input scaling.

NOTICE

Changes made to an analog input's offset, gain, and scaling values are written to the log.

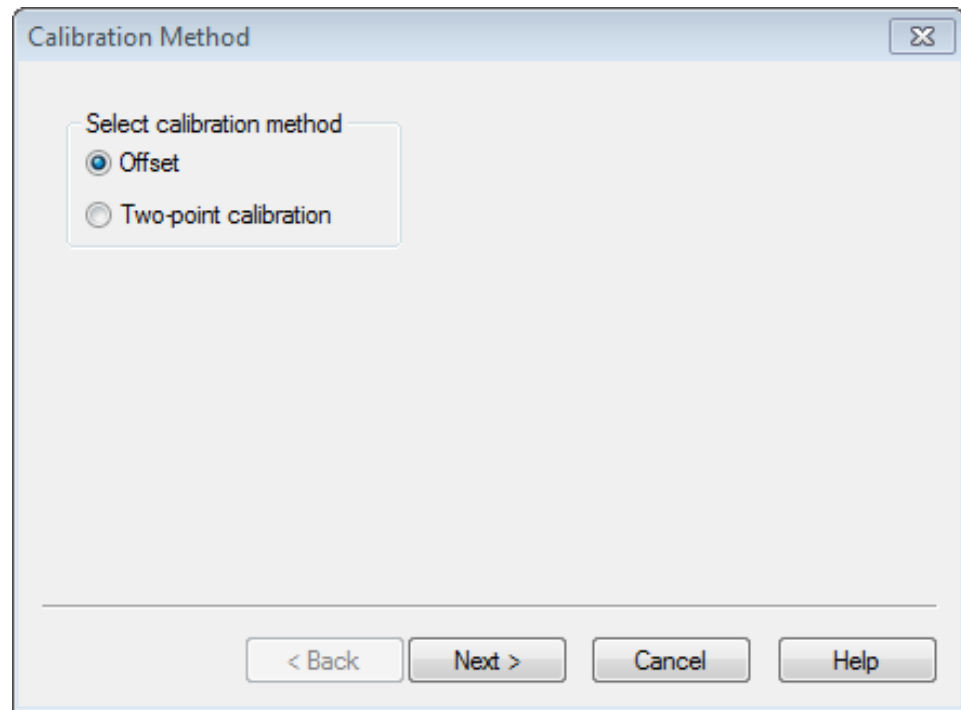
From MeterLink, select **Calibrate** to make changes using the Analog Inputs Wizard.

Procedure

1. Choose the analog input to calibrate, either temperature or pressure and click **Next**. The **Current** → **Calibration** screen shows the current offset and gain and the input scaling (i.e., the pressures or temperatures corresponding to the minimum (4 mA) input and maximum (20 mA) inputs).

2. Click **Next** to proceed to the **Calibration** → **Method** screen then, select either the offset or two-point calibration methods.
 - The Offset method requires a single calibration point and only affects the input's calibration offset parameter.
 - The two-point calibration requires calibrating at two different points (ideally far apart in value) and affects the input's calibration offset and gain parameters. Depending upon the selected calibration method, either one or two screens will follow when the **Next** button is clicked.
3. The screen(s) displays the current (live) reading. When the input is stable, click the **Hold** button to freeze the current reading.
4. Enter the correct value in the Actual edit box. Finally, the Finish screen shows the new calculated offset and gain values.

Figure 5-5: Offset calibration



5. Click **Finish** to write the values to the meter. If the meter is not configured to use live values from the analog input for calculation, a prompt displays asking if the configuration should be changed to use the live input.
6. Enable the **WRITE PROT.** switch on the CPU Module to write-protect the configuration.

Table 5-6: Calibrate analog inputs and outputs

MeterLink™ Display name	Data Points, options and guidelines
Current output Output setting	<p>Data points affected:</p> <ul style="list-style-type: none"> • AO1TestModeOutputPercent <p>Options:</p> <ul style="list-style-type: none"> • Enter the integer percentage of full scale for the analog output within the range [0, 100 %] where 0% corresponds to the minimum output (4 mA) and 100% corresponds to the maximum output (20 mA). <p>Guidelines</p> <ul style="list-style-type: none"> • The specified test value takes effect within one batch period of clicking the Start button.
Current output Start (Stop) AO1	<p>Data points affected:</p> <ul style="list-style-type: none"> • IsAO1EnableTest <p>Options:</p> <ul style="list-style-type: none"> • Click on the StartAO1 button to enter the test mode (TRUE). <hr/> <p>Note The Start button will become the Stop button after clicking on it.</p> <hr/> <ul style="list-style-type: none"> • Click on the StopAO1 button to exit the test mode (FALSE). <hr/> <p>Note The Stop button will become the Start button after clicking on it.</p> <hr/> <p>Guidelines</p> <ul style="list-style-type: none"> • The specified test value takes effect within one batch period of clicking the Start button (see below).
Current output Output setting	<p>Data points affected:</p> <ul style="list-style-type: none"> • AO2TestModeOutputPercent <p>Options:</p> <ul style="list-style-type: none"> • Enter the integer percentage of full scale for the analog output within the range [0, 100 %] where 0% corresponds to the minimum output (4 mA) and 100% corresponds to the maximum output (20 mA). <p>Guidelines</p> <ul style="list-style-type: none"> • The specified test value takes effect within one batch period of clicking the Start button. <hr/> <p>Note The AO2 is only available with CPU module, part number 1-360-03-010.</p> <hr/>

Table 5-6: Calibrate analog inputs and outputs (continued)

MeterLink™ Display name	Data Points, options and guidelines
	<p>Data points affected:</p> <ul style="list-style-type: none"> • IsAO2EnableTest <p>Options:</p> <ul style="list-style-type: none"> • Click on the StartAO2 button to enter the test mode (TRUE). <hr/> <p>Note The Start button will become the Stop button after clicking on it.</p> <hr/> <ul style="list-style-type: none"> • Click on the StopAO2 button to exit the test mode (FALSE). <hr/> <p>Note The Stop button will become the Start button after clicking on it.</p> <hr/> <p>Guidelines</p> <ul style="list-style-type: none"> • The specified test value takes effect within one batch period of clicking the Start button (see below).

The maximum length of time that the analog output can remain in the test mode is specified via the **NonNormalModeTimeout** data point. Note that this data point applies to other tests as well. The **NonNormalModeTimeout** data point can be changed using the MeterLink **Edit/Compare Configuration** screen. It can be set within the range **[1, 30 min]** and has a default value of 2 min.

5.3 Calibrate meter factors

The factory calibrated flow velocity is the result of applying a third-order polynomial equation (see [Third-order polynomial for wet calibration](#)) to the average weighted flow velocity. Rosemount 3410 Gas Ultrasonic Flow Meters are factory calibrated and the default calibration settings are recommended.

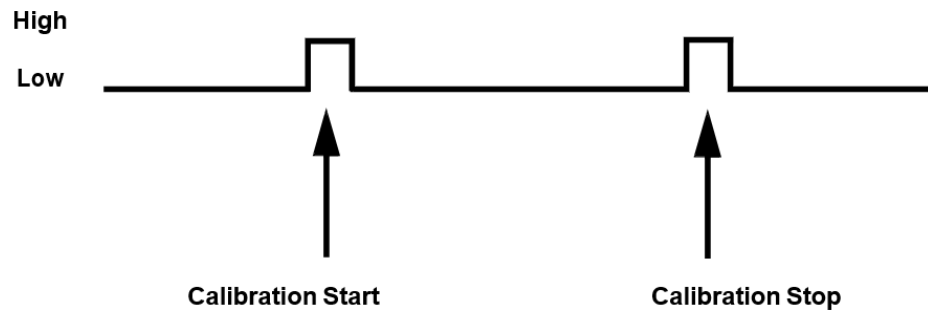
5.3.1 Flow calibration

In a timed calibration, the meter records the volume through the meter over a user specified period of time for a calibration run.

A gated calibration records the volume seen between switch closures directly from a prover for the number of passes it takes for the prover to make a run. Use the spin buttons or type in the number of passes of a prover to make a run. Calibration Gating configuration parameter selections are:

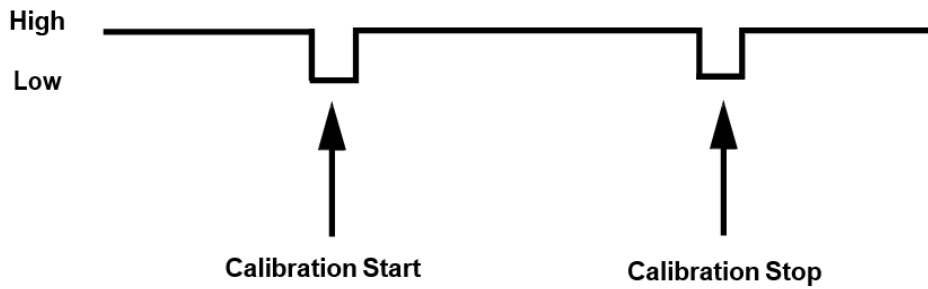
- Edge gated, active high

Figure 5-6: Gating configuration parameter Edge gated, active high



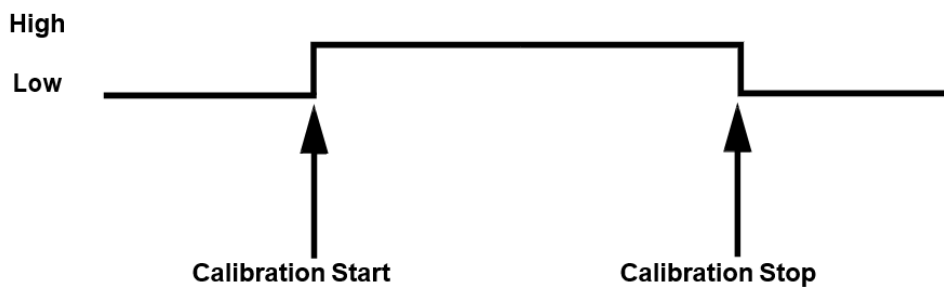
- Edge gated, active low

Figure 5-7: Gating configuration parameter Edge gated, active low



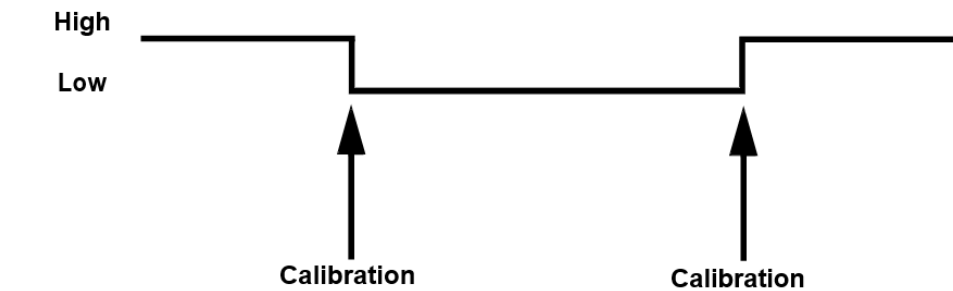
- State gated, active high

Figure 5-8: Gating configuration parameter State gated, active high



- State gated, active low

Figure 5-9: Gating configuration parameter State gated, active low



A Microsoft Excel® file is generated and the calibration log report can be saved or appended to an existing file.

5.3.2 Configure Frequency/Digital output sources

The meter has three user-configurable outputs that can be configured for either a Frequency output or Digital output (FODO).

- FODO1 (eight possible parameter configurations) [Type 2] [Type 4]
- FODO2 (eight possible parameter configurations) [Type 2] [Type 4]
- FODO3 (eight possible parameter configurations) [Type 2] [Type 4]
- FODO4 (eight possible parameter configurations) [Type 4]
- FODO5 (eight possible parameter configurations) [Type 4]
- FODO6 (eight possible parameter configurations) [Type 4]
 - (DI1Mode must be set to Frequency/Digital Output 6 to enable FODO6)

Frequency or Digital Outputs (FODO1, FODO6) source options ~ Group 1

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- Frequency output 1A is the A Phase of Frequency output 1 content (Uncorrected volume flow rate, Corrected volume flow rate, Average flow velocity, Average speed of sound, Energy flow rate, Mass flow rate)
- Frequency output 1B is the B Phase of Frequency output 1
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 2B is based on frequency content and Frequency 2B Phase
- Digital output 1A is based on Digital output1A content (Frequency Output 1 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)
- Digital output 1B is based on Digital output1B content (Frequency Output 1 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)
- Digital output 2A is based on Digital output 2A content (Frequency Output 2 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)
- Digital output 2B is based on Digital output 2B content (Frequency Output 2 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)

Frequency or Digital Outputs (FODO2, FODO3, FODO4, FODO5) source options ~ Group 2

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B

- Frequency output 1A is the A Phase of Frequency output 1 content (Uncorrected volume flow rate, Corrected volume flow rate, Average flow velocity, Average speed of sound, Energy flow rate, Mass flow rate)
- Frequency output 1B is the B Phase of Frequency output 1
- Frequency output 2A is the A Phase of Frequency output 2 content (Uncorrected volume flow rate, Corrected volume flow rate, Average flow velocity, Average speed of sound, Energy flow rate, Mass flow rate)
- Frequency output 2B is the B Phase of Frequency output 2 content
- Digital output 1A is based on Digital output1A content (Frequency Output 1 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)
- Digital output 1B is based on Digital output1B content (Frequency Output 1 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)
- Digital output 2A is based on Digital output 2A content (Frequency Output 2 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)
- Digital output 2B is based on Digital output 2B content (Frequency Output 2 Validity, Flow Direction, Process Validity, and Dual Configuration Flow Range Validity)

Mode options

- Open Collector (requires external excitation supply voltage and pull-up resistor)
- TTL (internally powered by the meter 0-5 VDC signal)

Channel B Phase options:

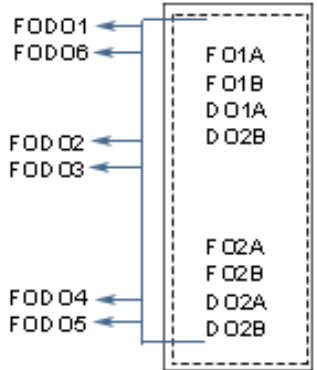
- Lag forward, Lead reverse (Phase B lags Phase A while reporting forward flow, leads Phase A while reporting reverse flow)
- Lead forward, Lag reverse (Phase B leads Phase A while reporting forward flow, lags Phase A while reporting reverse flow)

Phase A and Phase B output (based on flow direction)

- Reverse flow - output only reports flow in the reverse direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Forward flow - output only reports flow in the forward direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Absolute - output reports flow in both directions. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Bidirectional - output reports flow on Phase A only in the forward direction and on Phase B only in the reverse direction.

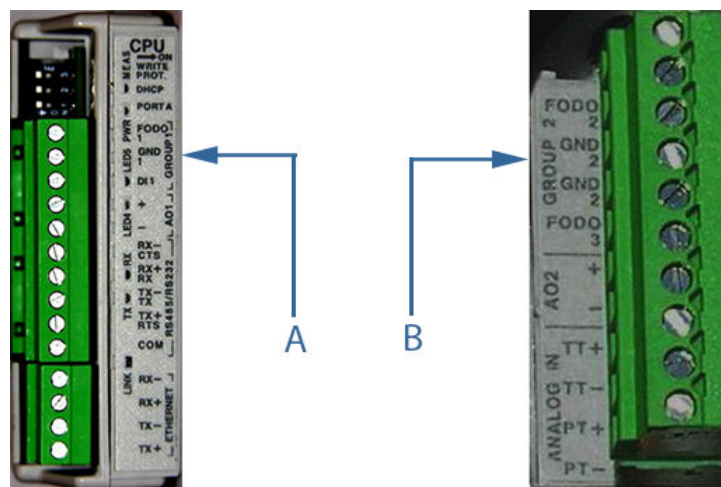
Maximum frequency for the frequency outputs

- 1000Hz
- 5000Hz

Frequency/Digital output		Source configuration
Frequency /Digital Output 1 Frequency /Digital Output 2 Frequency /Digital Output 3 Frequency /Digital Output4 Frequency /Digital Output 5 Frequency /Digital Output 6	<ul style="list-style-type: none"> • Frequency output 1A • Frequency output 1B • Digital output 1A • Digital output 1B • Frequency output 2A • Frequency output 2B • Digital output 2A • Digital output 2B 	

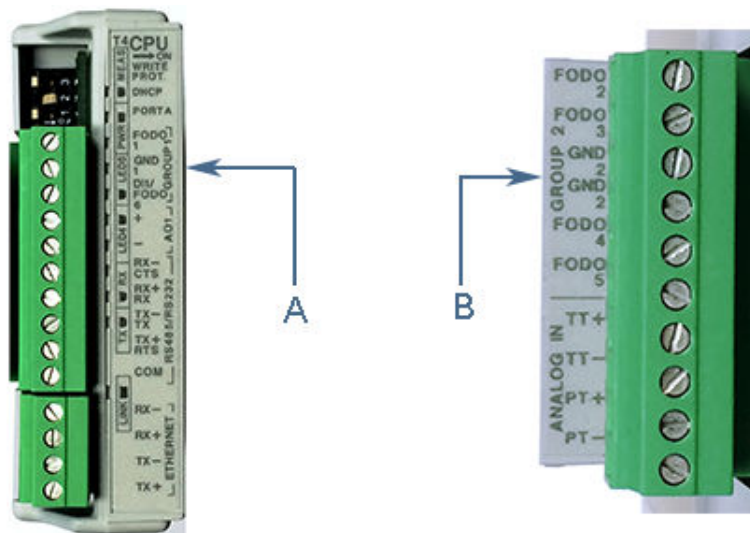
Output for FODO1 and Digital Input 1 (Group 1 on the CPU Module) share a common ground and have 50V isolation. FODO2 and FODO3 (Group 2 on the CPU Module) share a common ground and have 50V isolation. This allows an output to be connected to a different flow computer. The outputs are opto-isolated from the CPU Module and have a withstand voltage of at least 500V rms dielectric.

Figure 5-10: CPU Module - Frequency/Digital outputs common ground - Type 2



- A. FODO1 and Digital input1 - shared common ground (Group 1)
- B. FODO2 and FODO3 - shared common ground (Group 2)

Figure 5-11: CPU Module - Frequency/Digital outputs common ground - Type 4



- A. FODO1 and DI1/FODO6 - shared common ground - Type 4 CPU Module (Group 1)
B. FODO2, FODO3, FODO4 and FODO5 - shared common ground - Type 4 CPU Module (Group 2)

5.4 Configure frequency outputs

The Frequency Outputs allows you to configure the available frequency outputs for the meter.

If you previously configured one or more Frequency/Digital outputs, make selections for the following parameters.

Content:

- Valid outputs are based on Uncorrected (Actual) flow rates or on Corrected (Standard) flow rates. If pressure or temperature is set to Not used, or the Base condition correction is cleared on the Startup Page, the Corrected (Standard) option will not be available.
- Rosemount™ Gas Ultrasonic meters will also allow you to set the outputs for Average Flow Velocity, Average Sound Velocity, Energy Rate, and Mass Rate.

Direction:

- Reverse*: The output only reports flow in the reverse direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Forward*: The output only reports flow in the forward direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Absolute*: The output reports flow in both directions. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Bidirectional*: The output reports flow on Phase A only in the forward direction and on Phase B only in the reverse direction.

Maximum frequency output:

- Valid frequency output options are 1000 Hz and 5000 Hz.

The following fields are used to configure the frequency outputs selected to output a volumetric flow rate. The fields are only enabled if the associated output's Content is set to Uncorrected (Actual) or Corrected (Standard).

Full scale volumetric flow rate used with output:

- Enter the flow rate to be equivalent to the maximum frequency of the frequency output. This property is disabled if Frequency outputs was cleared on the Startup Page.

K-factor:

A read-only value showing the calculated K-factor from the Full scale volumetric flow rate used with frequency outputs and the Maximum frequency for frequency output. This property is disabled if Frequency outputs was cleared on the Startup Page.

Vol/pulse:

A read-only value showing the calculated inverse of the K-factor. This property is disabled if Frequency outputs was cleared on the Startup Page.

Velocity:

- Maximum scale velocity used with output: Enter the velocity to be equivalent to the maximum frequency of the frequency output. These values are only enabled if the Content is set to Average flow velocity or Average sound velocity. This property is disabled if Frequency outputs was cleared on the Startup Page.
- Minimum scale velocity used with output: Enter the velocity to be equivalent to the minimum frequency (i.e. 0Hz) of the frequency output. These values are only enabled if the Content is set to Average flow velocity or Average sound velocity. This property is disabled if Frequency outputs was cleared on the Startup Page.

Energy Rate:

The following fields are used to configure the frequency or current outputs selected to output an energy rate. The fields are only enabled if the associated output's Content is set to Energy rate.

- Full scale energy rate used with output: Enter the energy rate to be equivalent to the maximum frequency of the frequency output.
- Energy/pulse: A read-only value showing the calculated inverse of the K-factor. Each frequency output has its own register.

Mass Rate:

- The following fields are used to configure the frequency outputs selected to output a mass rate. The fields are only enabled if the associated output's Content is set to Mass rate.
- Full scale mass rate used with output: Enter the mass rate to be equivalent to the maximum frequency of the frequency output.
- Mass/pulse: A read-only value showing the calculated inverse of the K-factor. Each frequency output has its own register.

5.5 Configure digital input/outputs

Digital input

- FALSE - normal polarity (default setting), or
- TRUE - inverted polarity

The digital input is not configurable via the MeterLink Field Setup Wizard. It must be configured via the MeterLink **Tools** → **Edit/Compare Configuration**.

Digital input calibration

The **IsDI1UsedForCal** specifies whether digital input 1 (DI1) is used for general purpose (when set to FALSE) or for synchronizing calibration (when set to TRUE). If used for calibration, the polarity is determined by the **IsDI1ForCalActiveLow** data point select one of the following:

- FALSE - general purpose (default setting), or
- TRUE - for synchronizing calibration

The **IsDI1ForCalActiveLow** data point specifies the polarity for digital input 1 (DI1) when it is configured (via **IsDI1UsedForCal**) for use in synchronizing a calibration. See also **IsDI1ForCalStateGated**.

- FALSE = Cal Active High
- TRUE = Cal Active Low (default)

The **IsDI1ForCalStateGated** data point specifies the calibration gating for digital input 1 (**DI1**) when it is configured (via **IsDI1UsedForCal**) for use in synchronizing a calibration. When FALSE, the calibration is started/stopped via an inactive->active edge; when TRUE, the calibration is started via an **inactive** → **active** state change and stopped via an **active** → **inactive** state change. The active edge/state is specified via the **IsDI1ForCalActiveLow** data point.

- FALSE = Cal Edge Gated (default)
- TRUE = Cal State Gated

.

Digital output

Select the function for which the digital output should be configured. Available options are validity and direction.

The inverted operation option is useful if the output of the ultrasonic meter is reversed from what a flow computer is expecting. This means that if the output normally outputs a HIGH for a TRUE condition, selecting this checkbox will change the output to output a LOW for a TRUE condition.

5.6 Outputs test mode

The Rosemount 3410 Gas Ultrasonic Flow Meters provides a mode of operation for testing the frequency, current (analog) and digital output signals. Entering, configuring, and exiting this mode is accomplished by setting data points using the MeterLink **Tools** → **Outputs Test**.

Figure 5-12: Meter Outputs Test page

The screenshot shows the 'Outputs Test' dialog box with the following details:

- Frequency output 1:** (K-factor: 0.509703 pulses/ft3, Inverse K-factor: 1.96193 ft3/pulse). Output setting: 50%. Test mode is checked. Readouts: Channel A (4.32 Hz, 30544.4 ft3/hr), Channel B (4.32 Hz, 30544.4 ft3/hr), 100% Scaling (1000 Hz, 7.06293e+006 ft3/hr).
- Frequency output 2:** (K-factor: 0.509703 pulses/ft3, Inverse K-factor: 1.96193 ft3/pulse). Output setting: 50%. Test mode is checked. Readouts: Channel A (4.33 Hz, 30551.8 ft3/hr), Channel B (4.33 Hz, 30551.8 ft3/hr), 100% Scaling (1000 Hz, 7.06293e+006 ft3/hr).
- Current output 1:** Output setting: 50%. Test mode is checked. Readouts: Start AO1 (3.5 mA, -220717 ft3/hr).
- Current output 2:** Output setting: 50%. Test mode is checked. Readouts: Start AO2 (4 mA, 0 lbm/hr).
- Digital output 1:** Output 1A: Low (Test low selected). Output 1B: (empty). Start DO1 button. Test mode is checked.
- Digital output 2:** Output 2A: (empty). Output 2B: (empty). Start DO2 button. Test mode is unchecked.

A status bar at the bottom of the dialog reads: "Frequency 1 test mode output percentage (For Help, press F1)".

Note

The AO2 is only available with CPU module, part number 1-360-03-010.

The Outputs Test dialog box allows you to monitor the live values of all the frequency, current (analog) and digital outputs. Additionally, the outputs can be set into a Test mode to force the outputs to a specific user defined value. This dialog box is only available while connected to a meter.

When the dialog box first opens, the available Outputs show the current "Live" values the outputs are driving. The LED Test mode will remain gray while not in Test mode.

To fix the frequency and current outputs to a user-defined value, enter the desired percentage of full-scale into the Output setting. For Rosemount 3410 Gas Ultrasonic Flow Meters, each available output has individual output control and can be set from 0 to 150%. The 100% Scaling indicates the full scale value for the frequency outputs and can be changed from the Field Setup Wizard.

Click the **Start** button to enter Test mode. Each output has its own start button, so each available output can be tested one at a time. The frequency and current outputs will not be updated until the end of the next batch cycle. Once the Test mode LED turns green, the output values displayed represent the values the outputs are driving under test.

The frequency outputs for both the A and B channels are displayed. If **Channel B zero on error** is selected in the Field Setup Wizard the Channel B phase will show zero because the frequency output is considered invalid during test mode.

The K-Factor and Inverse K-Factor will be displayed for the frequency outputs configured for Volumetric flow rate. The values will be displayed next to the label for the associated frequency output.

To set the digital outputs to a known state, select the Test High or Test Low for the appropriate digital output and click the **Start** button for the digital output. Once the Test mode LED turns green, the value displayed for the outputs will represent the values the outputs are driving under test.

The timeout for each output in test mode is reset by MeterLink each time the values are updated. As long as this dialog is open with an output in test mode, the output will remain in test mode or until the **Stop** button is clicked to end the test.

In the event communications are lost between MeterLink and the meter (before a test mode is stopped), the meter will automatically end the test mode after the **NonNormalModeTimeout** has expired. This can be from 1 to 30 minutes depending on its settings. By default, the timeout is set to two minutes.

The Output setting can only be changed while out of Test mode. To end the Test mode, click **Stop** and wait for the end of the batch and the Test mode LED to turn gray to indicate the Outputs are driving live values.

Click **Cancel** to close the dialog box. If the meter is currently in Test mode when **Cancel** is clicked, MeterLink will first end the test mode before returning to the Main Screen.

5.7 Configure HART outputs

Configure the HART outputs of the Rosemount Ultrasonic meter. For additional information, refer to the *HART Field Device Specification Manual* (00825-0400-3240).

5.7.1 Configure the four dynamic variables

- **Primary** - set to match the Content for Current Output 1
- **Secondary** - set to match the Content for Current Output 2
- **Third** - select from the following variables: Uncorrected flow rate, Corrected flow rate, Average flow velocity, Energy flow rate, Mass flow rate, Mass flow rate Pressure and Temperature
- **Fourth** - select from the following variables: Uncorrected flow rate, Corrected flow rate, Average flow velocity, Energy flow rate, Mass flow rate, Pressure and Temperature

5.7.2 Configure the device identification

Configure the common variables in HART devices used to identify the particular device.

- **Tag** - the tag name for the HART device which may be used by host systems to uniquely identify the meter. The tag may be up to 8 characters in length.
- **Long tag** - the specified long tag matches that of the meter. The tag may be 32 bytes in length.
- **Date** - a 3 byte value where the most significant byte is the day of the month (1-31), the second byte is the month of the year (1-12), and the third byte is the year-1900.
- **Message** - a string value that can be no more than 32 characters in length.

- **Descriptor** - a string value that can be no more than 16 characters in length.
- **Final assembly number** - a numeric value that must be between 0 and 1677215.
- **Polling address** - the HART address for the meter. By default the meter is 0 but the address can range from 0 to 63.

5.7.3 Configure the HART units

Configure the units that values will be read in over the HART interface.

- Volume units
- Mass units
- Energy units
- Flow rate time units
- Velocity
- Pressure
- Temperature

5.8 Configure meter corrections

Meter profile corrections are used for Rosemount™ 3415 and 3416 Ultrasonic Flow meters only as shown in [Flow profile correction](#), [Temperature expansion correction](#) and [Pressure expansion correction](#).

5.8.1 Flow profile correction

Select the profile correction; Fixed, Calculated or Default.

- If Live or Fixed is selected on the MeterLink Startup page, for both temperature and pressure enter a value from 0.9 to 1.0 for Fixed correction factor.
- If Not used was selected for either temperature or pressure on the Startup Page, then choose from Fixed or Default for a correction factor. Calculated will be disabled. Enter a value from 0.9 to 1.0 for Fixed correction factor.
- Default - The default value is 0.95.

5.8.2 Temperature expansion correction

- Linear expansion coefficient of the meter body material.
- Linear expansion coefficient reference temperature.

5.8.3 Pressure expansion correction

- Pipe outside diameter: enter the outside diameter of the meter body.
- Young's modulus: enter the Young's Modulus value (ratio of tensile stress to tensile strain).
- Poisson's ratio: enter the Poisson's Ratio value (the absolute ratio of the pipe material lateral strain over axial strain).

5.9 Configure temperature and pressure

5.9.1 Flow-condition pressure and temperature

The flow-condition pressure and temperature are used by the Rosemount 3410 Series Gas Ultrasonic Flow Meter for various calculations such as:

- Expansion correction
- Flow profile correction (JuniorSonic™ meters only)
- Calculation of base (standard) condition volumetric flow rate and volumes
- Sound velocity calculation

Configuration

The flow-condition pressure and temperature are individually configurable (via the **EnablePressureInput** and **EnableTemperatureInput** data points) to be:

- Disabled (0)
- Live (1) (4-20 mA input signal)
- Fixed (2)
- Transmitter Head 1 (3)
 - (Available only on Dual-Configuration Transmitter Head 2)

If an input is live, then the values corresponding to the minimum and maximum input (4 and 20 mA, respectively) are specified via data points (**MinInputPressure**, **MaxInputPressure**, **MinInputTemperature**, **MaxInputTemperature**).

If an input is fixed, then its value is specified via a data point (**SpecFlowPressure**, **SpecFlowTemperature**).

If an input is set to Transmitter Head 1, then its value is specified by the in use Temperature or Pressure of the Transmitter Head 1. If transmitter Head 1 is set to Live, then Transmitter Head 2 will use the same value. If Head 2 fails to read data from Head 1, then in use value will be determined by Alarm selection setting (FlowPorTsrcUponAlarm), Used last good value or Use fixed value.

Data points associated with Analog inputs shared by Head 1 to Head 2 are the following:

- **FlowPressure** (**AbsFlowPressure** to be calculated by transmitter head 2 based on **InputPressureUnit** configuration)
- **PressureValidity** (Transmitter head 2 shall internally calculate **PressureInvalid**)
- **FlowPressureSrc**
- **FlowTemperature**
- **TemperatureValidity** (Transmitter head 2 shall internally calculate **TemperatureInvalid**)
- **FlowTemperatureSrc**

Verify Gage/Absolute and Atmospheric Pressures are configured the same in each meter.

Alarm limits can be specified for each input (**LowPressureAlarm**, **HighPressureAlarm**, **LowTemperatureAlarm**, **HighTemperatureAlarm**). Additionally, the flow-condition pressure is configurable to be gage or absolute (via the **InputPressureUnit** data point). If the pressure is gage, then the atmospheric pressure must be specified (via the **AtmosphericPress** data point). See [Configure the temperature parameters for the meter](#)

and [Configure the pressure parameters for the meter](#) for details on configuring the flow-condition pressure and temperature.

Another data point (**FlowPortSrcUponAlarm**), common to both pressure and temperature, is used to specify the data source to use when the selected input data is invalid (i.e., value at or outside its alarm limits or a live input in calibration) as either:

- Last good value (0), or
- Fixed value (1).

This data point (**FlowPortSrcUponAlarm**) is configurable via the MeterLink **Field Setup Wizard** → **Temperature and Pressure** page under Alarm Selection. It is also configurable via the MeterLink **Tools** → **Edit/Compare Configuration** screen. The default is to use the last good value.

Data updates

The Rosemount 3410 Series Gas Ultrasonic Flow Meter samples the input analog signal(s) and updates the corresponding data point(s) (**LiveFlowPressure**, **LiveFlowTemperature**) once per second regardless of the input selection (disabled, live, fixed, or Transmitter Head 1).

Every five seconds, the meter updates the "in-use" flow-condition pressure and temperature values (**FlowPressure**, **AbsFlowPressure**, **FlowTemperature**) depending upon the input selection, validity of the input data, and the selected data source upon alarm according to [Table 5-7](#).

Table 5-7: Flow-condition pressure and temperature data source

Input Type (EnablePressureInput or EnableTemperatureInput)	Data Validity (PressureValidity or TemperatureValidity)	Data Source Upon Alarm (FlowPortSrcUponAlarm)	"In-Use" Data Source (FlowPressure or FlowTemperature)
Disabled	N/A	N/A	"In-Use" value unchanged
Live	Valid	N/A	Average of live values (LiveFlowPressure or FlowTemperature)
	Invalid ⁽¹⁾	Last good value	"In-Use" value unchanged
		Fixed	Fixed data point (SpecFlowPressure or SpecFlowTemperature)
Fixed	Valid	N/A	Fixed data point (SpecFlowPressure or SpecFlowTemperature)
	Invalid	Last good value	"In-Use" value changed
		Fixed	Fixed data point (SpecFlowPressure or SpecFlowTemperature)
Transmitter Head 1	Head 1 Valid	N/A	Average of live values for Head 1 (LiveFlowPressure or FlowTemperature)
Transmitter Head 1	Head 1 Invalid	Last good value	"In-Use" value unchanged
Transmitter Head 1	Head 1 Invalid	Fixed	Fixed data point (SpecFlowPressure or SpecFlowTemperature) of Head 1

Table 5-7: Flow-condition pressure and temperature data source (continued)

Input Type (EnablePressureInput or EnableTemperatureInput)	Data Validity (PressureValidity or TemperatureValidity)	Data Source Upon Alarm (FlowPortSrcUponAlarm)	"In-Use" Data Source (FlowPressure or FlowTemperature)
Transmitter Head 1	No shared value from Head 1	Last good value	"In-Use" value unchanged
Transmitter Head 1	No shared value from Head 1	Fixed	Fixed data point (SpecFlowPressure or SpecFlowTemperature) of Head 1

(1) Live input can be invalid due to (a) one or more live values is/are at or outside the alarm limits, or (b) the input is being calibrated.

The flow-condition absolute flow pressure is calculated as shown in [Flow-condition absolute pressure](#).

Equation 5-6: Flow-condition absolute pressure

$$P_{abs,f} = P_f + P_{Atmosphere} \text{InputPressureUnit} = FALSE(\text{Gage})$$

$$P_{abs,f} = P_f \text{InputPressureUnit} = TRUE(\text{Absolute})$$

where

- $P_{abs,f}$ = flow-condition absolute pressure (MPaa) (**AbsFlowPressure**)
- P_f = flow-condition pressure (MPa if **InputPressureUnit**=FALSE, MPaa if **InputPressureUnit**=TRUE) (**FlowPressure**)
- $P_{Atmosphere}$ = (specified) atmospheric pressure (MPaa) (**AtmosphericPress**)

5.9.2 Configure the temperature parameters for the meter

- **Live temperature** - If Live Analog was selected for Temperature for meter corrections on the MeterLink Startup Page, enter the scaling for the transmitter connected to the analog input. Minimum input is the zero scale temperature of the transmitter (i.e. 1 Volt or 4mA). Maximum input is the full scale temperature of the transmitter (i.e. 5 Volts or 20 mA).
- **Fixed temperature** - If Fixed was selected on the MeterLink Startup Page for Temperature, it will also be enabled if a live temperature input was selected. Enter a fixed value to use for calculations if the live input goes into alarm. Enter an average temperature of the process fluid.
- **Temperature alarm** - Enter the low and high alarm limits. A temperature reading outside of these limits causes a Temperature Validity alarm. The Alarm selection determines what value to use while a live input is in alarm. This value is common with the pressure Alarm selection so when one is changed, the other will change to match.

5.9.3 Configure the pressure parameters for the meter

- **Pressure reading** - Select either Gage or Absolute for the type of pressure reading desired. If a live pressure transmitter is connected, select the type of reading the transmitter outputs. If Absolute is selected, you must also enter the Atmospheric pressure.

- **Live pressure** - Enter in the scaling for the transmitter connected to the analog input. Min. input is the zero scale pressure of the transmitter (i.e. 1 Volt or 4mA). Max. input is the full scale pressure of the transmitter (i.e. 5 Volts or 20 mA).
- **Fixed pressure** - Enabled if Fixed was selected for Temperature for meter corrections on the Startup Page. It will also be enabled if a live temperature input was selected to allow you to enter a fixed value to use for calculations if the live input goes into alarm. Enter an average pressure of the process fluid.
- **Pressure alarm** - Enter the low and high alarm limits. A pressure reading outside of these limits causes a Pressure Validity alarm. The Alarm selection determines what value to use while a live input is in alarm. This value is common with the temperature Alarm selection so when one is changed, the other will change to match.

5.10 Configure Gas Chromatograph parameters

Use the **Meter** → **Field Setup Wizard** menu and enable the **View Gas Chromatograph setup** checkbox. Configure the following parameters to setup a port as a Modbus master for polling a GC.

- **Port** - Select which port will be connected to the GC. While a serial port is configured for communications to a GC, it will not act as a Modbus slave device for communications from MeterLink or a SCADA system. USM can also poll a gas chromatograph using Modbus TCP/IP. Choose Port as Ethernet.
- **GC protocol** - Select the protocol for which the GC is configured. The Rosemount Gas Ultrasonic meter uses 7 data bits, Even parity, and 1 stop bit for ASCII Modbus and 8 data bits, No parity, and 1 stop bit for RTU Modbus. This option will be enabled only when a serial port is selected.
- **GC baud rate** - Select the baud rate for which the GC is configured. This option will be enabled only when a serial port is selected.
- **GC comms address/unit identifier** - Enter the Modbus ID of the GC.
- **GC IP address** - Enter the IP address of the GC. This option is only enabled when Port is selected as Ethernet.
- **GC TCP/IP port number** - Enter Modbus TCP/IP port number of the GC. This option is only enabled when Port is selected as Ethernet.
- **GC IP address** - This option will be enabled only when the Ethernet is selected.
- **GC TCP/IP port number** - This option will be enabled only when the Ethernet is selected.
- **GC stream number** - Enter the stream number for the gas composition the Rosemount Gas Ultrasonic meter will read.
- **GC heating value units** - Select the units for which the heating value is configured in the GC.
 - Btu/ft³
 - kJ/m³
 - kJ/dm³
 - MJ/m³
 - kCal/m³
 - kWh/m³
- **GC heating value type** - Select the type of heating value the GC will return.
 - Btu-Dry

- Btu-Saturated
- Btu-Actual
- **Gas composition on GC alarm** - Select which gas composition the Rosemount Gas Ultrasonic meter will use if the GC goes into alarm.
 - **Fixed** - if selected, the meter will start using the fixed gas composition stored in the meter.
 - **Last Good Value** - if selected, the meter will use the last gas composition collected from the GC before the GC started to report alarms.

5.10.1 Gas properties

Gas property data (composition and heating value) are used by the meter for AGA8 calculations (for converting to base or standard volumes and for mass calculation), for energy calculation, and for sound velocity calculations (sound velocity calculation and comparison).

The data are also used by JuniorSonic™ meters when the profile correction factor is to be calculated by the meter (rather than fixed or a default value). See [Table 5-12](#) for GC registers polled by the meter. The gas property data can either be fixed (specified via data points) or optionally read from a Rosemount™ Gas Chromatograph (GC). Head 2 of Dual-Configuration Meters can be set to use Transmitter Head 1's Live or Fixed GC data. Reading the gas property data from a GC requires a valid GC feature key (See [GC interface key](#)). Use the Field Setup Wizard in MeterLink™ to configure these parameters.

Fixed gas property data

If the data is fixed, then the heating value and its reference temperature are specified via the **MeasVolGrossHeatingVal** and **RefTemperatureHV** data points, respectively; the gas components are specified via the data points listed in [Table 5-8](#) below. Fixed gas property data is always assumed to be valid.

NOTICE

If the gas composition is specified from within MeterLink, the data point's unit is mole percentage, not mole fraction (as the data point name would imply).

Table 5-8: Fixed gas composition data points

Gas composition data points
MoleFractionN2Method2
MoleFractionCO2
MoleFractionH2
MoleFractionCO
MoleFractionMethane
MoleFractionEthane
MoleFractionPropane
MoleFractionIsoButane
MoleFractionNButane
MoleFractionIsoPentane
MoleFractionNPentane

Table 5-8: Fixed gas composition data points (continued)

Gas composition data points
MoleFractionNHexane
MoleFractionNHeptane
MoleFractionNOctane
MoleFractionNNonane
MoleFractionNDecane
MoleFractionH2S
MoleFractionHelium
MoleFractionWater
MoleFractionOxygen
MoleFractionArgon

Live (GC) gas property data

The purpose of this section is to give a brief overview of the gas property data read from a GC. Refer to [MeterLink utilities](#) for information on configuring the Rosemount 3410 Series Gas Ultrasonic Flow Meter (using the MeterLink program) for communicating with a Rosemount GC.

If the gas components are read from the GC, then the GC-reported heating value is readable via the **HeatingValueGC** data point. Note that type of heating value to be read from the GC must be specified via the **GCHeatingValueType** data point as either Btu-Dry, Btu-Saturated, or Btu-Actual. So that the correct GC register is read. Also, the heating value unit must be specified via the **GCHeatingValueUnit** data point as either Btu/ft³, kJ/m³, kJ/dm³, MJ/m³, kCal/m³, or kWh/ m³. The GC-reported gas composition is readable via the data points listed in [Table 5-9](#) below:

Table 5-9: GC-reported gas composition data points

GC reported composition data points
N2GC
CO2GC
H2GC
COGC
MethaneGC
EthaneGC
PropaneGC
IsoButaneGC
NButaneGC
IsoPentaneGC
NPentaneGC
NHexaneGC
NHeptaneGC
NOctaneGC

Table 5-9: GC-reported gas composition data points (continued)

GC reported composition data points
NNonaneGC
NDecaneGC
H2SGC
HeliumGC
WaterGC
OxygenGC
ArgonGC
C6PlusGC (C6PlusGCComponentID)
NeoPentaneGC

The validity of the GC-read gas property data is readable via the **AreGasPropertiesInvalidGC** data point where TRUE(1) indicates invalid data and FALSE(0) indicates valid data. Refer to [GC data validity](#) for further information on how the data validity is determined.

In-Use gas property data

The "In-Use" gas property data is the actual data used by the meter for calculations.

The **GasPropertiesSrcSel** data point is used to select the gas property data source as either Fixed (0) or Live - GC (1). If the data source is Live - GC and the GC-read data is invalid, then the **GasPropertiesSrcSelGCAlarm** data point is used to select the data source as either Last good value (0) or *Fixed value* (1). When Last good value is selected, the "In-Use" gas property data is not updated with the invalid GC-read gas property data. When *Fixed value* is used, the "In-Use" gas property data is updated with the fixed gas property data.

The meter maps the appropriate input gas property data points (fixed or GC-reported as discussed above) to the corresponding "In-Use" data points (the **HeatingValueInUse** data point and the gas composition data points listed in the [Table 5-10](#) below).

Table 5-10: In-Use gas composition data points

"In-Use" gas composition data points
N2InUse
CO2InUse
H2InUse
COInUse
MethaneInUse
EthaneInUse
PropaneInUse
IsoButaneInUse
NButaneInUse
IsoPentaneInUse
NPentaneInUse
NHexaneInUse

Table 5-10: In-Use gas composition data points (continued)

"In-Use" gas composition data points
NHeptaneInUse
NOctaneInUse
NNonaneInUse
NDecaneInUse
H2SInUse
HeliumInUse
WaterInUse
OxygenInUse
ArgonInUse

The fixed gas component data points map directly to the corresponding "In-Use" gas component data points. The GC-reported gas component data points map directly to the corresponding "In-Use" gas component data points except for the **C6PlusGC** and **NeoPentaneGC** components. The **C6PlusGC** quantity is divided among the **NHexaneInUse**, **NHeptaneInUse**, and **NOctaneInUse** data points according to the component ID (**C6PlusGCComponentID**) as listed in [Table 5-11](#) below:

Table 5-11: C₆+ breakdown to standard components by component ID

C ₆ + Component ID (C ₆ PlusGCComponentID)	Percentage to NHexaneInUse	Percentage to NHeptaneInUse	Percentage to NOctaneInUse
108	47.466	35.340	17.194
109	50.000	50.000	0.000
110	60.000	30.000	10.000
111	57.143	28.572	14.285

For example, if the **C₆PlusGC** mole percentage is 1% and its component ID is 110, then 60% of the C₆+ mole percentage (0.60x1%=0.60%) is added to **NHexaneInUse**, 30% (0.30x1%=0.30%) is added to **NHeptaneInUse**, and 10% (0.10x1%=0.10%) is added to **NOctaneInUse**.

The GC-reported **NeoPentane** component (**NeoPentaneGC**) quantity is added to the **IsoPentane** component (**IsoPentaneInUse**).

The validity of the "In-Use" gas property data is readable via the **AreGasPropertiesInvalidInUse** data point where TRUE(1) indicates invalid data and FALSE(0) indicates valid data. The validity of the "In-Use" gas property data is a function of the validity of the selected source data. If the source data is selected as Fixed, then the "In-Use" gas property data is valid (since the fixed data is assumed to be valid). If the source data is selected as *Live - GC*, then the "In-Use" gas property data is valid only if the GC-read gas property data is valid.

Optional gas chromatograph interface

The Rosemount 3410 Series Gas Ultrasonic Flow Meter can optionally interface with any Rosemount gas chromatograph (GC) that supports the SIM 2251 mode to read gas property data (such as for AGA8, sound velocity, energy rate, mass rate, and/or profile correction calculations).

NOTICE

The gas chromatograph interface is an optional feature that requires a valid GC feature key. Refer to [GC interface key](#).

The following table lists the Gas Chromatograph SIM registers polled by the meter. Also refer to Rosemount Engineering Specification Part Number ES-17128-005 Rev. B.

Table 5-12: Gas chromatograph Sim 2251 Registers

Sim 2251 Register	Description
3034	Stream identifier
3041	Cycle time start - month(1-12)
3042	Cycle time start - day(1-31)
3043	Cycle time start - last two year digits
3044	Cycle time start - hour(0-23)
3045	Cycle time start - minutes(0-59)
3046	GC alarm bitmap 1
3047	GC alarm bitmap 2
3001 - 3016	Component codes
7001 - 7016	Mole fractions for corresponding component codes
7033	BTU (dry)
7034	BTU (sat)
7035	Specific gravity
7038	Total unnormalized mole percent
7054	BTU (actual)

Table 5-13: Supported Components IDs

Component IDs
METHANE (100)
CO2 (117)
PROPANE (102)
H2S (140)
CO (115)
IBUTANE (103)
IPENTANE (105)
NHEXANE (139)
NOCTANE (152)
NDECANE (150)
ARGON (146)
C6PLUS_COMP_ID_1 (108)
C6PLUS_COMP_ID_3 (110)

Table 5-13: Supported Components IDs (continued)

Component IDs
NITROGEN (114)
ETHANE (101)
H2O (144)
HYDROGEN (112)
O2 (116)
NBUTANE (104)
NPENTANE (106)
NHEPTANE (145)
NNONANE (151)
HELIUM (113)
NEO_PENTANE (107)
C6PLUS_COMP_ID_2 (109)

Note

Gas Component IDs can be configured using “Gas Chromatograph Component Data” page in Field Setup Wizard of the MeterLink. This allows USM to read gas properties from GC system, which support different component IDs.

Gas property data

The gas property data read from the GC includes gas composition, heating value, and specific gravity (relative density).

The gas composition includes the 21 standard components plus C6+ and Neopentane (see [Table 5-9](#) for a list of data point names). Refer to [In-Use gas property data](#) for further information on how the GC-read gas properties are mapped to the 'in-use' gas property data points.

The GC-read heating value and specific gravity are stored in the **HeatingValueGC** and **SpecificGravityGC** data points, respectively.

Data polling

The meter periodically polls the GC looking for data updates. If the meter is communicating normally with the GC, then it polls the GC every one minute looking for an update (i.e., a change in the GC analysis time). Otherwise, the meter polls the GC every 15 seconds.

When the meter determines that a GC update is available for the specified stream number, it then reads the GC data using multiple reads one second apart until all the data is read. The GC analysis time is read again at the end of the data collection to determine if another update occurred during the data collection (i.e., the data is not all from the same update). If so, the meter discards the gas property data just read and begins looking immediately for the next update.

If the meter cannot successfully communicate with the GC after four consecutive polls (15 seconds apart), then the meter indicates the communication alarm via the **IsGComErr** data point with the **GComStatus** data point indicating an error code (listed in [Table 5-14](#) below).

Table 5-14: GC Communications status list

GCComm status value	Error description
0	No error.
1	Desired stream not found.
2	GC controller is busy (error defined by Modbus protocol).
3	GC detected an illegal Modbus function code from the meter.
4	GC detected an illegal Modbus data address from the meter.
5	GC detected an illegal data value from the meter.
6	Failure in associated device (Modbus defined error).
7	GC has accepted the meter's request but is still processing.
8	A firmware logic error was detected.
9	Modbus address mismatch.
10	Modbus function code mismatch.
11	GC reports an exception code that is unrecognized.
12	The meter's Modbus request message is too long (exceeds the maximum allowable length).
13	The GC's Modbus response message is too long (exceeds the maximum allowable length).
14	GC response message has incorrect number of registers.
15	GC does not support the requested message data type.
16	GC does not support the requested data protocol.
17	The meter's Modbus request message (RTU protocol) is too long (exceeds the maximum allowable length).
18	GC response not received within the communication timeout.
19	GC response message (ASCII protocol) incomplete.
20	GC response message (RTU protocol) incomplete.
21	GC gas property data spans more than one update.
22	Server port not open. Gateway path not available or target device failed to respond.
23	GC IP address incorrect.

GC data validity

The GC-read gas property data validity is indicated by the **AreGasPropertiesInvalidGC** data point. The data is considered invalid if any of the conditions listed in [Table 5-15](#) is true. These conditions are indicated by the MeterLink Monitor page Field I/O indicator.

Table 5-15: GC-read gas property invalid conditions

Indication Data Point	Condition
IsGCAlarmPresent	GC reported alarm (GC Alarm1 bits 14 and/or 15 set, GC Alarm2 bits 0, 1, 2, and/or 3 set).
IsGCWarningPresent	Not presently used - reserved for future use.

Table 5-15: GC-read gas property invalid conditions (continued)

Indication Data Point	Condition
IsGCCommErr	The meter is not able to communicate successfully with the GC. Refer to communication error conditions listed in Table 5-14 .
IsGCDataErr	The total unnormalized gas composition mole percentage of all the gas components read from the GC is not within [85%, 115%].
	An individual gas composition mole percentage is not within [0%, 100%].
	The specific gravity is not within the range of [0.2, 0.8].
	The heating value is greater than 50 kJ/dm ³ .
	Specified gas stream (GCStreamNumber) not found within the specified period (GCDesiredStreamTimeout).
	Invalid GC feature key (GC interface key) Port improperly configured (such as if configured without using the MeterLink Field Setup Wizard).

GC alarm handling

The following data points are included in the meter's alarm log (See [Event log: alarm/audit](#)): **AreGasPropertiesInvalidGC**, **IsGCAlarmPresent**, **IsGCCommErr**, **GCCommStatus**, and **IsGCDataErr**.

5.10.2 Configure AGA8 parameters

Configure the properties necessary for the AGA8 calculations.

How the AGA8 calculations to be performed:

- **Internally by the meter** - calculates the flow mass density, the flow compressibility and the base compressibility.
- **Externally** - calculations are done externally. The calculated values must then be written to the meter using MeterLink™ or a flow computer.

AGA8 method

- Gross Method 1
- Gross Method 2
- Detail Method - enter the amount of each of the 21 gas components as a percentage.
- GERG-2008

Gas composition

- **Fixed** - use the fixed gas composition stored in the meter for all calculations.
- **Live GC** - use a gas composition collected by the meter from a gas chromatograph for all calculations. This option is only available with a GC key or is enabled with the Continuous Flow Analysis key.
- Transmitter Head 1 (Available only on Head 2 of Dual-Configuration meter)
- Configure the Gas properties for the gas chromatograph
- Base temperature
- Base pressure
- Gas composition to use on GC alarm

- Specific gravity
- Specific gravity reference temperature
- Specific gravity reference pressure
- Volumetric gross heating value
- Volumetric gross heating value reference temperature
- Molar density reference temperature
- Molar density reference pressure
- Flow mass density⁽¹⁾
- Flow compressibility⁽¹⁾
- Base compressibility⁽¹⁾

5.10.3 Configure Continuous Flow Analysis parameters

Configure the Continuous Flow Analysis features of the Rosemount Ultrasonic meter. This MeterLink™ Field Setup Wizard page is displayed only if the View Continuous Flow Analysis setup was selected on the Startup Page and you have a valid Continuous Flow Analysis key.

These features require that the meter baseline be set using the **Tools** → **Set Baseline Wizard**.

- **Flow limits** - low and high flow velocity limits.
- **SOS comparison** - compares the meter average speed of sound to the AGA 10 calculated speed of sound. SOS comparison is also performed when AGA8 method is Detail Method or GERG-2008.
- **Liquid detection** - identifies when liquids may be present in the bottom of the meter run base on the meter's flow characteristics.
- **Abnormal profile** - identifies if the meter flow profile has shifted from the original baseline profile of the meter.
- **Blockage** - identifies a possible blockage of an upstream flow conditioner.
- **Internal bore buildup** - indicates that the flow characteristics have changed indicating a build up on the internal bore of the meter.

Set baseline parameters

Select the direction to baseline and what data to use to perform the baseline. The wizard will step you through setting a baseline in one direction.

It is necessary to baseline the meter in both directions if the meter will be operating in a bi-directional application. For meters only operating in a uni-directional application, the meter only needs one baseline. The status message displayed on the Meter monitor screen about the baseline not being set can simply be acknowledged to clear the alarm for a flow direction you do not want to baseline.

Setting baselines in two directions is only necessary if the meter is installed in a bi-directional application. Flow through the meter in one direction can be quite different from flow through a meter in the opposite direction. This could be because of flow conditioners, thermowells, or elbows.

- Select baseline flow direction - forward or reverse

(1) If a flow computer or SCADA system is used to write these values to the meter, they do not have to be entered at this time.

- Select baseline data source
 - **1-minute averages from the meter** - the preferred option when setting the baseline for a new meter. The meter must be under typical flowing conditions when the baseline is set.
 - **Maintenance log** - if the meter has already been installed in the field for a period of time and a MeterLink maintenance log is available from the initial startup that was taken during normal flowing conditions.
 - **Manual entry** - manually enter data for each of the parameters. This could be used to modify a single parameter for a baseline already set or it could be to enter data from a historical record from when the meter was first put into service.

Configure the Local Display

Configure the parameters for the local display.

Use the drop-down arrow in the Display Items list box and select or modify the parameters that will be displayed; the Display items, the Display units and the Scroll delay.

Important

When connected to a meter with the local display option, reverse flow direction is indicated with a minus sign (negative) before the value(s) shown on the local display.

Figure 5-13: Field Setup Wizard - Local Display

Mode

Select Scroll items 1-10 or Uncorrected volume only. The default value is Scroll items 1-10. Scroll items 1-10 mode, allows selection of up to ten data points to be displayed on the local display. In Uncorrected volume only mode, the display will only alternate between the forward and reverse uncorrected volume in units of cubic meters in compliance with OIML

R-137-1 and the European MID directive. Depending on the size of the meter, the value displayed in the Uncorrected volume only mode will be X 10 cubic meters or X 100 cubic meters as indicated on the display in the bottom line.

Display items and display units

Display units - Meter volume units displayed are either U.S. Customary or Metric. The Meter volume units displayed reflect the meter's units selected on the **File** → **Program Settings** dialog (e.g. U.S. Customary or Metric units). Configure the Meter volume units for U.S. Customary selections:

- Cubic feet,
- Thousand cubic feet

Or

Metric unit selections are:

- Cubic meters
- Thousand cubic meters

Configure the Flow rate time units:

- Second
- Hour
- Day

Display units preceded by a plus or minus sign indicate forward and reverse flow direction, as shown in the table below.

Table 5-16: Local display labels, descriptions and valid units

Local display labels, descriptions and valid units
QFLOW - Uncorrected volume flow rate — ACF - Actual Cubic Feet — ACM - Actual Cubic Meters — MACF - Thousand Actual Cubic Feet — MACM - Thousand Actual Cubic Meters
TDYVL - Current day's forward uncorrected volume — +ACF - Actual Cubic Feet — +ACM - Actual Cubic Meters — +MACF - Thousand Actual Cubic Feet — +MACM - Thousand Actual Cubic Meters
TDYVL - Current day's reverse uncorrected volume — -ACF - Actual Cubic Feet — -ACM - Actual Cubic Meters — -MACF - Thousand Actual Cubic Feet — -MACM - Thousand Actual Cubic Meters

Table 5-16: Local display labels, descriptions and valid units (continued)

Local display labels, descriptions and valid units
YSTVL - Previous day's forward uncorrected volume — +ACF - Actual Cubic Feet — +ACM - Actual Cubic Meters — +MACF - Thousand Actual Cubic Feet — +MACM - Thousand Actual Cubic Meters
YSTVL- Previous day's forward uncorrected volume — -ACF - Actual Cubic Feet — -ACM - Actual Cubic Meters — -MACF - Thousand Actual Cubic Feet — -MACM - Thousand Actual Cubic Meters
TOTVL - Forward uncorrected volume — +ACF - Actual Cubic Feet — +ACM - Actual Cubic Meters — +MACF - Thousand Actual Cubic Feet — +MACM - Thousand Actual Cubic Meters
TOTVL - Reverse uncorrected volume — -ACF - Actual Cubic Feet — -ACM - Actual Cubic Meters — -MACF - Thousand Actual Cubic Feet — -MACM - Thousand Actual Cubic Meters
QBASE - Corrected volume flow rate — SCF - Standard Cubic Feet — SCM - Standard Cubic Meters — MSCF - Thousand Standard Cubic Feet — MSCM - Thousand Standard Cubic Meters
TDYVL- Current days forward corrected volume — +SCF - Standard Cubic Feet — +SCM - Standard Cubic Meters — +MSCF - Thousand Standard Cubic Feet — +MSCM - Thousand Standard Cubic Meters
TDYVL- Current days reverse corrected volume — -SCF - Standard Cubic Feet — -SCM - Standard Cubic Meters — -MSCF - Thousand Standard Cubic Feet — -MSCM - Thousand Standard Cubic Meters

Table 5-16: Local display labels, descriptions and valid units (continued)

Local display labels, descriptions and valid units
YSTVL - Previous days forward corrected volume — +SCF - Standard Cubic Feet — +SCM - Standard Cubic Meters — +MSCF - Thousand Standard Cubic Feet — +MSCM - Thousand Standard Cubic Meters
YSTVL - Previous days reverse corrected volume — -SCF - Standard Cubic Feet — -SCM - Standard Cubic Meters — -MSCF - Thousand Standard Cubic Feet — -MSCM - Thousand Standard Cubic Meters
TOTVL - Forward uncorrected volume — +SCF - Standard Cubic Feet — +SCM - Standard Cubic Meters — +MSCF - Thousand Standard Cubic Feet — +MSCM - Thousand Standard Cubic Meters
TOTVL - Reverse uncorrected volume — -SCF - Standard Cubic Feet — -SCM - Standard Cubic Meters — -MSCF - Thousand Standard Cubic Feet — -MSCM - Thousand Standard Cubic Meters
VEL - Average flow velocity — Ft/S - Feet per Second — M/S - Meters per Second
SOS - Average sound velocity — Ft/S - Feet per Second — M/S - Meters per Second
TEMP - Flow-condition temperature — DEGF - Degrees Fahrenheit — DEGC - Degrees Celsius
PRESS - Flow-condition pressure — PSI - Pound per square inch — MPA - Megapascals
FRQ1A - Frequency channel 1A — HZ - Hertz
FRQ1B - Frequency channel 1B — HZ - Hertz

Table 5-16: Local display labels, descriptions and valid units (continued)

Local display labels, descriptions and valid units
KFCT1 - Frequency 1K-factor — CF - Cubic Feet — CM - Cubic Meters — MCF - Thousand Cubic Feet — MCM - Thousand Cubic Meters
FRQ2A - Frequency channel 2A — HZ - Hertz
FRQ2B - Frequency channel 2B — HZ - Hertz
KFCT2 - Frequency 2K-factor — CF - Cubic Feet — CM - Cubic Meters — MCF - Thousand Cubic Feet — MCM - Thousand Cubic Meters
AO1- Analog Output 1 current — MA- Miliamperes
AO2 - Analog Output 2 current — MA- Miliamperes

Scroll delay - Time interval for the selected display items to be shown on the Local Display. Use the spin buttons to increase or decrease the time interval.

5.11 Configure users

Rosemount 3410 Series Firmware v1.60 and later require user authentication to connect to the meter with MeterLink. Meters ship from the factory with a single default user named administrator. The default password is Administrator-XXXXX where XXXXX is the non-zero padded CPU serial number which can be found on a label on the CPU Module. It is highly recommended to change this password on meter startup for cybersecurity reasons. For added security, the default username, administrator, can be changed as well. See [Manage users](#) for more details on how to add, change, and delete users.

6 Logs/reports

6.1 Archive logs

The Rosemount 3410 Series Gas Ultrasonic Flow Meters provides five types of data logs (daily, hourly, audit, alarm, and system logs).

From Rosemount 3410 Series Firmware v1.42 and later, the meter can store up to 1825 daily records (5 years) and 4320 hourly records (180 days).

Each log type is discussed in detail below followed by MeterLink instructions to read (and optionally save) meter log records ([Options for reading daily and/or hourly log records](#)).

6.1.1 Daily and Hourly log data points actions

Five different log data point actions are supported by the daily and hourly logs: snapshot, average, flow-gated (average), totalize, and macro as described below:

- **SNAPSHOT:** causes the data point's value at the log time to be recorded.
- **AVERAGE:** causes the data point's average value over the log interval (day or hour) to be recorded.
- **FLOW_GATED:** Average value of the data point over the log interval (day or hour) to be recorded while the volumetric flow rate (**QFlow**) is above the volumetric flow rate threshold (**QCutOff**). If the volumetric flow rate does not exceed the threshold during the log interval, then the flow gated average of the data point is the same as the average value of the data point over the log interval to be recorded.
- **FLOW_ANALYSIS_GATED:** Average of the data point over the log interval (day or hour) to be recorded while the average flow velocity (**AvgFlow**) is between the diagnostic flow analysis limits (**FlowAnalysisLowFlowLmt** and **FlowAnalysisHighFlowLmt**). If the average flow velocity is not within the limits during the interval, then the flow analysis gated average of the data point is the same as the average value of the data point over the log interval to be recorded.
- **TOTALIZE:** causes the data point's accumulated value over the log interval (day or hour) to be recorded.
- **MACRO:** causes the (boolean) data point's 'latched' value over the log interval (day or hour) to be recorded. A (boolean) data point's latched value indicates if the point was ever TRUE during the log interval (where a TRUE value is represented by a 1 and a FALSE value is represented by a 0). This allows a group of boolean data points to be grouped into a single integer value where each bit represents the latched value of a single boolean data point.

Daily log

The Rosemount 3410 Series Gas Ultrasonic Flow Meter stores a daily log record once per day at the specified contract hour.

(Refer to the MeterLink Help files for information on specifying the **ContractHour** data point).

The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point **DoOverwriteUnreadDailyLog**. This point can be modified using the MeterLink **Tools** → **Edit/Compare Configuration** screen. The default is to overwrite old, unread records. Refer to [Options for reading daily and/or hourly log](#)

records for information on reading records and marking records as read. The data point **IsDailyLogFull** indicates whether or not the daily log is full and cannot overwrite old, unread records.

The data points included in the daily log and the corresponding log action are as shown in the table below. Data points required by the API Chapter 21 standard are marked with an asterisk (*). For information on a *particular* data point, consult MeterLink online help (see the help topic for any data point in MeterLink. Click **Help** → **Gas 3410 Series Registers Reference**, select the **Index** tab, start typing the data point name until the desired point is highlighted, and then click the **Display** button).

Table 6-1: Daily log data points

Data point	Content	Log action
DailySMVResult		SNAPSHOT
PosVolFlow		TOTALIZE and SNAPSHOT
NegVolFlow		TOTALIZE and SNAPSHOT
AccumFlowTime		TOTALIZE
DailyMacro1		MACRO

Table 6-1: Daily log data points (continued)

Data point		Content	Log action
	bit 0	IsQFlowInvalid	
	bit 1	IsQBaseInvalid	
	bit 2	IsMassRateInvalid	
	bit 3	IsEnergyRateInvalid	
	bit 4	IsEstimatedFlowVelocityInUse	
	bit 5	IsTooFewOperChords	
	bit 6	IsFwdBaselineNotSet	
	bit 7	IsRevBaselineNotSet	
	bit 8	IsGCDataErr	
	bit 9	Unused	
	bit 10	IsAcqModuleIncompatible	
	bit 11	IsHourlyLogFull	
	bit 12	IsDailyLogFull	
	bit 13	IsAuditLogFull	
	bit 14	IsAlarmLogFull	
	bit 15	IsSystemLogFull	
	bit 16	IsXdcrFiringSyncError	
	bit 17	IsColocMeterCommErr	
	bit 18	IsGCCommErr	
	bit 19	IsGCAlarmPresent	
	bit 20	IsElecVoltOutOfRange	
	bit 21	IsElecTempOutOfRange	
	bit 22	DidCnfgChksumChg	
	bit 23	DidPowerFail	
	bit 24	IsAcqModuleError	
	bit 25	IsAcqMode	
	bit 26	DidColdStart	
	bit 27	IsCorePresent	
	bit 28	WatchDogReset	
	bit 29	DI1	
	bit 30	IsWarmStartReq	
	bit 31	IsClkInvalid	
DailyMacro2			MACRO

Table 6-1: Daily log data points (continued)

Data point		Content	Log action
	bit 0	Unused	
	bit 1	Unused	
	bit 2	Unused	
	bit 3	AreGasPropertiesInvalidInUse	
	bit 4	IsSndVelCompErr	
	bit 5	IsReverseFlowDetected	
	bit 6	IsAbnormalProfileDetected	
	bit 7	IsLiquidDetected	
	bit 8	IsBoreBuildupDetected	
	bit 9	IsBlockageDetected	
	bit 10	IsDiagnosticSndSpdRangeErr	
	bit 11	Unused	
	bit 12	IsColocMeterSndSpdRangeErr	
	bit 13	IsColocMeterQFlowRangeErr	
	bit 14	DidWarmStart	
	bit 15	DidResetUsers	
	bit 16	IsAnyLogFull	
	bit 17	TemperatureInvalid	
	bit 18	PressureInvalid	
	bit 19	Unused	
	bit 20	IsChordLengthMismatched	
	bit 21	IsXdcrMaintenanceRequired	
	bit 22	IsSNRTooLow	
	bit 23	IsPeakSwitchDetected	
	bit 24	IsHardFailedD	
	bit 25	IsHardFailedC	
	bit 26	IsHardFailedB	
	bit 27	IsHardFailedA	
	bit 28	IsMeterVelAboveMaxLmt	
	bit 29	IsAvgSoundVelRangeErr	
	bit 30	IsMeasSndSpdRange	
	bit 31	Unused	
DailyMacro3			MACRO
	bits 0 - 3	IsChordLengthMismatched<A..D>	
	bits 4 - 7	Unused	
	bits 8 - 11	IsBatchInactive<A..D>	
	bits 12 - 15	Unused	
	bits 16 -19	IsXdcrMaintenanceRequired<A..D>	
	bits 20 - 23	Unused	
	bits 24 - 27	IsFailedForBatch<A..D>	
	bits 28 - 31	Unused	
DailyMacro4			

Table 6-1: Daily log data points (continued)

Data point		Content	Log action
	bits 0 - 3 bits 4 - 7 bits 8 - 11 bits 12 - 15 bits 16 - 19 bits 20 - 23 bits 24 - 27 bits 28 - 31	DidDltTmChkFail<A..D> Unused IsSigQtyBad<A..D> Unused DidExceedMaxNoise<A..D> Unused IsSNRTooLow<A..D> Unused	
DailyMacro5			MACRO
	bits 0 - 3 bits 4 - 7 bits 8 - 11 bits 12 - 15 bits 16 - 19 bits 20 - 23 bits 24 - 27 bits 28 - 31	DidTmDevChkFail<A..D> Unused IsSigDistorted<A..D> Unused IsPeakSwitchDetected<A..D> Unused IsSigClipped<A..D> Unused	
DailyMacro6			
	bits 0 - 3 bits 4 - 7 bits 8 - 11 bits 12 - 31	IsMeasSndSpdRange<A..D> Unused IsStackingIncomplete<A..D> Unused	
ProfileFactor			FLOW_ANALYSIS_GATED
SwirlAngle			FLOW_ANALYSIS_GATED
Symmetry			FLOW_ANALYSIS_GATED
CrossFlow			FLOW_ANALYSIS_GATED
Turbulence<A..D>			FLOW_ANALYSIS_GATED
SndVel<A..D>			FLOW_GATED
SpdSndSpread			AVERAGE
AvgSndVel			FLOW_GATED
SndVelDiff<A..D>			FLOW_GATED
AGA10SndVel			FLOW_GATED
SndVelCompErr			FLOW_ANALYSIS_GATED
ColocMeterTH2VsTH1AvgSndVelPctDiff			FLOW_GATED
FlowVel<A..D>			FLOW_GATED
AvgFlow			FLOW_GATED
FlowVelRatio<A..D>			AVERAGE

Table 6-1: Daily log data points (continued)

Data point	Content	Log action
PctGood<A1..D2>		AVERAGE
Gain<A1..D2>		AVERAGE
SNR<A1..D2>		AVERAGE
NoiseAmplitude<A1..D2>		AVERAGE
EnergyRate		FLOW_GATED
PosEnergy		TOTALIZE and SNAPSHOT
NegEnergy		TOTALIZE and SNAPSHOT
MassRate		FLOW_GATED
PosMass		TOTALIZE and SNAPSHOT
NegMass		TOTALIZE and SNAPSHOT
PosVolBase		TOTALIZE and SNAPSHOT
NegVolBase		TOTALIZE and SNAPSHOT
QFlow		FLOW_GATED
ColocMeterTH2VsTH1QFlowPctDiff		FLOW_GATED
QBase		FLOW_GATED
FlowTemperature		FLOW_GATED
ExpCorrTemperature		FLOW_GATED
FlowPressure		FLOW_GATED
ExpCorrPressure		FLOW_GATED
AbsFlowPressure		FLOW_GATED
CorrectionFactor		FLOW_GATED
RhoMixFlow		FLOW_GATED
ZFlow		FLOW_GATED
ZBase		FLOW_GATED
MethaneInUse		FLOW_GATED
N2InUse		FLOW_GATED
CO2InUse		FLOW_GATED
EthaneInUse		FLOW_GATED
PropaneInUse		FLOW_GATED
WaterInUse		FLOW_GATED
H2SInUse		FLOW_GATED
H2InUse		FLOW_GATED
COInUse		FLOW_GATED

Table 6-1: Daily log data points (continued)

Data point	Content	Log action
OxygenInUse		FLOW_GATED
IsoButaneInUse		FLOW_GATED
NButaneInUse		FLOW_GATED
IsoPentaneInUse		FLOW_GATED
NPentaneInUse		FLOW_GATED
NHexaneInUse		FLOW_GATED
NHeptaneInUse		FLOW_GATED
NOctaneInUse		FLOW_GATED
NNonaneInUse		FLOW_GATED
NDecaneInUse		FLOW_GATED
HeliumInUse		FLOW_GATED
ArgonInUse		FLOW_GATED
HeatingValueInUse		FLOW_GATED
SpecificGravityInUse		FLOW_GATED
CnfgChksumValue		SNAPSHOT
CnfgChksumDate		SNAPSHOT

Hourly log

The Rosemount 3410 Series Gas Ultrasonic Flow Meter meter stores an hourly log record once per hour on the hour. The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point **DoOverwriteUnreadHourlyLog**.

This point can be modified using the MeterLink™ **Tools** → **Edit/Compare Configuration** screen. The default is to overwrite old, unread records. Refer to [Options for reading daily and/or hourly log records](#) for information on reading records and marking records as read. The data point **IsHourlyLogFull** indicates whether or not the hourly log is full and cannot overwrite old, unread records.

The data points included in the hourly log and the corresponding log action are as shown in the table below. Data points required by the API Chapter 21 standard are marked with an asterisk (*). For information on a *particular* data point, consult MeterLink online help.

Table 6-2: Hourly log data points

Data point	Content	Log action
HourlySMVResult		SNAPSHOT
PosVolFlow		TOTALIZE and SNAPSHOT
NegVolFlow		TOTALIZE and SNAPSHOT
AccumFlowTime		TOTALIZE
HourlyMacro1		MACRO

Table 6-2: Hourly log data points (continued)

Data point		Content	Log action
	bit 0	IsQFlowInvalid	
	bit 1	IsQBaseInvalid	
	bit 2	IsMassRateInvalid	
	bit 3	IsEnergyRateInvalid	
	bit 4	IsEstimatedFlowVelocityInUse	
	bit 5	IsTooFewOperChords	
	bit 6	IsFwdBaselineNotSet	
	bit 7	IsRevBaselineNotSet	
	bit 8	IsGCDataErr	
	bit 9	Unused	
	bit 10	IsAcqModuleIncompatible	
	bit 11	IsHourlyLogFull	
	bit 12	IsDailyLogFull	
	bit 13	IsAuditLogFull	
	bit 14	IsAlarmLogFull	
	bit 15	IsSystemLogFull	
	bit 16	IsXdcrFiringSyncError	
	bit 17	IsColocMeterCommErr	
	bit 18	IsGCCommErr	
	bit 19	IsGCAlarmPresent	
	bit 20	IsElecVoltOutOfRange	
	bit 21	IsElecTempOutOfRange	
	bit 22	DidCnfgChksumChg	
	bit 23	DidPowerFail	
	bit 24	IsAcqModuleError	
	bit 25	IsAcqMode	
	bit 26	DidColdStart	
	bit 27	IsCorePresent	
	bit 28	WatchDogReset	
	bit 29	DI1	
	bit 30	IsWarmStartReq	
	bit 31	IsClkInvalid	
HourlyMacro2			MACRO

Table 6-2: Hourly log data points (continued)

Data point		Content	Log action
	bit 0	Unused	
	bit 1	Unused	
	bit 2	Unused	
	bit 3	AreGasPropertiesInvalidInUse	
	bit 4	IsSndVelCompErr	
	bit 5	IsReverseFlowDetected	
	bit 6	IsAbnormalProfileDetected	
	bit 7	IsLiquidDetected	
	bit 8	IsBoreBuildupDetected	
	bit 9	IsBlockageDetected	
	bit 10	IsDiagnosticSndSpdRangeErr	
	bit 11	IsSevereFlowConditionDetected	
	bit 12	IsColocMeterSndSpdRangeErr	
	bit 13	IsColocMeterQFlowRangeErr	
	bit 14	DidWarmStart	
	bit 15	DidResetUsers	
	bit 16	IsAnyLogFull	
	bit 17	TemperatureInvalid	
	bit 18	PressureInvalid	
	bit 19	Unused	
	bit 20	IsChordLengthMismatched	
	bit 21	IsXdcrMaintenanceRequired	
	bit 22	IsSNRTTooLow	
	bit 23	IsPeakSwitchDetected	
	bit 24	IsHardFailedD	
	bit 25	IsHardFailedC	
	bit 26	IsHardFailedB	
	bit 27	IsHardFailedA	
	bit 28	IsMeterVelAboveMaxLmt	
	bit 29	IsAvgSoundVelRangeErr	
	bit 30	IsMeasSndSpdRange	
	bit 31	Unused	
HourlyMacro3			MACRO
	bits 0 - 3	IsChordLengthMismatched<A..D>	
	bits 4 - 7	Unused	
	bits 8 - 11	IsBatchInactive<A..D>	
	bits 12 - 15	Unused	
	bits 16 -19	IsXdcrMaintenanceRequired<A..D>	
	bits 20 - 23	Unused	
	bits 24 - 27	IsFailedForBatch<A..D>	
	bits 28 - 31	Unused	
HourlyMacro4			MACRO

Table 6-2: Hourly log data points (continued)

Data point		Content	Log action
	bits 0 - 3 bits 4 - 7 bits 8 - 11 bits 12 - 15 bits 16 -19 bits 20 - 23 bits 24 - 27 bits 28 - 31	DidDltTmChkFail<A..D> Unused IsSigQltyBad<A..D> Unused DidExceedMaxNoise<A..D> Unused IsSNRTooLow<A..D> Unused	
HourlyMacro5			MACRO
	bits 0 - 3 bits 4 - 7 bits 8 - 11 bits 12 - 15 bits 16 -19 bits 20 - 23 bits 24 - 27 bits 28 - 31	DidTmDevChkFail<A..D> Unused IsSigDistorted<A..D> Unused IsPeakSwitchDetected<A..D> Unused IsSigClipped<A..D> Unused	
HourlyMacro6			MACRO
	bits 0 - 3 bits 4 - 7 bits 8 - 11 bits 12 - 31	IsMeasSndSpdRange<A..D> Unused IsStackingIncomplete<A..D> Unused	
ProfileFactor			FLOW_ANALYSIS_GATED
SwirlAngle			FLOW_ANALYSIS_GATED
Symmetry			FLOW_ANALYSIS_GATED
CrossFlow			FLOW_ANALYSIS_GATED
Turbulence<A..D>			FLOW_ANALYSIS_GATED
SndVel<A..D>			FLOW_GATED
SpdSndSpread			AVERAGE
AvgSndVel			FLOW_GATED
SndVelDiff<A..D>			FLOW_GATED
AGA10SndVel			FLOW_GATED
SndVelCompErr			FLOW_ANALYSIS_GATED
ColocMeterTH2VsTH1AvgSndVelPctDiff			FLOW_GATED
FlowVel<A..D>			FLOW_GATED
AvgFlow			FLOW_GATED
FlowVelRatio<A..D>			FLOW_GATED

Table 6-2: Hourly log data points (continued)

Data point	Content	Log action
PctGood<A1..D2>		AVERAGE
Gain<A1..D2>		AVERAGE
SNR<A1..D2>		AVERAGE
NoiseAmplitude<A1..D2>		AVERAGE
EnergyRate		FLOW_GATED
PosEnergy		TOTALIZE and SNAPSHOT
NegEnergy		TOTALIZE and SNAPSHOT
MassRate		FLOW_GATED
PosMass		TOTALIZE and SNAPSHOT
NegMass		TOTALIZE and SNAPSHOT
PosVolBase		TOTALIZE and SNAPSHOT
NegVolBase		TOTALIZE and SNAPSHOT
QFlow		FLOW_GATED
ColocMeterTH2VsTH1QFlowPctDiff		FLOW_GATED
QBase		FLOW_GATED
FlowTemperature		FLOW_GATED
ExpCorrTemperature		FLOW_GATED
FlowPressure		FLOW_GATED
ExpCorrPressure		FLOW_GATED
AbsFlowPressure		FLOW_GATED
CorrectionFactor		FLOW_GATED
RhoMixFlow		FLOW_GATED
ZFlow		FLOW_GATED
ZBase		FLOW_GATED
MethaneInUse		FLOW_GATED
N2InUse		FLOW_GATED
CO2InUse		FLOW_GATED
EthaneInUse		FLOW_GATED
PropaneInUse		FLOW_GATED
WaterInUse		FLOW_GATED
H2SInUse		FLOW_GATED
H2InUse		FLOW_GATED
COInUse		FLOW_GATED

Table 6-2: Hourly log data points (continued)

Data point	Content	Log action
OxygenInUse		FLOW_GATED
IsoButaneInUse		FLOW_GATED
NButaneInUse		FLOW_GATED
IsoPentaneInUse		FLOW_GATED
NPentaneInUse		FLOW_GATED
NHexaneInUse		FLOW_GATED
NHeptaneInUse		FLOW_GATED
NOctaneInUse		FLOW_GATED
NNonaneInUse		FLOW_GATED
NDecaneInUse		FLOW_GATED
HeliumInUse		FLOW_GATED
ArgonInUse		FLOW_GATED
HeatingValueInUse		FLOW_GATED
SpecificGravityInUse		FLOW_GATED
CnfgChksumValue		SNAPSHOT
CnfgChksumDate		SNAPSHOT

Audit log

The Rosemount 3410 Gas Ultrasonic Flow Meters stores an audit log record whenever any parameter affecting the flow measurement is modified. The audit log record indicates which data point changed, the date and time of the change, and both the 'as-found' and 'as-left' values.

The meter can store up to 3000 audit records. The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point **DoOverwriteUnreadAuditLog**. This point can be modified using the MeterLink **Tools** → **Edit/Compare Configuration** screen. The default is to overwrite old, unread records. Refer to [Options for reading audit, alarm, and/or system log records](#) for information on reading records and marking records as read. The data point **IsAuditLogFull** indicates whether or not the audit log is full and cannot overwrite old, unread records.

The data points monitored and collected for the audit log are as shown in [Audit log](#) through [Event log: alarm/audit](#) below. The points are grouped and, within each group, are listed alphabetically.

The groupings are as follows:

- AGA8
- Baseline
- Calculated Sound Velocity
- Calibration
- Chord Proportions
- Co-located meter
- Communications

- Data Logging
- Expansion Correction
- Flow analysis
- Frequency, Digital, and Analog Signals
- Gas chromatograph
- General
- Indicators
- Local display
- Meter Information
- Pressure & Temperature
- Reynolds Number Calculation
- Signal Processing
- Tracking

For information on a *particular* data point, consult MeterLink online help.

Table 6-3: Audit log AGA 8 group monitored data points

Data group	Data Point
	HCH_Method PBase RefPressureGr RefPressureMolarDensity RefTemperatureGr RefTemperatureHV RefTemperatureMolarDensity Tbase

Table 6-4: Audit log Calculated Sound Velocity group monitored data points

Data group	Data Point
	AGA10Key IsGasCompositionValidationEnabled IsSndVelCompEnabled SndVelCompErrLimit

Table 6-5: Audit log Baseline group monitored data points

Data group	Data Point
	FwdBaselineAvgFlow FwdBaselineComment FwdBaselineCrossFlow FwdBaselineFlowPressure FwdBaselineFlowTemperature FwdBaselineProfileFactor FwdBaselineSwirlAngle FwdBaselineSymmetry FwdBaselineTime FwdBaselineTurbulence<A..D> RevBaselineAvgFlow RevBaselineComment RevBaselineCrossFlow RevBaselineFlowPressure RevBaselineFlowTemperature RevBaselineProfileFactor RevBaselineSwirlAngle RevBaselineSymmetry RevBaselineTime RevBaselineTurbulence<A..D>

Table 6-6: Audit log calibration group monitored data points

Data group	Data Point
	AvgDly<A..D> CalFlag CalMethod DltDly Fwd<A0..A3> Fwd<C0..C3> FwdFlwRt<1..12> FwdMtrFctr<1..12> MeterHousingLength<A..D> L<A..D> PipeDiam Rev<A0..A3> Rev<C0..C3> RevFlwRt<1..12> RevMtrFctr<1..12> SystemDelay Wt<A..D> X<A..D> XdcrAssyComponent4SerialNumber XdcrAssyComponent4Length XdcrAssyComponent3SerialNumber XdcrAssyComponent3Length XdcrAssyComponent2SerialNumber XdcrAssyComponent2Length XdcrAssyComponent1SerialNumber XdcrAssyComponent1Length

Table 6-7: Audit log Chord proportions group monitored data points

Data group	Data Point
	LowFlowLmt NumVals PropUpdtSeconds ResetProp

Table 6-8: Audit log collocated meter group monitored data point

Data group	Data Point
	ColocMeterIPAddress ColocMeterMode ColocMeterQFlowErrLimit ColocMeterRunningAverageInterval ColocMeterSndSpdErrLimit IsColocMeterClockSyncEnabled IsColocMeterQFlowRangeCheckEnabled IsColocMeterSndSpdRangeCheckEnabled

Table 6-9: Audit log communication group monitored data point

Data group	Data Point
	BaudPort<A..C> CommTCPMaxDatagramSizePort<A..C> CommTCPTimeoutPort<A..C> CommTimeoutPort<A..C> CommRspDlyPort<A..C> DriveSelectionPort<A..C> Eth1AltMapfilePt Eth1AltModbusPort Eth1AltModbusReadWriteMode Eth1DfltGatewayAddr Eth1IPAddr Eth1MapfilePt Eth1ModbusID Eth1ModbusReadWriteMode Eth1SubnetMask FTPServerControlPort HTTPServerPort IsHWFlowControlEnabledPortA IsTelnetServerEnabled MaxConnDBAPI ModbusIDPort<A..D> PortAMapfilePt PortBMapfilePt PortCMapfilePt ProtocolPort<A..C> PTPDomainNumber ReadWriteModePort<A..C> RTSOFFDelayPortA RTSOnDelayPortA

Table 6-10: Audit log data logging group monitored data point

Data group	Data Point
	AlarmTurnOffHysterisisCount AlarmTurnOffHysterisisTimeSpan ContractHour DailyLogInterval DoOverwriteUnreadAlarmLog DoOverwriteUnreadAuditLog DoOverwriteUnreadDailyLog DoOverwriteUnreadHourlyLog DoOverwriteUnreadSystemLog HourlyLogInterval IsAuditLogFixedDataPointsEnabled

Table 6-11: Audit log Expansion correction group monitored data point

Data group	Data Point
	EnableExpCorrPress EnableExpCorrTemp LinearExpansionCoef PipeOutsideDiameter PoissonsRatio RefPressExpCoef RefTempLinearExpCoef YoungsModulus

Table 6-12: Audit log Flow analysis group monitored data point

Data group	Data Point
	AbnormalProfileDetectionLmt BlockageCrossFlowLmt BlockageSymmetryLmt BlockageTurbulenceLmt<A..D> ContinuousFlowAnalysisKey DiagnosticChordRunningAvgSeconds DiagnosticSndSpdErrLimit FlowAnalysisHighFlowLmt FlowAnalysisLowFlowLmt IsAbnormalProfileDetectionEnabled IsBlockageDetectionEnabled IsBoreBuildupDetectionEnabled IsDiagnosticChordEnabled IsDiagnosticSndSpdDetectionEnabled IsLiquidDetectionEnabled IsReverseFlowDetectionEnabled LiquidDetectionSDevCrossFlowLmt LiquidDetectionSDevProfileFactorLmt LiquidDetectionSDevSymmetryLmt ReverseFlowDetectionZeroCut ReverseFlowVolLmt SwirlAngleLmt

Table 6-13: Audit log frequency, digital and analog group monitored data point

Data group	Data Point
	AO1ActionUponInvalidContent
	AO1Content
	AO1CurrentTrimGain
	AO1CurrentTrimZero
	AO1Dir
	AO1FullScaleEnergyRate
	AO1FullScaleMassRate
	AO1FullScaleVolFlowRate
	AO1MaxVel
	AO1MinVel
	AO1TestModeOutputPercent
	AO1TrimCurrent
	AO1TrimGainExtMeasCurrent
	AO1TrimZeroExtMeasCurrent
	AO1ZeroScaleEnergyRate
	AO1ZeroScaleMassRate
	AO1ZeroScaleVolFlowRate
	AO2ActionUponInvalidContent
	AO2Content
	AO2CurrentTrimGain
	AO2CurrentTrimZero
	AO2Dir
	AO2FullScaleEnergyRate
	AO2FullScaleMassRate
	AO2FullScaleVolFlowRate
	AO2MaxVel
	AO2MinVel
	AO2TestModeOutputPercent
	AO2TrimCurrent
	AO2TrimGainExtMeasCurrent
	AO2TrimZeroExtMeasCurrent
	AO2ZeroScaleEnergyRate
	AO2ZeroScaleMassRate
	AO2ZeroScaleVolFlowRate
	DI1IsInvPolarity
	DI1Mode
	DO1AContent ... DO1BContent
	DO1AIsInvPolarity ... DO1BIsInvPolarity
	DO1PairTestEnable
	DO2AContent ... DO2BContent
	DO2AIsInvPolarity... DO2BIsInvPolarity
	DO2PairTestEnable
	FODO1Mode
	FODO1Source
	FODO2Mode
	FODO2Source
	FODO3Mode
	FODO3Source

Data group	Data Point
	FODO4Mode
	FODO4Source
	FODO5Mode
	FODO5Source
	FODO6Mode
	FODO6Source
	Freq1BPhase
	Freq1Content
	Freq1Dir
	Freq1FeedbackCorrectionPcnt
	Freq1FullScaleEnergyRate
	Freq1FullScaleMassRate
	Freq1FullScaleVolFlowRate
	Freq1MaxFrequency
	Freq1MaxVel
	Freq1MinVel
	Freq1TestModeOutputPercent
	Freq1ZeroScaleEnergyRate
	Freq1ZeroScaleMassRate
	Freq1ZeroScaleVolFlowRate
	Freq2BPhase
	Freq2Content
	Freq2Dir
	Freq2FeedbackCorrectionPcnt
	Freq2FullScaleEnergyRate
	Freq2FullScaleMassRate
	Freq2FullScaleVolFlowRate
	Freq2MaxFrequency
	Freq2MaxVel
	Freq2MinVel
	Freq2TestModeOutputPercent
	Freq2ZeroScaleEnergyRate
	Freq2ZeroScaleMassRate
	Freq2ZeroScaleVolFlowRate
	IsAO1EnableTest
	IsAO2EnableTest
	IsDI1ForCalActiveLow
	IsDI1ForCalStateGated
	IsFreq1BZeroedOnErr
	IsFreq1EnableTest
	IsFreq2BZeroedOnErr
	IsFreq2EnableTest

Table 6-14: Audit log gas chromatograph group monitored data point

Data group	Data Point
	GasPropertiesSrcSel GasPropertiesSrcSelGCArm GCBaud GCommTimeout GCDesiredStreamTimeout GHeatingValueType GHeatingValueUnit GCIPAddr GCKey GCModbusID GCProtocol GCSerialPort GCStreamNumber GCTCPPort

Table 6-15: Audit log general group monitored data point

Data group	Data Point
	AlarmDef
	AsyncEnable
	AvgSoundVelHiLmt
	AvgSoundVelLoLmt
	ChordalConfig
	ChordInactv<A..D>
	DampEnable
	DeviceNumber
	DitherEnable
	FlowDir
	IsPlaybackSimulationEnabled
	MaxNoDataBatches
	MeterMaxVel
	MinChord
	MinPctGood
	NonNormalModeTimeout
	PeakSwitchDetectModeSimFileName
	PerfStatusSuppressLmt
	RTCSecondsSinceEpochSet
	SevereFlowConditionFactor
	SevereFlowConditionLmt1
	SevereFlowConditionLmt2
	SpecCorrectionFactor
	SSMax
	SSMin
	UnitsSystem
	UserChanged
	VelHold
	VolFlowRateTimeUnit
	VolUnitMetric
	VolUnitUS
	WallRoughness
	XdcrFiringSync
	XdcrMaintenanceGainRange
	XdcrMaintenanceSNRRange
	XdcrType
	ZeroCut

Table 6-16: Audit log HART data group monitored data point

Data group	Data Point
	HARTDate HARTDensityUnit HARTDescriptor HARTDeviceFinalAssyNum HARTEnergyUnit HARTHeatingValueUnit HARTLengthUnit HARTLongTag HARTMassUnit HARTMessage HARTMicroLengthUnit HARTMinNumPreambles HARTNumPreambleBytesFromSlave HARTPollingAddress HARTPressureUnit HARTQVContent HARTRateTimeUnit HARTSlot0Content HARTSlot1Content HARTSlot2Content HARTSlot3Content HARTTag HARTTemperatureUnit HARTTVContent HARTTVVelUnit HARTViscosityUnit HARTVolUnit HARTYoungsModulusPressureUnit IsHARTSlaveEnabled

Table 6-17: Audit log indicators group monitored data point

Data group	Data Point
	CnfgChksumDate CnfgChksumValue DidCnfgChksumChg DidColdStart DidPowerFail DidWarmStart DoWarmStart IsConfigProtected IsCorePresent IsProgrammingStarted MeterResetTime WatchDogReset

Table 6-18: Audit log local display group monitored data point

Data group	Data Point
	LocalDisplayFlowRateTimeUnit LocalDisplayItem<1..10> LocalDisplayMode LocalDisplayScrollDelay LocalDisplayVolUnitMetric LocalDisplayVolUnitUS

Table 6-19: Audit log meter information group monitored data point

Data group	Data Point
	Address City CPUBdBootLoaderSwVer CPUBdSwVer FileSysVer MeterModel MeterName MeterNominalSize MeterSerialNumber OSVer StateAndCountry StationName UserScratch1 UserScratch2

Table 6-20: Audit log pressure and temperature group monitored data point

Data group	Data Point
	AtmosphericPress EnablePressureInput EnableTemperatureInput FlowPOrTsrcUponAlarm FlowPressureWhileCal FlowTemperatureWhileCal HighPressureAlarm HighTemperatureAlarm InputPressureUnit LiveFlowPressureCalCtrl LiveFlowPressureGain LiveFlowPressureOffset LiveFlowTemperatureCalCtrl LiveFlowTemperatureGain LiveFlowTemperatureOffset LowPressureAlarm LowTemperatureAlarm MaxInputPressure MaxInputTemperature MinInputPressure MinInputTemperature

Table 6-21: Audit log Reynolds number calculation group monitored data point

Data group	Data Point
	Viscosity

Table 6-22: Audit log signal processing group monitored data point

Data group	Data Point
	BatchPercentSmoothing
	BatchSize
	CRange
	DltChk
	EmRateActual
	EmRateDesired
	Filter
	FireSeq
	GainHighLmt
	GainLowLmt
	MaxHoldTm
	MaxNoise
	MinHoldTime
	MinSigQty
	NegSpan
	Pk1Pct
	Pk1Thrsh
	Pk1Wdth
	PosSpan
	SampInterval
	SampPerCycle
	SetXdcrType
	SndSpdChkMaxVel
	SndSpdChkMinVel
	SNRatio
	SpecBatchUpdtPeriod
	StackEmRateActual
	StackEmRateDesired
	StackSize
	TmDevFctr1
	TmDevLow1
	XdcrFreq
	XdcrNumDriveCycles

Table 6-23: Audit log tracking group monitored data point

Data group	Data Point
	ResetTrkParam
	Tamp
	TampHi
	TampLo
	TampSen
	TampWt
	Tspe
	TspeHi
	TspeLmt
	TspeLo
	TspeSen
	TspeWt
	Tspf
	TspfHi
	TspfLo
	TspfMatch
	TspfSen
	TspfWt

Table 6-24: Audit Log Fixed data points

Fixed value configuration data points, which are written by external client like flow computer at regular interval of time, can be enabled by setting IsAuditLogFixedDataPointsEnabled as TRUE. By default, IsAuditLogFixedDataPointsEnabled is set to FALSE which disables audit logging of following data points.

Data group	Data Point
AGA 8	ArgonComponentIndex COComponentIndex CO2ComponentIndex C6PlusComponentIndex C6PlusDecaneFrac C6PlusHeptaneFrac C6PlusHexaneFrac C6PlusNonaneFrac C6PlusOctaneFrac EthaneComponentIndex GCDisabled HeliumComponentIndex H2ComponentIndex H2SComponentIndex IsC6PlusAutoDetectionEnabled IsoButaneComponentIndex IsoPentaneComponentIndex MeasVolGrossHeatingVal MethaneComponentIndex MoleFractionArgon MoleFractionCO MoleFractionCO ₂ MoleFractionEthane MoleFractionHelium MoleFractionH ₂ MoleFractionH ₂ S MoleFractionIsoButane MoleFractionIsoPentane MoleFractionMethane MoleFractionNButane MoleFractionNDecane MoleFractionNHeptane MoleFractionNHexane MoleFractionNNonane MoleFractionNOctane MoleFractionNPentane MoleFractionN ₂ Method ₂ MoleFractionOxygen MoleFractionPropane MoleFractionWater NeoPentaneComponentIndex NButaneComponentIndex NDecaneComponentIndex NHeptaneComponentIndex NHexaneComponentIndex NNonaneComponentIndex NOctaneComponentIndex NPentaneComponentIndex N2ComponentIndex OxygenComponentIndex

Data group	Data Point
	PropaneComponentIndex
	SpecFlowPressure
	SpecFlowTemperature
	SpecificGravity
	SpecRhoMixFlow
	SpecZBase
	SpecZFlow
	WaterComponentIndex

Determining meter power-up and power-down times

The audit log can be used to determine the meter start (or re-start) time and the meter power-down time by examining the **MeterResetTime** record(s). The **MeterResetTime** record time stamp indicates (to within a few seconds) the time that the meter was started. The **As-left** value indicates the time (to within a few seconds) that the meter was powered-down.

6.1.2 Event log: alarm/audit

The meter monitors several data points with respect to each point's alarm limit(s). Non-boolean data points can have low and high alarm limits. Boolean data points only have a single alarm limit (i.e., either TRUE or FALSE).

The Rosemount 3410 Series Ultrasonic Flow Meter stores an alarm log record whenever any monitored data point's alarm status (cleared or set) changes. The alarm log record indicates the data point, date and time, alarm status, corresponding alarm limit, and data point value.

The meter can store up to 3000 alarm records. The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point **DoOverwriteUnreadAlarmLog**. This point can be modified using the MeterLink **Tools** → **Edit/Compare Configuration** screen. The default is to overwrite old, unread records. Refer to [Options for reading audit, alarm, and/or system log records](#) for information on reading records and marking records as read. The data point **IsAlarmLogFull** indicates whether or not the alarm log is full and cannot overwrite old, unread records.

The user-settable data points **AlarmTurnOffHysterisisCount** and **AlarmTurnOffHysterisisTimeSpan** are used to prevent very repetitive alarms from filling up the alarm log. When an alarm is set **AlarmTurnOffHysterisisCount** times within **AlarmTurnOffHysterisisTimeSpan** seconds, then the alarm is suppressed until the alarm frequency drops below the specified rate (counts per time span) at which point the next alarm clearing "unsuppresses" the alarm. The alarm log records indicate when an alarm suppression is started and ended. The default values are 8 occurrences in 240 seconds.

The data points monitored for the alarm log are as shown in the tables below. Note that the alarm limits are themselves data points. The user-settable alarm limits are listed by data point name. Non-settable alarm limits are listed by data point value.

Table 6-25: Alarm log monitored data points

Data point	Low alarm limit	High alarm limit
GainA1, GainA2, GainB1, GainB2, GainC1, GainC2, GainD1, GainD2	GainLowLmt	GainHighLmt

Table 6-25: Alarm log monitored data points (continued)

Data point	Low alarm limit	High alarm limit
AvgSndVel	AvgSoundVelLoLmt	AvgSoundVelHiLmt
SpecFlowPressure	LowPressureAlarm	HighPressureAlarm
SpecFlowTemperature	LowTemperatureAlarm	HighTemperatureAlarm
LiveFlowPressure	LowPressureAlarm	HighPressureAlarm
LiveFlowTemperature	LowTemperatureAlarm	HighTemperatureAlarm
AvgFlow	MeterMaxNegVel	MeterMaxVel
SysTemp	-40 °C	100 °C
SysVoltage1V	0.90 V	1.10 V
SysVoltage1V2	1.08 V	1.32 V
SysVoltage2V5	2.225 V	2.775 V
SysVoltage3V3	2.937 V	3.663 V

Table 6-26: Alarm log Boolean alarm limit

Data point	Boolean alarm unit
IsClkInvalid	TRUE
SpecFlowTemperature	TRUE
SpecFlowPressure	TRUE
PressureInvalid	TRUE
TemperatureInvalid	TRUE
AGA8BaseCalcStatus	TRUE
AGA8BaseCalcValidity	FALSE
AGA8FlowCalcStatus	TRUE
AGA8FlowCalcValidity	FALSE
IsAcqModuleError	TRUE
AvgFlow	TRUE
IsMeterVelAboveMaxLmt	TRUE
AvgSndVel	TRUE
IsAvgSoundVelRangeErr	TRUE
QMeterValidity	FALSE
QFlowValidity	FALSE
QBaseValidity	FALSE
DidColdStart	TRUE
IsMeasSndSpdRange<A..D>	TRUE
IsAcqMode	TRUE
IsTooFewOperChords	TRUE
IsHardFailed<A..D>	TRUE

Table 6-26: Alarm log Boolean alarm limit (continued)

Data point	Boolean alarm unit
Freq1DataValidity	FALSE
Freq2DataValidity	FALSE
SysTemp	TRUE
SysVoltage2V5	TRUE
SysVoltage3V3	TRUE
IsHourlyLogFull	TRUE
IsDailyLogFull	TRUE
IsAuditLogFull	TRUE
IsSystemLogFull	TRUE
IsAcqModuleIncompatible	TRUE
LiveFlowPressure	TRUE
LiveFlowTemperature	TRUE
IsSndVelCompErr	TRUE
EnergyRateValidity	FALSE
AreGasPropertiesInvalidInUse	TRUE
AreGasPropertiesInvalidInUseLatched	TRUE
AreGasPropertiesInvalidGC	TRUE
GCCommStatus	TRUE
IsGCCommErr	TRUE
IsGCDataErr	TRUE
IsGCAlarmPresent	TRUE
MassRateValidity	FALSE
AO1IsSaturated	TRUE
AO2IsSaturated	TRUE
AO1DataValidity	FALSE
AO2DataValidity	FALSE
AreSwComponentsCompatible	TRUE
IsAcqModuleErrorLatched	TRUE
IsAcqModeLatched	TRUE
IsTooFewOperChordsLatched	TRUE
TemperatureInvalidLatched	TRUE
PressureInvalidLatched	TRUE
IsMeterVelAboveMaxLmtLatched	TRUE
IsAvgSoundVelRangeErrLatched	TRUE
IsBlockageDetected	TRUE
IsBlockageDetectedLatched	TRUE

Table 6-26: Alarm log Boolean alarm limit (continued)

Data point	Boolean alarm unit
IsBoreBuildupDetected	TRUE
IsBoreBuildupDetectedLatched	TRUE
IsLiquidDetected	TRUE
IsLiquidDetectedLatched	TRUE
IsAbnormalProfileDetected	TRUE
IsAbnormalProfileDetectedLatched	TRUE
IsReverseFlowDetected	TRUE
ReverseFlowVol	TRUE
IsFwdBaselineNotSet	TRUE
IsRevBaselineNotSet	TRUE
IsReverseFlowDetectedLatched	TRUE
IsSndVelCompErrLatched	TRUE
SysVoltage1V2	TRUE
SysVoltage1V	TRUE
SysVoltageAcqModule1V2	TRUE
SysVoltageAcqModule2V5	TRUE
SysVoltageAcqModule3V3	TRUE
SysTempAcqModule	TRUE
IsDiagnosticSndSpdRangeErr	TRUE
IsDiagnosticSndSpdRangeErrLatched	TRUE
IsXdcrFiringSyncError	TRUE
IsColocMeterCommErr	TRUE
IsColocMeterCommErrLatched	TRUE
IsColocMeterSndSpdRangeErr	TRUE
IsColocMeterSndSpdRangeErrLatched	TRUE
IsColocMeterQFlowRangeErr	TRUE
IsColocMeterQFlowRangeErrLatched	TRUE
IsChordLengthMismatched<A..D>	TRUE
DidResetUsers	TRUE

System log

The Rosemount 3410 Series Gas Ultrasonic Flow Meter meter logs all system messages in the system log.

The meter can store up to 3000 system records. The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point **DoOverwriteUnreadSystemLog**.

This point can be modified using the MeterLink **Tools** → **Edit/Compare Configuration** screen. The default is to overwrite old, unread records. Refer to [Options for reading audit](#),

alarm, and/or system log records for information on reading records and marking records as read. The data point **IsSystemLogFull** indicates whether or not the system log is full and cannot overwrite old, unread records.

Repetitive system messages are prevented from filling up the system log. When a particular system message occurs 3 times within 60 seconds, that system message is suppressed until that message's frequency drops below the 3 times-per-60 sec rate. ***The system log records indicate when a system message suppression is started and ended.***

6.1.3 Reading log records

There are three log groups:

- Daily
- Hourly
- Event (audit, alarm, and systems logs)

Select the desired log group(s) via the **Collect daily log/Collect hourly log/Collect event log** check boxes. If the event group is selected, the audit, alarm, and system logs are individually selectable. Whenever any log is collected, the current meter configuration is also collected.

6.1.4 Options for reading daily and/or hourly log records

The options for reading daily and hourly log records are the same. The MeterLink™ **Logs/Reports** → **Meter Archive Logs** screen indicates the number of daily records that are available to read. Select the log type(s) to be collected via the **Collect daily log and/or Collect hourly log** check boxes.

Select whether to collect all log records or the last specified number of daily records. Also, select whether to collect all log data or just the data points required by the API Chapter 21 standard. [Table 6-1](#) lists the daily log data points and [Table 6-2](#).

For both tables, data points required by the API Chapter 21 standard are marked with an asterisk (*).

6.1.5 Options for reading audit, alarm, and/or system log records

The options for reading audit, alarm, and system log records are the same. The MeterLink™ **Logs/Reports** → **Meter Archive Logs** screen indicates the number of records available for each log type. Select whether to collect either all the records or just the last specified number of daily records for the selected log type.

6.1.6 Collecting and viewing log records

Three log formats are available:

- **Microsoft Excel** - This is the recommended format for collecting/saving log records in order to get the full benefits of the data logging feature. This option, however, is only available if Microsoft® Excel® is installed on the PC. The Excel® file generated by this utility has up to six worksheets depending upon the logs collected: Daily Log, Hourly Log, Alarm Log, Audit Log, System Log, and Meter Config. The collected log data is also displayed on the screen.

- **Comma-separated values** - This format creates a file with data separated by commas. Each log record collected is put on a separate line in the file. Each log type is separated by a blank line. The meter configuration follows the log data separated by a blank line. The collected log data is also displayed on the screen.
- **Don't log to file** - This option will not save any of the collected log data to a file but will display it on the screen.

After selecting the desired log type(s) and the log format, click on the **Collect** button to initiate the log data collection. If a format that saves the data to a file is selected, then a Save As dialog box is opened to allow specifying the file name. A default file name is suggested but can be modified. A comment may also be entered to be included with the data file.

If a log type to be read is configured so that unread records are not over-written, then MeterLink queries the user as to whether or not that log's records should be marked as 'read'.

Once the data collection is completed, the data is displayed in the Meter Archive Logs dialog box one log type at a time. Select the log type to be displayed via the **View log** box. The data may be sorted by selecting either Oldest first or Newest first in the **Sort order** box.

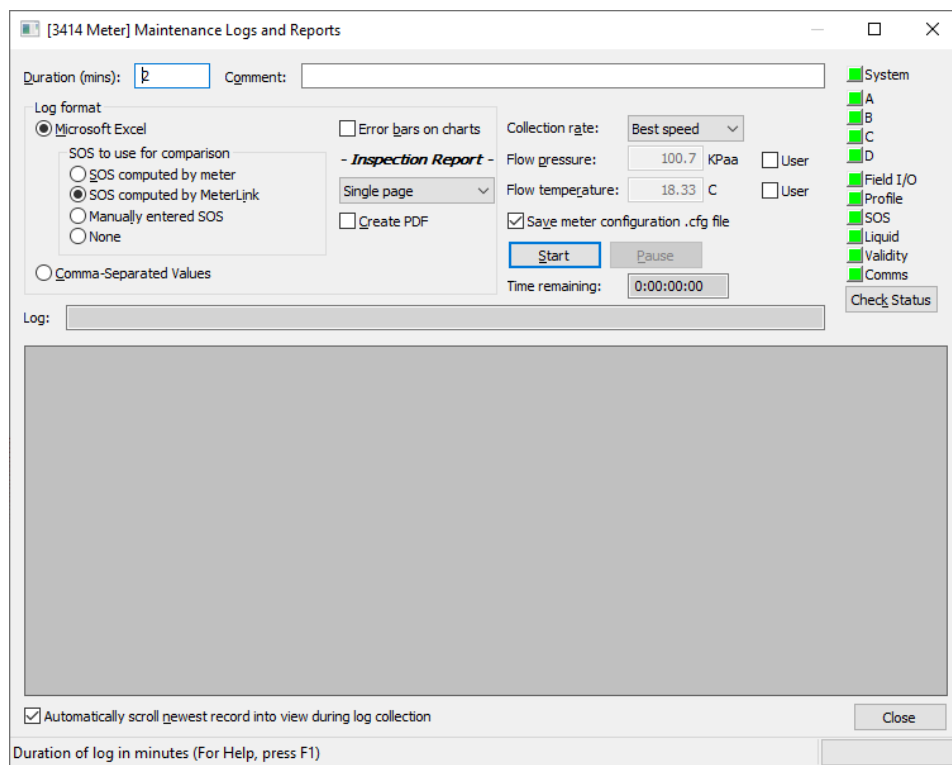
6.1.7 Collecting logs

To collect Maintenance and Trend Logs for meter diagnostics

Procedure

1. Establish communication with the meter via MeterLink.
2. From MeterLink main window, select **Logs/Reports** → **Maintenance Logs and Reports**. The Maintenance Logs and Reports dialog displays.

Figure 6-1: Maintenance Logs



3. Set the log collection Duration (mins) (2 minutes is the default value which is normally adequate to capture a good snapshot of the meter's current diagnostic parameters). To get a good representation of the meter performance, it is recommended that there be at least 30 records (lines of data). The actual number of records collected are a function of the type of communication (Serial or Ethernet), Stack Size (if stacking is turned on), and the Collection speed selected. The duration value can be changed by clicking the number in the display/edit box and entering a new value.
4. If desired, a comment may be included in the log file by entering it in the display/edit box provided.
5. In the Log Format field, select Microsoft® Excel®. Only select Comma Separated Values (CSV) if the Microsoft® Excel® option is unavailable, as this format is not compatible with the generation of graphics, trending and analysis offered by 3410 Series Gas Ultrasonic Flow Meters. Once the file is collected in the CSV format, it can not be converted to a Microsoft® Excel® format.
6. To begin collecting logs, click the **Start** button. MeterLink collects the meter's configuration and then begins collecting all the data from the meter.
7. MeterLink displays the Log Complete message box after the logs are collected.
8. To view the Microsoft® Excel® file, select **YES** to open the Workbook.
9. Select the **Workbook report view** from the Microsoft® Excel® toolbar at the bottom of the page. Tab selections include:
 - Charts
 - Inspection Report
 - Meter Config

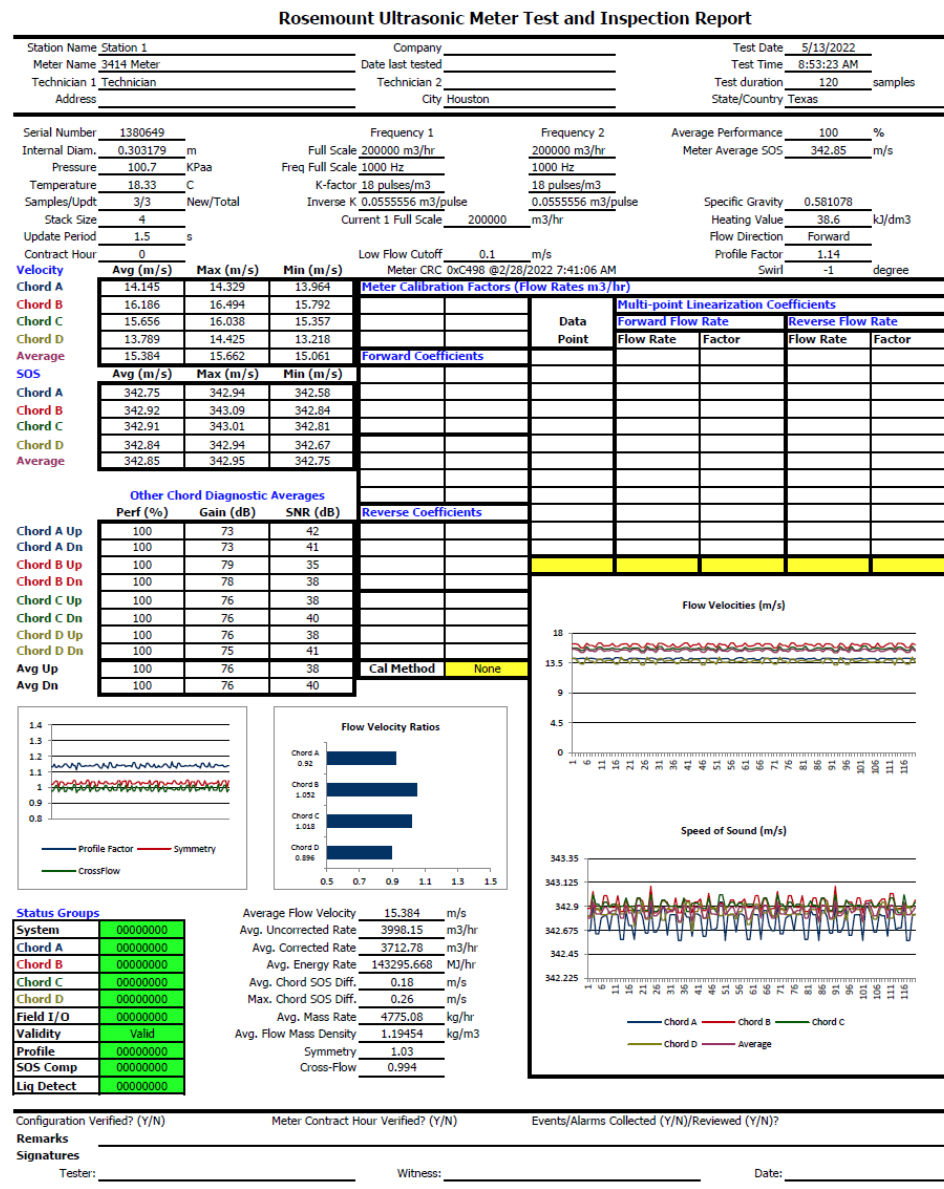
- Raw Data

Figure 6-2: Microsoft® Excel® report view toolbar



- Inspection Report is the default view when you open the Maintenance Log.

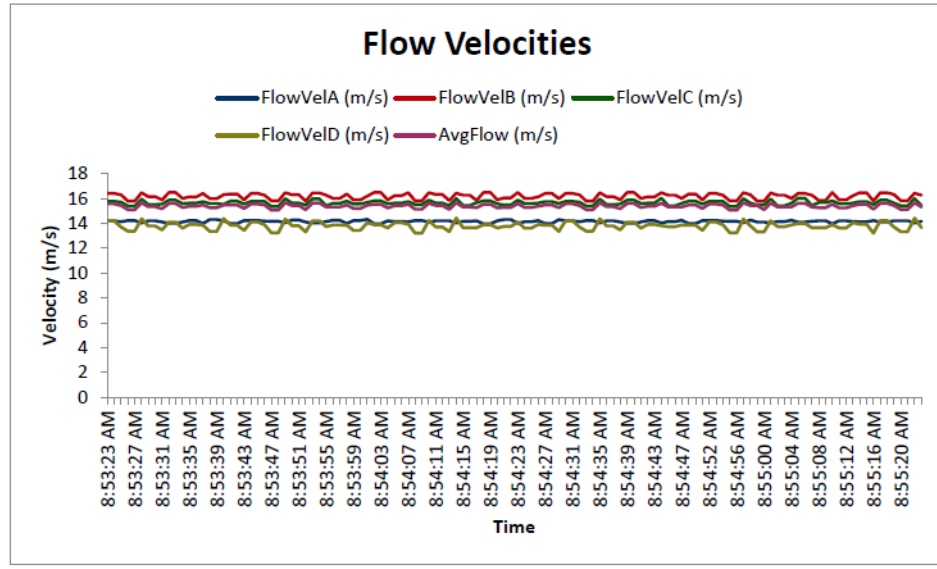
Figure 6-3: Rosemount Ultrasonic Meter Test and Inspection Report



- Charts is the view of charted data.

Figure 6-4: Microsoft® Excel® charts view

Meter Name: 3414 Meter Log started: 5/13/2022 8:53:23 AM Duration: 2 minutes # samples: 120
Company Name:
Comment:



12. The next Microsoft® Excel® report view is Meter Config.

Figure 6-5: Microsoft® Excel® Meter Config. view

Reg#	Label	Short Description	Value	Units	Access
201	DeviceNumber	Meter device number	3814 - Four-path		RW
3	MeterName	Meter name	3814 Meter		RW
6	MeterSerialNumber	Meter serial number	12106		RW
188	StationName	Station name	Station 1		RW
189	Address	Station address			RW
190	City	City	Houston		RW
191	StateAndCountry	State and country	Texas		RW
186	UserScratch1	User scratch point 1	Not set		RW
187	UserScratch2	User scratch point 2	Not set		RW
41	EthIPAddr	Ethernet port IP address	10.211.211.110		RW
42	EthSubnetMask	Ethernet port subnet mask	255.255.0.0		RW
1353	Eth1DHCPGatewayAddr	Ethernet default gateway address	10.211.211.1		RW
1946	Eth1AltModbusPort	Alternate TCP port used for Modbus TCP	0		RW
1945	Eth1ModbusID	Ethernet port Modbus address	155		RW
3812	Eth1ModbusReadWriteMode	Modbus TCP slave read and write mode	Modbus TCP slave read-write mode		RW
3813	Eth1AltModbusReadWriteMode	Modbus TCP alternate port slave read and write mode	Modbus TCP slave disabled		RW
3741	FTPServerControlPort	FTP server control port	0		RW
3738	HTFServerPort	TCP port used for HTTP server	80		RW
3731	MaxConnDBAPI	Maximum number of DB API connections	10		RW
45	PortAMapfilePt	Comm Port A mapfile name	Map1.txt		RW
2107	DriverSelectionPortA	Hardware protocol on Port A	RS-232		RW
47	BaudPortA	Communication Port A baud rate	19200	bits/s	RW
49	ModbusIDPortA	Comm Port A Modbus address	32		RW
50	CommRespDlyPortA	Comm Port A response delay	0	ms	RW
51	RTSOndelayPortA	Comm Port A handshaking RTS off delay time	0	ms	RW
52	RTSDelayPortA	Comm Port A handshaking RTS on delay time	0	ms	RW
56	CommTimeOutPortA	Comm Port A communication timeout value	4	s	RW
3814	ProtocolPortA	Serial port A protocol(s) allowed	PPP (for Meter/Link) or Modbus ASCII/RTU		RW
3718	ReadWriteModePortA	Serial port A read and write mode	Read-write mode		RW
57	IsHWFlowControlEnabledPortA	Enables comm port A hardware flow control	Disabled		RW
58	PortBMapfilePt	Comm Port B mapfile name	Map1.txt		RW
2422	DriverSelectionPortB	Hardware protocol on Port B	RS-232		RW
60	BaudPortB	Communication Port B baud rate	19200	bits/s	RW
62	ModbusIDPortB	Comm Port B Modbus address	32		RW
63	CommRespDlyPortB	Comm Port B response delay	0	ms	RW
68	CommTimeOutPortB	Comm Port B communication timeout value	4	s	RW
3815	ProtocolPortB	Serial port B protocol(s) allowed	PPP (for Meter/Link) or Modbus ASCII/RTU		RW
3719	ReadWriteModePortB	Serial port B read and write mode	Read-write mode		RW
1665	PortCMapfilePt	Comm Port C mapfile name	Map2.txt		RW
2423	DriverSelectionPortC	Hardware protocol on Port C	RS-232		RW
73	BaudPortC	Communication Port C slave mode baud rate	19200	bits/s	RW
75	ModbusIDPortC	Comm Port C Slave mode Modbus address	32		RW
76	CommRespDlyPortC	Comm Port C response delay	0	ms	RW

13. The last Microsoft® Excel® report view is Raw Data.

Figure 6-6: Microsoft® Excel® Raw Data view

	A	B	C	D	F	G	H	I	J	K	L	M
1	Date	Time	QMeter (L/hr)	QFlow (L/hr)	FlowTemperature (C)	FlowPressure (KPa)	SystemStatus	FlowVelA (m/s)	FlowVelB (m/s)	FlowVelC (m/s)	FlowVelD (m/s)	AvgFlow (m/s)
2	5/13/2022	7:46:20 AM	1299664.4	1299664.4	0	0	0x00020000	3.961	5.111	5.748	3.794	5
3	5/13/2022	7:46:21 AM	1299624.4	1299624.4	0	0	0x00020000	3.961	5.111	5.748	3.794	5
4	5/13/2022	7:46:22 AM	1299615.3	1299615.3	0	0	0x00020000	3.961	5.111	5.747	3.794	5
5	5/13/2022	7:46:23 AM	1299643.3	1299643.3	0	0	0x00020000	3.961	5.111	5.748	3.794	5
6	5/13/2022	7:46:24 AM	1299664.6	1299664.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
7	5/13/2022	7:46:25 AM	1299624.6	1299624.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
8	5/13/2022	7:46:26 AM	1299615.1	1299615.1	0	0	0x00020000	3.961	5.111	5.747	3.794	5
9	5/13/2022	7:46:27 AM	1299643.8	1299643.8	0	0	0x00020000	3.961	5.111	5.748	3.794	5
10	5/13/2022	7:46:28 AM	1299664.6	1299664.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
11	5/13/2022	7:46:29 AM	1299624.6	1299624.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
12	5/13/2022	7:46:30 AM	1299615	1299615	0	0	0x00020000	3.961	5.111	5.747	3.794	5
13	5/13/2022	7:46:31 AM	1299643.6	1299643.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
14	5/13/2022	7:46:32 AM	1299664.5	1299664.5	0	0	0x00020000	3.961	5.111	5.748	3.794	5
15	5/13/2022	7:46:33 AM	1299624.3	1299624.3	0	0	0x00020000	3.961	5.111	5.748	3.794	5
16	5/13/2022	7:46:34 AM	1299615.1	1299615.1	0	0	0x00020000	3.961	5.111	5.747	3.794	5
17	5/13/2022	7:46:35 AM	1299643.3	1299643.3	0	0	0x00020000	3.961	5.111	5.748	3.794	5
18	5/13/2022	7:46:36 AM	1299664.4	1299664.4	0	0	0x00020000	3.961	5.111	5.748	3.794	5
19	5/13/2022	7:46:37 AM	1299624.4	1299624.4	0	0	0x00020000	3.961	5.111	5.748	3.794	5
20	5/13/2022	7:46:38 AM	1299615.3	1299615.3	0	0	0x00020000	3.961	5.111	5.747	3.794	5
21	5/13/2022	7:46:39 AM	1299643.3	1299643.3	0	0	0x00020000	3.961	5.111	5.748	3.794	5
22	5/13/2022	7:46:40 AM	1299664.6	1299664.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
23	5/13/2022	7:46:41 AM	1299624.6	1299624.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
24	5/13/2022	7:46:42 AM	1299615.1	1299615.1	0	0	0x00020000	3.961	5.111	5.747	3.794	5
25	5/13/2022	7:46:43 AM	1299643.8	1299643.8	0	0	0x00020000	3.961	5.111	5.748	3.794	5
26	5/13/2022	7:46:44 AM	1299664.6	1299664.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
27	5/13/2022	7:46:45 AM	1299624.6	1299624.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
28	5/13/2022	7:46:46 AM	1299615	1299615	0	0	0x00020000	3.961	5.111	5.747	3.794	5
29	5/13/2022	7:46:47 AM	1299643.6	1299643.6	0	0	0x00020000	3.961	5.111	5.748	3.794	5
30	5/13/2022	7:46:48 AM	1299664.5	1299664.5	0	0	0x00020000	3.961	5.111	5.748	3.794	5
31	5/13/2022	7:46:49 AM	1299624.3	1299624.3	0	0	0x00020000	3.961	5.111	5.748	3.794	5
32	5/13/2022	7:46:50 AM	1299615.1	1299615.1	0	0	0x00020000	3.961	5.111	5.747	3.794	5
33	5/13/2022	7:46:51 AM	1299643.3	1299643.3	0	0	0x00020000	3.961	5.111	5.748	3.794	5
34	5/13/2022	7:46:52 AM	1299664.4	1299664.4	0	0	0x00020000	3.961	5.111	5.748	3.794	5
35	5/13/2022	7:46:53 AM	1299624.4	1299624.4	0	0	0x00020000	3.961	5.111	5.748	3.794	5
36	5/13/2022	7:46:54 AM	1299615.3	1299615.3	0	0	0x00020000	3.961	5.111	5.747	3.794	5

6.1.8 Collect meter archive logs

This utility allows you to collect historical log information from an ultrasonic meter. This dialog box is only available while connected to a meter.

Select the checkboxes for the types of logs you will collect. All of the logs will be collected into a single Archive log file. The Log format can be selected as either Microsoft® Excel®, Comma-separated values, and Don't log to file. The **Don't log to file** option will not save any of the log data to file but will only display it on the screen.

The meter configuration is always collected and included into the archive log file. Select the desired log options and click **Collect**. MeterLink opens a Save As dialog box to allow you to choose a name for the Archive log. A default name based on the Meter Name, type of logs collected, and PC date and time is suggested. Change the name or default location if desired.

Figure 6-7: Meter Archive Logs

6.2 Smart Meter Verification

The Rosemount 3410 Series Firmware v1.50 and later, supports Smart Meter Verification feature. Smart Meter Verification is a performance-diagnostic tool for Rosemount Ultrasonic Flow Meters as it delivers confidence in measurement integrity and performance by helping you to quickly identify and resolve meter or process issues. Using meter's hourly logs, the meter can generate Scheduled or On-Demand reports to monitor performance indicators like speed of sound, speed of sound spread, swirl angle, crossflow, profile factor, symmetry, turbulence, etc. over a period. No additional hardware or feature keys are required to use this feature. The feature is supported on model numbers 3414 (Gas 4-Path), 3418 (Gas 8-Path), 3415 (4-path head only), 3416 (4-path head only) and 3417. The meter can store 20 Smart Meter Verification reports in non-volatile memory of the meter. This includes a maximum of five On-Demand reports.

6.2.1 Smart Meter Verification report types

Smart Verification Reports can be created in 2 ways. MeterLink Software v1.80 and later, is required to collect Smart Meter Verification reports.

1. Scheduled – Meter automatically generate reports. This is enabled by default and generated at midnight (where midnight is understood to be the start of the day) of the first day of every month using data from hourly log records of the previous calendar month.

2. On-Demand – MeterLink can request meter to generate a report. This is created with hourly log records between the user specified start date and end date.

6.2.2 Replacing Smart Meter Verification reports

1. When an On-Demand report is created and five already exist, the oldest created On-Demand report will be deleted instead of the oldest created of all reports.
2. When a new On-Demand report is created and 20 total reports already exist, but 5 On-Demand reports do not exist, the oldest created report will be deleted. The deleted report could be either be Scheduled or On-Demand.
3. When a Scheduled report is created and 20 total reports already exist, the oldest created report will be deleted. The deleted report could be either Scheduled or On-Demand.

6.2.3 Smart Meter Verification report result

The report result is based on whether any alarm(s) is/are active during the report period. Rosemount Ultrasonic Meter alarms are divided in two groups, Meter and Process. These two groups have further subgroups for alarms. Alarms which represents issue with meter functioning like electronics, transducer, uncorrected volumetric flow rate measurement etc. are grouped under Meter group. Alarms which indicate a process issue like corrected volumetric flow rate calculation, gas composition, pressure and temperature etc. are grouped under Process group.

Below table shows mapping of alarms in groups and subgroups, where W is a Warning and F is a Fail.

Meter alarm group		Process alarm group	
Alarm subgroup	Alarm	Alarm subgroup	Alarms
Configuration	IsWarmStartReq(F) IsChordLengthMismatched<A..H>(F) DidCnfgChksumChg(W)	Base-condition volumetric flow rate	QBaseValidity(W)

Meter alarm group		Process alarm group	
Alarm subgroup	Alarm	Alarm subgroup	Alarms
Electronics	DidColdStart(F) IsCorePresent(F) WatchDogReset(F) IsAcqModuleError(F) IsAcqModuleIncompatible(F) IsXdcrFiringSyncError(W) IsClkInvalid(W) IsColocMeterCommErr(W) DidPowerFail(F) IsElecTempOutOfRange(W) IsElecVoltOutOfRange(W) IsHourlyLogFull(W) IsDailyLogFull(W) IsAuditLogFull(W) IsAlarmLogFull(W) IsSystemLogFull(W) DidWarmStart(W) DidResetUsers(W)	Flow rate diagnostics	IsColocMeterQFlowRangeErr(W) IsReverseFlowDetected(W)
Flow-condition volumetric flow rate	IsTooFewOperChords(F) IsEstimatedFlowVelocityInUse(W) QFlowValidity(F)	Gas composition/ pressure/ temperature	PressureInvalid(W) TemperatureInvalid(W) AreGasPropertiesInvalidInUse(W) IsGCCommErr(W) IsGCDataErr(W) IsGCAlarmPresent(W)
Performance	IsFailedForBatch<A..H>(W) IsHardFailed<A..H>(W) DidDltTmChkFail<A..H>(W) IsSigQtyBad<A..H>(W) DidExceedMaxNoise<A..H>(W) IsSNRTooLow<A..H>(W) DidTmDevChkFail<A..H>(W) IsSigDistorted<A..H>(W) IsPeakSwitchDetected<A..H>(W) IsSigClipped<A..H>(W)	Speed of sound diagnostics	IsSndVelCompErr(W) IsColocMeterSndSpdRangeErr(W) IsDiagnosticSndSpdRangeErr(W) IsAvgSoundVelRangeErr(W)
Speed of sound path spread	IsMeasSndSpdRange<A..H>(W)	Velocity diagnostics	IsMeterVelAboveMaxLmt(W) IsFwdBaselineNotSet(W) IsRevBaselineNotSet(W) IsBlockageDetected(W) IsBoreBuildupDetected(W) IsLiquidDetected(W) IsAbnormalProfileDetected(W)
Transducers	IsAcqMode(F) IsBatchInactive<A..H>(W) IsXdcrMaintenanceRequired<A..H>(W)		

If result of all alarm subgroups is Pass, then overall report result shall be Pass. If at least one alarm subgroup result is Warning and no alarm subgroup result is Fail, then overall report result shall be Warning. If at least one alarm subgroup result is Fail, then overall report result shall be Fail.

A "Pass" result represents that no alarms were present during the report period. The meter and/or process conditions were within specified limits.

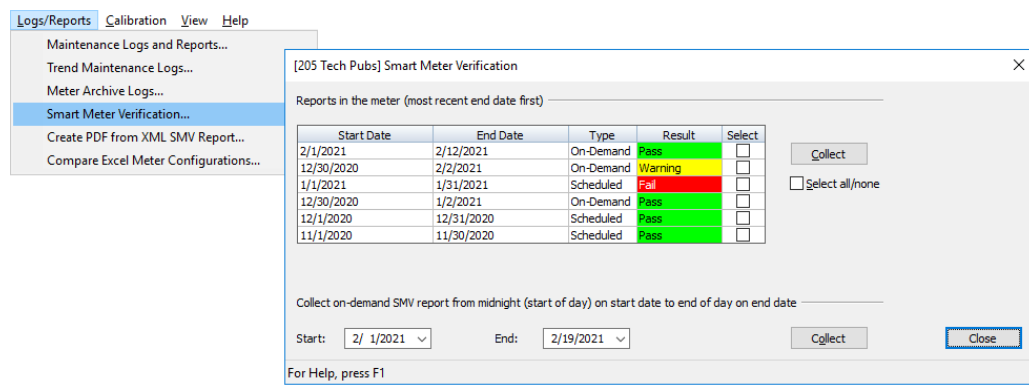
A "Warning" result represents that alarms occurred during the report period that indicate that the meter or process conditions may have an impact on measurement accuracy.

A "Fail" result represents alarms occurred during the report period that could indicate a loss of measurement validity or a reduction in measurement accuracy.

6.2.4 Collect Smart Meter Verification report

Collect Smart Meter Verification reports using Smart Meter Verification under the Logs/Reports menu in MeterLink. Select the checkbox for the report to be collected. Alternatively, select **Select all/none** to collect reports from the meter. Click **Collect** under **Reports in the meter** and MeterLink will retrieve report and generate the PDF report.

Figure 6-8: MeterLink's Smart Meter Verification Dialog



6.2.5 Create On-Demand Smart Meter Verification report

Create an On-Demand Smart Meter Verification report using Smart Meter Verification under the Logs/Reports menu in MeterLink. At the bottom of the dialog enter the **Start** date and the **End** date as report period. Click **Collect** under **Collect on-demand SMV Report...** and the meter will generate the report and MeterLink will retrieve it and generate the PDF report. See Figure 6-8.

6.2.6 Daily Smart Meter Verification results on Modbus

Flow computers/RTUs can read daily Smart Meter Verifications results via the Modbus protocol. Registers include the result date (month, day, year), an overall Pass, Warning or Fail result, and a Pass, Fail or Warning result for each of the 11 meter and process condition alarm "subgroup" categories. The results are calculated at midnight using hourly log records of the previous day. The following registers are used to read daily SMV results on Modbus.

Register	Data point	Description	Type	Value
7424 / 15424	SMVDailyResultMonth	Daily SMV result month	int	Not calculated (0) or month of year
7425 / 15425	SMVDailyResultDay	Daily SMV result day	int	Not calculated (0) or day of month
7426 / 15426	SMVDailyResultYear	Daily SMV result year (2 digit)	int	Not calculated (0) or 2-digit year
7427 / 15427	DailyResult	Daily SMV result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7428 / 15428	DailyFlowVolFlowRateResult	Daily SMV flow-condition volumetric flow rate group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7429 / 15429	DailyElectronicsResult	Daily SMV electronics group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7430 / 15430	DailySpdSndPathSpreadResult	Daily SMV speed of sound path spread group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7431 / 15431	DailyPerformanceResult	Daily SMV performance group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7432 / 15432	DailyTransducersResult	Daily SMV transducers group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7433 / 15433	DailyConfigurationResult	Daily SMV configuration group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7434 / 15434	DailyBaseVolFlowRateResult	Daily SMV base-condition volumetric flow rate group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7435 / 15435	DailyVelocityDiagnosticsResult	Daily SMV velocity diagnostics group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7436 / 15436	DailySpdSndDiagnosticsResult	Daily SMV speed of sound diagnostics group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7437 / 15437	DailyFlowRateDiagnosticsResult	Daily SMV flow rate diagnostics group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)
7438 / 15438	DailyGasCompPresTempResult	Daily SMV Gas composition/pressure/temperature group result	int	Not calculated (0), Pass (1), Warning (2), Fail (3)

7 Commands

7.1 Tools commands

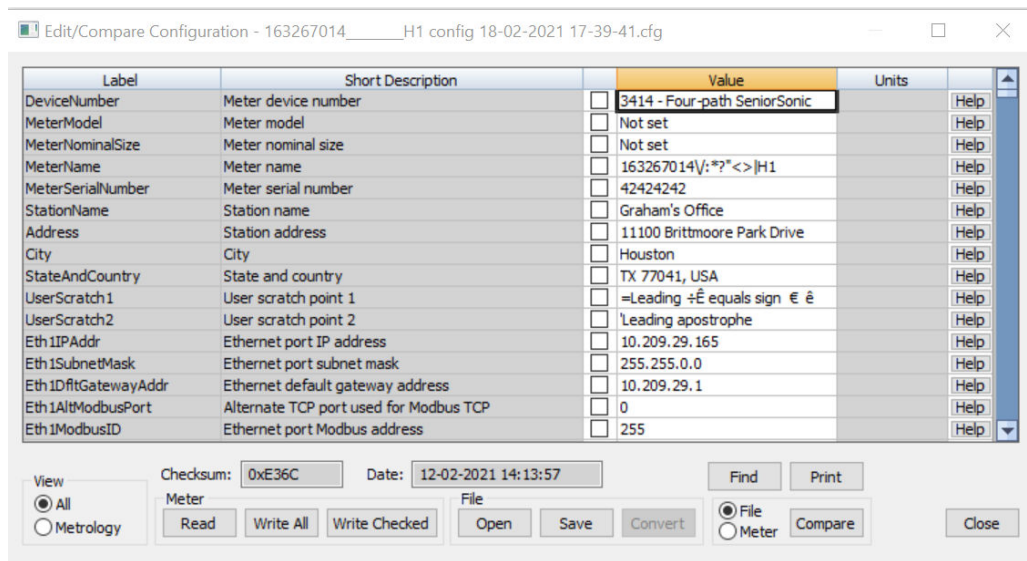
The MeterLink Tools menu commands provides the following utilities for the meter's health status, monitoring operational conditions, establishing a baseline of the meter's flow characteristics, updating the meter's program components and monitoring communications between MeterLink and the meter.

Command	Description
Edit/Compare Configuration	Open, edit, and compare configurations from files and meters.
Waveform Viewer	Collect, view, save, print ultrasonic waveforms from meter or file.
Gas SOS Calculator	Calculate speed of sound for a known gas composition.
Outputs Test	Test frequency, current, and digital outputs by fixing them to a set value.
Transducer Swap-Out	Adjust path length parameters when changing out transducers, stalks, holders, or mounts.
Set Baseline Wizard	Establishes the baseline for the meter's flow characteristics that can be used to monitor the health of the meter run using Continuous Flow Analysis features.
Program Download	Upgrade the program components in Rosemount Ultrasonic meters.
Communications Analyzer	Monitor communications between MeterLink and a meter.
Locate Meter	Selecting this command will prompt you, Are you sure you want to locate the meter by displaying a pattern on its local display? Click Yes to set the meter to display the 0-0-0-0 test pattern. Click No to cancel the operation. As long as the Locate Meter dialog is open, the meter shall continue to display the test pattern. Click Close to close the Locate Meter dialog and return the meter display back to normal operation.
Warm Start Meter	Selecting this command will prompt you, Do you want to warm start the meter and disconnect from it now? Click Yes to force the meter to restart itself. A warm start is the same restart as when power is removed and reapplied to the meter. No configuration or archive log history is lost. Some configuration changes require a restart of the meter for the changes to take effect. Click No to close the dialog.
Set Transducer Type	Select the appropriate transducer type and click Write to reconfigure the meter for that transducer type. The "transducer type" may be a set of transducer types with compatible default tracking parameters. If any of the changes require a warm start, a message will be displayed indicating this. Click Yes to warm start the meter so the changes will take effect. It is highly recommended not to use this dialog unless a Emerson Flow service representative has instructed you to do so and has given you specific instructions on what actions to perform. Click Cancel to close this dialog without making any changes to the meter configuration.

Command	Description
Reset Tracking	Displays the current tracking parameter values for Tspf, Tspe, and Tamp and allows the user to change them if needed. Click Reset Tracking to write any tracking parameter changes to the meter and reset the tracking operation in the meter. It is highly recommended not to use this dialog unless a Emerson Flow service representative has instructed you to do so and has given you specific instructions on what actions to perform.
Reset Velocity Estimation	Selecting this command will prompt you, Are you sure you want to reset chord proportions used for velocity estimation to their default values? Click Yes to return the chord proportions back to default values. Click No to close this dialog without making any changes to the meter configuration. It is recommended not to use this dialog unless a Emerson Flow service representative has instructed you to do so and has given you specific instructions on what actions to perform.
Override Velocity Estimation Update Time	In normal operation, the meter must run for a period of time (PropUpdateSeconds) with no performance issues before it will begin to update chord proportions. This information is used to compensate for chord failures that may occur at a later point in time. However, there are times such as during a flow calibration that it is not desirable to wait the period of time before updates begin. Running this command will force the meter to require only 24 consecutive batches before updates to the proportions are allowed. Any restart of the meter will force the meter to wait (PropUpdateSeconds) again before updates are allowed. So during a flow calibration, it is necessary to run this command after every restart if a chord failure test is required at the end of the test. To run this command, enter the Passcode and click Override. Click Cancel to close this dialog without making any changes to the meter configuration. This command will be disabled if unsupported in the meter.

7.1.1 Edit/Compare configuration parameters

Figure 7-1: Edit/Compare configuration parameters



This dialog's options include:

- View and edit configurations collected from the meter or opened from a file
- Write all or a portion of changed parameters of a configuration to a connected meter
- Comparing and converting legacy configurations
- Save and Print configurations
- **Find** button is used to find a data point using an alphabetically sorted list of data point labels


Procedure

1. Click **Read** to collect and display a configuration from a connected meter.
2. Click **ALL** to display the meter's extended configuration or **Metrology** to display only the metrology portion of the configuration.
3. Double-click the **Value** to change a parameter and select the option from the drop-down list or if a caret is displayed, enter the value [Figure 7-2](#).

If you change a data register, the Value displayed in the dialog turns yellow and the check box is selected. You can later choose to only Write Checked values to the meter.

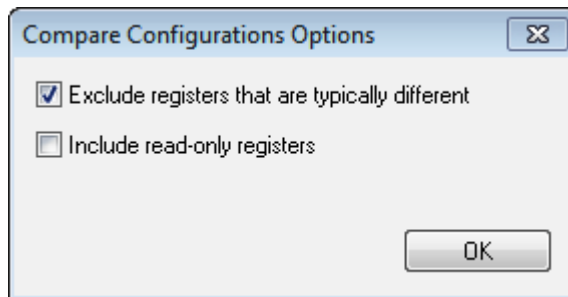
Figure 7-2: Edit/Compare configuration parameter changes


Label	Short Description		Value	Units	
RTSDnDelayPortA	Comm Port A handshaking RTS on delay time	<input type="checkbox"/>	0	ms	?
CommTimeoutPortA	Comm Port A communication timeout value	<input type="checkbox"/>	4	s	?
IsHWFlowControlEnabledPortA	Enables comm port A hardware flow control	<input type="checkbox"/>	Disabled		?
PortBMapfilePt	Comm Port B mapfile name	<input type="checkbox"/>	Map1.txt		?
ProtoPortB	Communication Port B protocol	<input type="checkbox"/>	ASCII		?
BaudPortB	Communication Port B baud rate	<input type="checkbox"/>	19200	bits/s	?
ModbusIDPortB	Comm Port B Modbus address	<input type="checkbox"/>	32		?
CommRspDlyPortB	Comm Port B response delay	<input type="checkbox"/>	0	ms	?
CommTimeoutPortB	Comm Port B communication timeout value	<input type="checkbox"/>	4	s	?
ContractHour	Hour of day to log daily record in military time	<input type="checkbox"/>	0		?
AlarmTurnOffHysteresisCount	Alarm log hysteresis filter number of occurrences	<input type="checkbox"/>	8		?
AlarmTurnOffHysteresisTimeSp	Alarm log hysteresis filter time span	<input type="checkbox"/>	120	s	?
DoOverwriteUnreadAlarmLog	Old unread alarm log records can be overwritten by new	<input type="checkbox"/>	Overwrite old records		?
DoOverwriteUnreadAuditLog	Old unread audit log records can be overwritten by new	<input checked="" type="checkbox"/>	Do not overwrite old records		?
DoOverwriteUnreadHourlyLog	Old unread hourly log records can be overwritten by new	<input type="checkbox"/>	Overwrite old records		?
DoOverwriteUnreadDailyLog	Old unread daily log records can be overwritten by new	<input type="checkbox"/>	Overwrite old records		?

4. Click the **question mark** icon, , to the right of a data point to display the additional information.
5. Click **Write All** to write the full configuration to a meter. Depending on the View selected, the displayed configuration may not be the full configuration. Click **Write Checked** to write only the values with a selected check box next to the value and are visible in the currently selected view. Select any values to write and clear any values you don't want to write to the meter before clicking **Write Checked**.
6. Open a configuration in the editor and select **Meter** or select **File** to compare it to a configuration saved as a file.
7. Click **Compare** to either read the configuration from the meter or open the Open dialog box to select the configuration to compare to the one in the editor.

Once the configurations are selected, a dialog displays, providing options to further customize the compare operation.

Figure 7-3: Compare Configurations Options dialog



- **Exclude registers that are typically different:** includes items that could change regularly such as **SpecFlowPressure**, **SpecFlowTemperature**, Gas composition, etc. A complete list is defined in **reg_list_compare_config_exclude.txt** found under the installation directory for MeterLink.
 - **Include read-only registers:** includes, in the compare, read-only registers stored in the collected configurations. This includes points like firmware version, K-factors, etc.
8. Click **Save** to save the configuration file. A default filename is provided based on the meter name, time, and date the configuration was collected. You can keep the default name or change it. The file is saved, by default, to the Data folder directory defined under **Program Settings**. You may change the directory location if desired.
 9. Click **Print** to print the configuration currently opened in the editor. Only the registers in the currently selected view will be printed. You can also click the print icon, , on the tool bar to print the opened configuration.
 10. Use **Convert** to download the configuration from a legacy Rosemount Ultrasonic meter to later generation of electronics.
 - a) First connect to the legacy electronics. Collect and save the configuration using the Edit/Compare Configuration dialog box. Upgrade the electronics on the meter.
 - b) Connect to the new meter electronics and open the Edit/Compare Configuration dialog. Open the configuration collected from the legacy electronics. The **Convert** button is enabled.
 - c) Click **Convert** to read the configuration from the new meter and modify it with the data from the legacy configuration. MeterLink displays this modified configuration in the dialog. At this point, MeterLink has not written anything to the new meter. All the values highlighted in yellow are values from the legacy configuration.
 - d) Click **Write Checked** to write the changed portion of the configuration to the new meter. If any data point failed to be written, you must correct the invalid value and click **Write Checked** again until the configuration is written without any errors. Once the configuration is written, you can choose to compare the displayed configuration with the configuration in the meter by selecting **Meter** and clicking **Compare**. This will verify everything was written correctly.

7.1.2 Waveform viewer

View the transducer waveforms

Rosemount 3410 Series Ultrasonic Flow Meters includes a feature for streaming transducer waveforms that can be viewed using the MeterLink **Tools** → **Waveform Viewer** screen. The speed at which the waveforms update is dependent upon the type of connection between the PC and the meter. With an Ethernet connection and MeterLink, several updates per second are possible. With a serial connection, updates may occur only every 15 to 30 seconds.

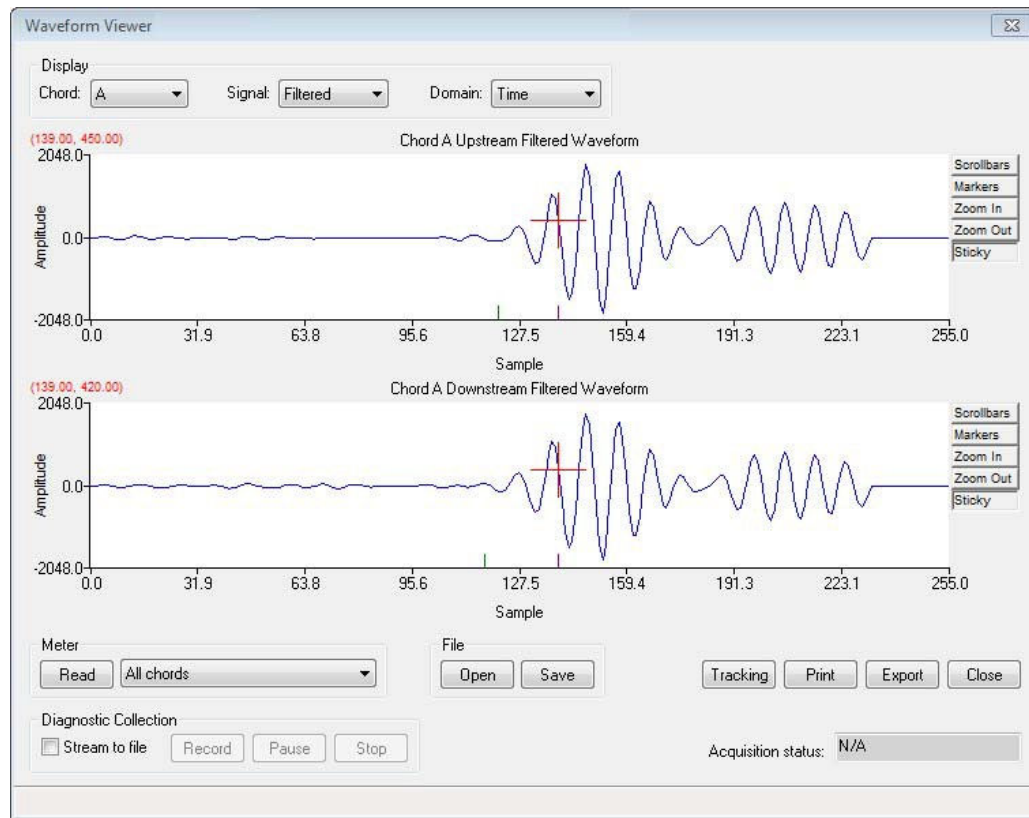
Up to three types of waveform signals can be displayed per chord:

- **Raw** - the sampled waveform received by the transducer (with gain applied)
- **Stacked** - the result of applying stacking to the raw signal(s). Note that when stacking is not used (**StackSize** is set to 1), the stacked signal is the same as the raw signal.
- **Filtered** - the result of applying the bandpass filter on the stacked signal. This waveform is only available when the filter is enabled (via the **Filter** data point).

For diagnostic purposes, the transducer waveform signals can be stored to a file using the **Diagnostic Collection - Stream to file** checkbox. This utilizes the Rosemount 3410 Series Gas Ultrasonic Flow Meter's patented "snapshot-and-playback" feature to accurately record the flow signals that can then be later reproduced for detailed analysis.

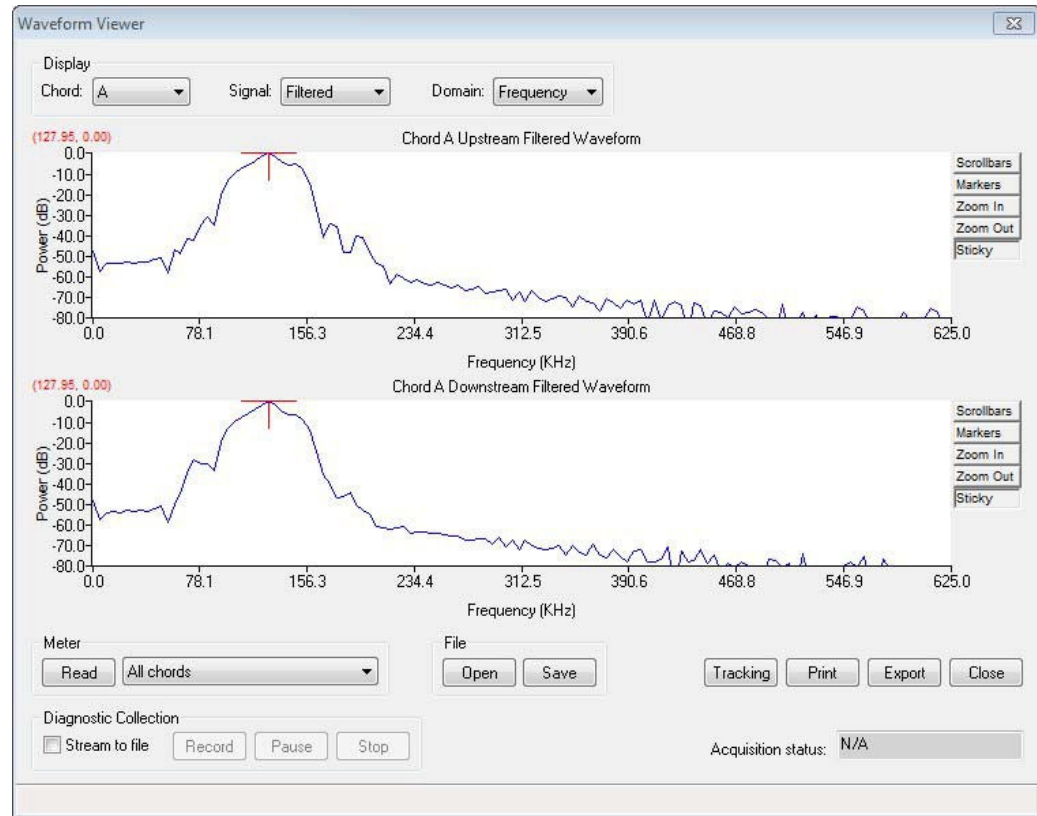
Waveforms are displayed in the time domain (e.g., the waveform signal is plotted against time).

Figure 7-4: Waveform viewer - time domain



The waveforms may also be displayed in the frequency domain. In this mode, a Fast Fourier Transform is taken of the waveform so that the frequency content of the waveform can be displayed. This can be useful in noisy environments to see the frequency of the noise and if it is in the range of the transducer signal.

Figure 7-5: Waveform viewer - frequency domain



Zero crossing and first motion markers

Two markers display along the horizontal axis for either the Stacked or Filtered waveform. If filtering is on, the markers will be on the Filtered waveform. If filtering is off, the markers will be on the Stacked waveform. The green marker shows the point where the first motion is detected. The purple marker shows the zero crossing which is the point that the meter uses as the arrival point of the signal.

Navigate the waveform viewer

Procedure

1. Select the waveforms to collect from the Meter box and click **Read**. Selections include:
 - All Chords
 - Chord A
 - Chord B
 - Chord C
 - Chord D

2. MeterLink starts to continuously stream waveforms from the meter.
3. Click **Save** while streaming waveforms or click **Stop** opens a Save As dialog box to allow you to choose a name for the Waveform file.
A default name based on the Meter Name, the type of waveform collected, and PC date and time is suggested. Change the name or default location if desired. Click **Save** to accept the file name and save the last set of waveforms collected.
4. Click **Open** and select the Waveform filename from the Open dialog box to view a previously saved waveform.
5. Click **Tracking** to display the transducer's raw, filtered or stacked signal Tracking Parameters dialog for the selected chord. This dialog displays the parameter's label, value and units. Some of the Tracking parameters included are Gain, Hold time, Time (stamp), Maximum Signal Quality, Peak width, Peak Position, and Peak Zero Crossing for upstream and downstream signals. These parameters are used in the diagnostics of field conditions.
6. Click **Export** to save the waveforms displayed to Microsoft® Excel® format. The Excel® file will contain three worksheets. The first worksheet called Charts contains charts for each of the waveforms collected. The second worksheet called Raw Data contains the waveform data to make the charts. The third worksheet called Tracking contains the tracking parameters for the chord.
7. Click **Close** to exit the Waveform Viewer.
8. Use Diagnostic Collection set of controls feature to capture a waveform snapshot to be played back on a simulator. This U.S. Patented feature is useful to allow Rosemount to reproduce any field specific conditions.
 - a) Click the **Stream to file** checkbox and wait for the waveforms to start streaming to the screen. The meter is returning raw waveforms just as they are received without any stacking or filtering.
 - b) Click **Record** to start saving all of the raw waveforms to file. The collection of waveforms can be paused and resumed without having to start a new file. Clicking **Stop** gives you the option to save the data collected to file. The file will have a .strm extension. There is no utility in MeterLink to playback these files. The files are only for use internally by Rosemount on special diagnostic tools. Clearing the **Stream to file** checkbox stops the streaming mode and returns the Waveform Viewer back to its normal mode of operation.

Note

The file created with the Diagnostic collection grows quite rapidly. Typically when connected via Ethernet to the meter, the file can easily take up 2.5 megabytes per minute. If the file must be e-mailed, many mail servers only allow 10 to 20 megabyte files or approximately 4 to 8 minutes of data.

9. Use the Chart utilities to control the waveform display. The controls for the waveform chart utility include:
 - *Scrollbar* - enables horizontal and vertical scrollbars on the chart.
 - *Markers* - displays markers for the series in order to see the data points collected.
 - *Zoom In* - zooms in on both the horizontal and vertical scales centered on the cursor.
 - *Zoom Out* - zooms out on both the horizontal and vertical scales centered on the cursor.
 - *Sticky* - forces the cursor to stick to the waveform trace.

- *Other keyboard commands* - use the keyboard commands as a shortcut to access the desired function. Right-click the mouse over the chart to display these commands or enter the keyboard command (Table 7-1).

Table 7-1: Waveform chart keyboard commands

Function	Keystroke	Description
Save State	Ctrl + Home	Save the current zoom settings. These settings can be recalled with the Restore State command. Any saved settings are lost once the utility is closed.
Restore State	Home	Restores the last saved zoom settings.
Cursor to Nearest Point	F8	Moves the cursor to the nearest point displayed.
Toggle Coarse/Fine Cursor	F4	Toggles the cursor between and fast and slow moving cursor. The cursor is physically larger for the fast moving cursor.
Toggle Lines/Markers	F9	Toggles off the lines connecting the collected data and forces on the markers.
Toggle Mouse Position Tip	Ctrl+F4	Turns on tool tip showing the coordinates at which the mouse pointer is pointing.
Toggle Nearest Point Tip	Ctrl+F9	Turns on tool tip showing the coordinates of the nearest data point to the mouse pointer.
Print	Ctrl+P	Prints the displayed chart.
Copy to clipboard	Ctrl+C	Copies the displayed chart to the Windows® clipboard as table data.
Paste from clipboard	Ctrl+V	Paste data from the Windows® clipboard to the chart utility. The data must be in the appropriate format to correctly paste as a new series to the chart. Copy data from the chart to a text file to see the appropriate format.
Waveform Zoom	Ctrl+I	Turns on/off the zoom feature while in Waveform Read or Stream to file mode.

7.1.3 Gas SOS calculator

The SOS Calculator dialog box allows you to calculate a Speed of Sound (SOS) for a given gas composition and operating conditions.

Figure 7-6: Gas SOS Calculator

Component	Mole %
Methane	100.0000
Nitrogen	
CO2	
Ethane	
Propane	
H2O	
H2S	
Hydrogen	
CO	
Oxygen	
i-Butane	
n-Butane	
i-Pentane	
n-Pentane	
n-Hexane	
n-Heptane	
n-Octane	
n-Nonane	
n-Decane	
Helium	
Argon	
TOTAL	100

The SOS calculations are selectable as either AGA-10 (AGA Report No. 10 - May 2003) or GERG-2008 (AGA-8 Part 2, 2017). You do not need to be connected to a meter to use this utility. The units for the values displayed are defined in the **File** → **Program Settings** dialog.

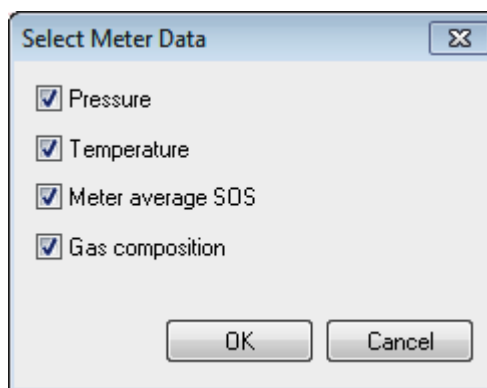
Calculate SOS for the gas composition

Procedure

1. Enter the gas composition as percentages into the Gas composition inputs table. If you are connected to a Rosemount Gas Ultrasonic meter running AGA8 Detailed Method, the "In Use" gas composition is read from the meter and displayed in Gas composition inputs. It also indicates if the values are **Fixed** or **Live** from a GC, and if Live from a GC, the GC Start Cycle Time of the composition will be displayed.
2. Click **Normalize** to adjust the percentages so that the TOTAL gas composition equals 100%. The normalize operation maintains the ratios between the different components.

3. If you are connected to a meter with pressure or temperature set to **Fixed** or **Live**, the values are read from the meter and entered in the Pressure/temperature inputs. If you are not connected, enter the Pressure and Temperature for the gas. Pressure can be entered as either absolute or gage. Select the desired pressure type. If **Gage** is selected for pressure type, enter in the Atmospheric pressure. The label after the units for Pressure and Temperature is set as follows:
 - *User*: The value was entered manually or imported from a saved file.
 - *Fixed*: The value was read from a meter with the value set as Fixed.
 - *Live*: The value was read from a meter with the value read from a Live sensor.
 - *Frozen*: Indicates the value is frozen on the last good reading before going either into alarm or calibration.
4. If you are connected to a meter, the Meter average SOS will always be read from the meter and displayed.
5. While connected to a meter, click **Read from Meter** to display a dialog to give you the option to update Pressure, Temperature, Meter average SOS, and Gas Composition. Only available options will be enabled.

Figure 7-7: Select Meter Data dialog



6. In addition to reading values from a meter, click **Write to Meter** to display a dialog to give you the option to write Pressure, Temperature, and Gas Composition to the meter. Only available options will be enabled. Pressure and Temperature must be set to **Fixed** in the meter to enable the selections to write these values to the meter. Likewise to enable the Gas Composition selection, a meter must be configured for AGA 8 Detailed Method. If no options are available, the **Write to Meter** button will be grayed out.
7. Once the gas composition and operating conditions are entered, click **Calculate** to compute the Compressibility (Zf), Density, and Computed SOS. If connected to a meter the Percent difference will show the percent error from the Average meter SOS to the Computed SOS.
8. Enter a **Comment** to associate with the SOS calculation. The comment is included in saved gas composition files and print outs.
9. Click **Save** to save the Meter Name if connected to a meter, Company Name as set under **File** → **Program Settings**, Date and Time based on the PC clock, Comment, Gas composition inputs, Pressure/temperature inputs, and Calculated values to a comma-separated values (.csv) file.

10. Click **Open** to select a saved gas composition file to bring into the SOS Calculator. Only the Gas composition inputs, Pressure/temperature inputs, and Comment are imported from a saved file.
11. Click **Calculate** to compute the calculated values.

Note

The SOS Calculator can open the comma-separated value files exported from MON20/20 or MON2000 Software for Gas Chromatographs Calculation Results screen. If you have customized any of the component names in the gas chromatograph you will need to modify the SOS Calculator's map file. MeterLink lists any component names that cannot be processed.

12. Click **Print** to print the Meter name if connected to a meter, Company name as set under Program Settings, Date and Time based on the PC clock, Comment, Gas composition inputs, Pressure/temperature inputs, and Calculated values.
13. If the SOS Calculator was launched from Maintenance Logs and Reports, click **Finish** to accept the calculation and finish creating the Maintenance log. Click **Cancel** to skip the computed SOS and continue making the Maintenance log.
14. If the SOS Calculator was launched from the **Tools** → **SOS Calculator** menu, click **Close** to return to the Main window of MeterLink™.

7.1.4 Outputs test

The Outputs Test dialog box allows you to monitor the live values of all the frequency, current and digital outputs. Additionally, the outputs can be set into a Test mode to force the outputs to a specific user defined value. This dialog box is only available while connected to a meter.

Refer to [Outputs test mode](#) in this manual for additional information about the Outputs Test Mode.

7.1.5 Transducer swap-out

The transducer swap-out utility allows you to update parameters such as path lengths, delay times, and delta times for chord. This is necessary anytime transducers, mounts, holders, or stalks have to be replaced for a chord.

Refer to the *Rosemount 3410 Series Gas Ultrasonic Flow Meters Maintenance and Troubleshooting Manual (00809-0200-3104, Sections 3.3-3.6)* for detailed instructions for replacing the transducers, mounts and stalks and setting the parameters for the pairs of transducers you replaced.

7.1.6 Baseline viewer

Use the Baseline viewer to monitor the meter's flow direction and flow characteristics including:

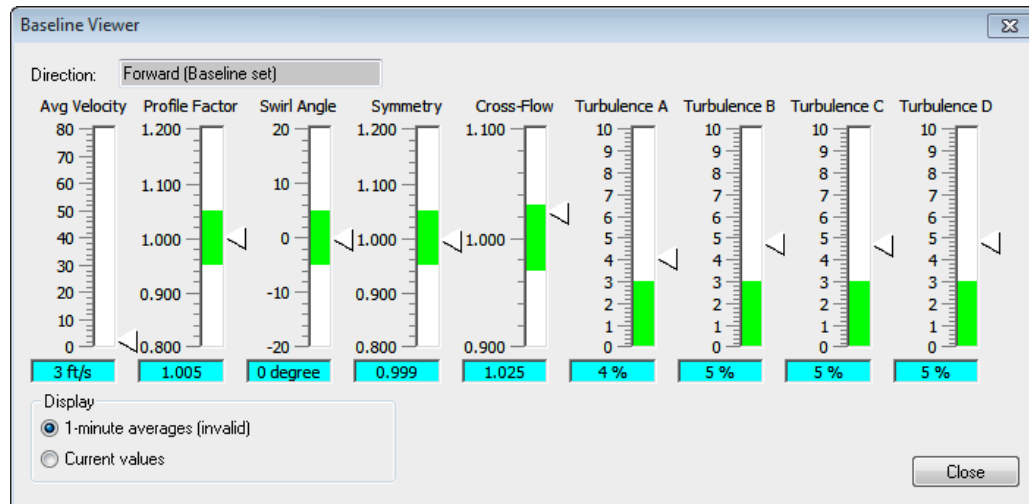
- Flow Velocity
- Profile Factor
- Swirl Angle
- Symmetry
- Cross-flow
- Path Turbulences

Access the Baseline viewer from the **Meter** → **Monitor (Detailed)** dialog while connected to your meter.

Note

You must have a valid Continuous Flow Analysis key to enable this feature. See [Set baseline parameters](#) to configure the baseline parameters for your meter using the **Tools** → **Set Baseline Wizard** menu.

Figure 7-8: Baseline viewer



The Baseline viewer indicates the current flow direction, forward or reverse, and gauges display the flow characteristics of the meter. The Baseline viewer dialog displays a horizontal "green zone" that indicates the expected value range. As an example, [Figure 7-8](#) depicts out-of-range values for turbulence on all four chords.

Read the baselines viewer gauge values

[Table 7-2](#) describes the values for each gauge and how the green zones are defined.

Table 7-2: Baseline viewer gauge values

Value	Description
Avg Velocity	Displays the average flow velocity for the meter. This gauge contains no green zone.
Profile Factor	Displays the velocity flow profile factor for the meter. The profile factor is calculated from the chordal velocities as ((VelocityB+VelocityC)/(VelocityA+VelocityD)). The green zone is centered on the profile factor set in the baseline ± the percentage defined by Profile factor limit configurable in the Field Setup Wizard on the Continuous Flow Analysis page.
Swirl Angle	Displays the swirl angle in degrees for the meter. The green zone is centered on the swirl angle set in the baseline ± 5%.
Symmetry	Displays the symmetry for the meter. The symmetry is calculated from the chordal velocities as ((VelocityA+VelocityB)/(VelocityC+VelocityD)). The green zone is centered on the Symmetry set in the baseline ± the percentage defined by Symmetry limit configurable in the Field Setup Wizard on the Continuous Flow Analysis page.

Table 7-2: Baseline viewer gauge values (continued)

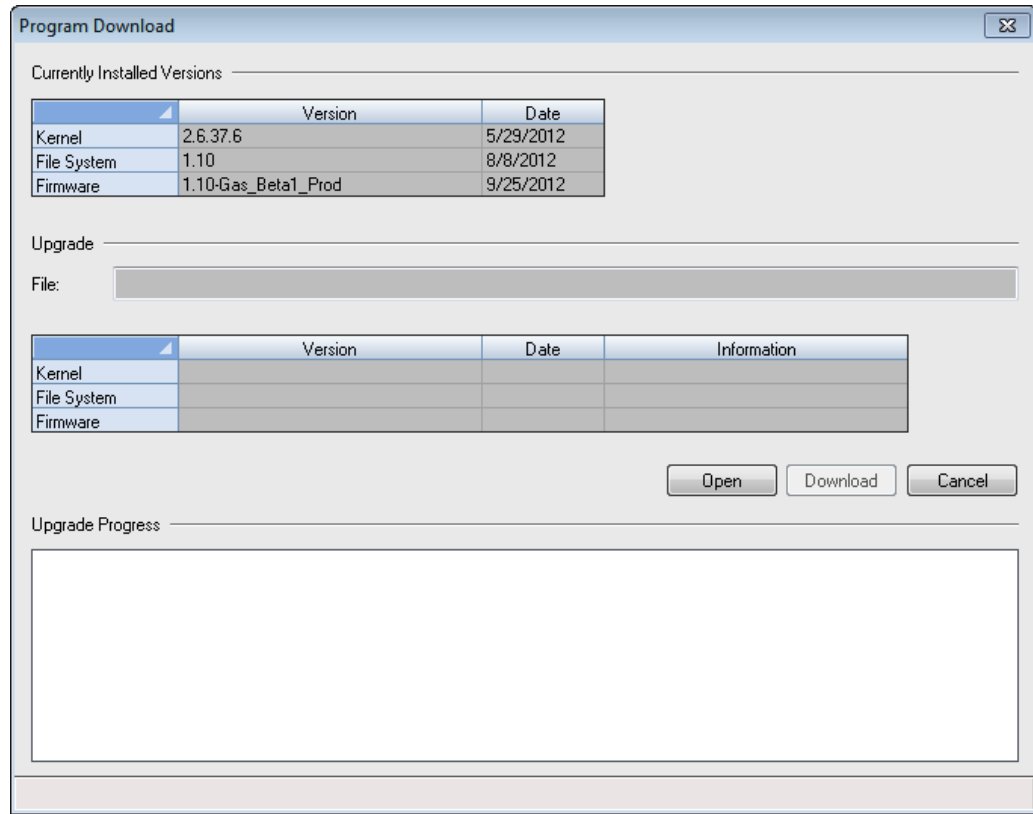
Value	Description
Cross-Flow	Displays the cross-flow for the meter. The cross-flow is calculated from the chordal velocities as $((VelocityA+VelocityC)/(VelocityB+VelocityD))$. The green zone is centered on the cross-flow set in the baseline \pm the percentage defined by Cross-flow limit configurable in the Field Setup Wizard on the Continuous Flow Analysis page.
Turbulence A through D	Displays the percent turbulence values for each path of the meter. The green zone extends for 0% to the Chord turbulence limit configurable in the Field Setup Wizard on the Continuous Flow Analysis page.
Display	Description
1-minute averages	Selecting 1-minute averages will make the gauges display a one minute rolling average. Next to this selection will be an indication if the one minute average values are valid or invalid. For the averages to be valid, the meter must meet the following criteria for at least one full minute: flowing in only one direction, no chord failures or inactive chords present and flowing within the Flow limits configurable in the Field Setup Wizard on the Continuous Flow Analysis page.
Current values	Displays the most recently calculated values.

7.1.7 Upgrade program components

Use the MeterLink™ **Tools** → **Program Download** dialog to upgrade the program components in Rosemount Ultrasonic meter. When the dialog is first opened, the Currently Installed Versions table will show the currently installed program components in the meter.

The firmware to download to a meter is available as a compressed file with a .zip extension. MeterLink™ unzips the file when it is opened.

Figure 7-9: Program download dialog



Procedure

1. Click **Open** to display an Open Download File dialog and select the desired file and click **Open**.
The filename displays in the File edit box under Upgrade. The Version and Date of the components to download display in the table under Upgrade. All of the components will be identified as if they are older, newer, or the same as what is currently installed in the meter.
2. MeterLink™ only downloads components that are different than what is currently installed in the meter. At least one component must be different for download before the **Download** button is enabled.
3. Click **Download** to initiate the download process. MeterLink™ collects the configuration from the meter and displays a message where it was saved. If the upgrade requires the database to be reset, then it will be necessary to use the Edit/Compare Configuration dialog to write this configuration back down to the meter after the program download is complete ([Edit/Compare configuration parameters](#)). After the configuration is saved, a progress bar will appear showing the status of the file download. After the files have been transferred successfully to the meter, the meter will start the upgrade process and the status will be shown down below Upgrade Progress.
4. The meter will have to restart to install the firmware. MeterLink™ will prompt you with a message that it must disconnect from the meter. Once the firmware upgrade is complete you will be able to reconnect to the meter with MeterLink™.

- MeterLink™ prompts you with a message that it must disconnect from the meter. Once the firmware upgrade is complete you will be able to reconnect to the meter with MeterLink™.

Important

When the meter restarts, it takes about two minutes before you will be able to reconnect depending on the firmware upgrade being performed. If the database does need to be re-initialized, it could take up to five minutes.

- Reconnect to the meter and repeat the Program Download process after the program downloads. If all the program components are successfully updated, they will show to be the same date and version as the Currently Installed Versions and the **Download** button will be disabled. If one or more components are still not updated, click **Download** to continue the upgrade process. Repeat the process to ensure all components are updated.

CAUTION

POWER LOSS DURING PROGRAM DOWNLOAD

The meter's program may be lost if the meter loses power in the middle of a program download. If connection to the meter is unsuccessful after a failed program download, contact Emerson Flow Support for assistance.

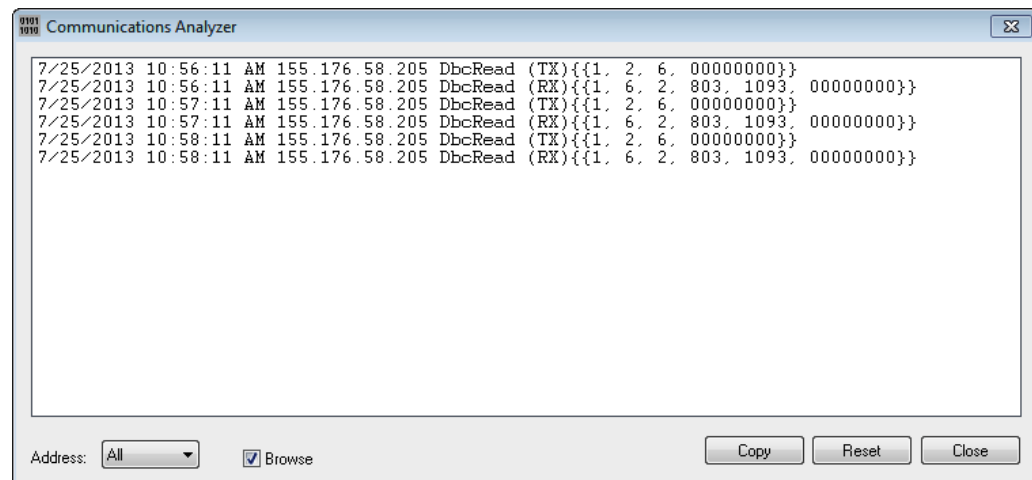
7.1.8 Communications analyzer

The Communications Analyzer is a Windows® application that displays "messages" transmitted to and received from an addressable device, such as a Modbus slave, by another Windows® application.

The messages are display from the oldest (at the top of the list) to the newest (at the bottom of the list). The Communications Analyzer date and time stamps each message displayed. After 4096 messages have been displayed, the oldest messages are cleared from the list as new messages are added.

The Address combo box filters new messages so that only those with the selected address (1-32) are displayed. By default, all addresses are displayed. The address filter does not affect messages already displayed, only new messages.

Figure 7-10: Communications analyzer



Procedure

1. Check **Browse** to disable automatic scrolling. This is useful if you want to look at a certain message while new message are being added to the list.
2. Click **Copy** to copy the messages to your clipboard so that they can be pasted into another Windows® application, e.g. Notepad.
3. Click **Reset** to clear the list of displayed messages.

A Conversion factors

A.1 Conversion factors per unit of measurement

The following table includes conversion factors for many of the Metric and U.S. Customary units of measure used with Rosemount Ultrasonic Gas Flow Meters and MeterLink.

Table A-1: Conversion Factors per unit of measurement

Conversion Factors	Unit of Measurement
$(^{\circ}\text{F}-32)\times(5/9) \rightarrow ^{\circ}\text{C}$ ($^{\circ}\text{C}+273.15) \rightarrow \text{K}$	
1	K/ $^{\circ}\text{C}$
5/9	$^{\circ}\text{C}/^{\circ}\text{F}$
10^{-6}	MPa/Pa
0.006894757	MPa/psi
0.1	MPa/bar
0.101325	MPa/atm
0.000133322	MPa/mmHg
0.3048	m/ft
10^3	dm^3/m^3
10^{-6}	$\text{m}^3/\text{cc} (= \text{m}^3/\text{cm}^3)$
$(0.3048)^3$	m^3/ft^3
$(0.0254)^3$	m^3/in^3
3600	s/h
86400	s/day
10^3	g/kg
0.45359237	kg/lbm
4.1868	kJ/kcal
1.05505585262	kJ/Btu _I T
10^{-3}	Pas·s/cPoise 1.488
1.488	Pas·s/(lb/(ft·s))

B Miscellaneous equations

B.1 K-Factor and Inverse K-Factor

Equation B-1: Frequency Volumetric Flow Rate K-Factor

$$KFactor = \frac{(MaxFreq)(3600s/hr)}{FreqQFullScale}$$

and

Equation B-2: Frequency Volumetric Flow Rate Inverse K-Factor

$$InvKFactor = \frac{FreqQFullScale}{(MaxFreq)(3600s/hr)}$$

where

KFactor = frequency "K-Factor" (pulses/m³ or pulses/ft³) (**Freq1KFactor** and **Freq2KFactor**)

InvKFactor = frequency "Inverse K-Factor" (m³/pulse or ft³/pulse) (**Freq1InvKFactor** and **Freq2InvKFactor**)

FreqQFullScale = frequency full-scale volumetric flow rate (m³/h or ft³/h) (**Freq1FullScaleVolFlowRate** and **Freq2FullScaleVolFlowRate**)

MaxFreq = maximum frequency (Hz = pulses/s) (Either 1000 or 5000 Hz) (**Freq1MaxFrequency** and **Freq2MaxFrequency**)

B.1.1 Volumetric Flow Rate

Equation B-3: Volumetric Flow Rate - U.S. Customary units

$$\begin{aligned} Q_{ft^3/hr} &= V_{ft/s} \times 3600s/hr \times \left[\frac{\pi D_{in}^2}{4} \right] \times \left[\frac{1ft}{12in} \right]^2 \\ &= V_{ft/s} \times D_{in}^2 \times \left[\frac{3600 \times \pi \text{ s ft}^2}{4 \times 12^2 \text{ hr in}^2} \right] \\ &= V_{ft/s} \times D_{in}^2 \times 19.63495 \left((s \text{ ft}^2) / (hr \text{ in}^2) \right) \end{aligned}$$

where

$Q_{ft^3/hr}$ = volumetric flow rate (ft³/h) (**QMeter**)

$V_{ft/s}$ = gas flow velocity (ft/s) (**AvgFlow**)

π = geometric constant, pi (dimensionless) (3.14159265...)

D_{in} = pipe inside diameter (in) (**PipeDiam**)

Equation B-4: Volumetric Flow Rate - Metric Units

$$\begin{aligned} Q_{m^3/hr} &= V_{m/s} \times 3600s/hr \times \left[\frac{\pi D_m^2}{4} \right] \\ &= V_{m/s} \times D_m^2 \times \left[\frac{3600 \times \pi}{4} (s/hr) \right] \\ &= V_{m/s} \times D_m^2 \times 20827.433 (s/hr) \end{aligned}$$

where

$Q_{m^3/hr}$ = volumetric flow rate (m³/h) (**QMeter**)
 $V_{m/s}$ = gas flow velocity(m/s) (**AvgFlow**)
 π = geometric constant, pi (dimensionless) (3.14159265...)
 D_m = pipe inside diameter (m) (**PipeDiam**)

B.2 Calculation of Chord "L" dimension

The chord "L" dimension is calculated from the meter housing length as well as the transducer pair lengths, mount lengths, holder lengths, and stalk lengths as shown in [Equation B-5](#). The transducer lengths are etched on the transducers. Likewise, the lengths of the mounts, stalk assemblies, and transducer holders are also etched on the individual components. The length of the meter body is found on the original calibration sheet supplied with the meter.

Equation B-5: Chord "L" Dimension

$$L_{chord} = L_{MeterHousing} + L_{Mount1} + L_{Mount2} \\ - L_{Xdr1} - L_{Stalk1} - L_{Hldr1} \\ - L_{Xdr2} - L_{Stalk2} - L_{Hldr}$$

where

L_{chord} = chord "L" dimension (in) (**LA... LD**)
 $L_{MeterHousing}$ = meter housing length (in)
 L_{Mount1} = transducer 1 mount length (in)
 L_{Mount2} = transducer 2 mount length (in)
 L_{Xdr1} = transducer 1 length (in)
 L_{Xdr2} = transducer 2 length (in)
 L_{Stalk1} = transducer 1 stalk length (in)
 L_{Stalk2} = transducer 2 stalk length (in)
 L_{Hldr1} = transducer 1 holder length (in)
 L_{Hldr2} = transducer 2 holder length (in)

C Troubleshooting comm., mech., and elec.

C.1 Communications troubleshooting

Q1. Why won't the CPU Module LINK LED come on when connecting to the meter via the Ethernet?

A1. The LINK light indicates good electric connectivity between two LAN ports. It also indicates proper polarity in the Ethernet connection.

WHEN CONNECTING DIRECTLY: Check to ensure that the Ultrasonic cable (P/N 1-360-01-596) cable is properly connected.

WHEN USING A HUB: When using a hub between the meter and the PC, a straight-through patch cable is required between the meter and the hub and a straight-through patch cable is required between the hub and the PC. Do not connect either the meter or PC to the hub UPLINK port. Most hubs do not allow use of the port immediately next to the hub UPLINK port when the UPLINK port is used to connect the hub to a LAN. Ensure the meter and PC are not plugged in to a hub non-usable UPLINK port.

Verify that the meter is powered up by checking that CPU Module LED 1 is on (either solid red or green). If the LED is not on, check power to the meter. If the LED is on, check the Ethernet cable connections.

Q2. My CPU Module LINK LED is on but I can't communicate with the meter using Ethernet. What's wrong?

A2. If you are connecting for the first time, refer to [Setup the meter directory](#) for instructions on initial communication (via Ethernet) setup.

If you are using the MeterLink program, ensure that the optional Ethernet connection is enabled.

Ensure that the meter's DHCP server is enabled (CPU Module switch ON). Verify that the PC has received an IP address from the meter as follows:

- Bring up DOS prompt window (Start | Run | (type)cmd)
- In the DOS prompt window, type ipconfig.

You should then see something like:

Windows® IP Configuration

Ethernet adapter Local Area Connection 1:

Connection-specific DNS Suffix:

IP Address: 192.168.135.35 (*note: the last .35 can be up to .44*)

Subnet Mask: 255.255.255.0 Default Gateway:

If you get the following:

Ethernet adapter Local Area Connection 1:

IP Address: 0.0.0.0

then the PC has *not* yet received an IP address from the DHCP server and you should wait (up to 30 seconds) to receive an IP address before attempting to connect to the meter. If after 30 seconds the PC has not received an IP address from the meter DHCP

server or the IP address shown above (from ipconfig) is different from the range of 192.168.135.35 through 192.168.135.44, verify that the PC is configured to receive its IP address automatically (via DHCP).

To ensure connection to the meter from the PC, at the DOS prompt type:

```
ping 192.168.135.100 <enter>
```

If the meter is reachable, then you will see a message like:

```
Pinging 192.168.135.100 with 32 bytes of data:
```

```
Reply from 192.168.135.100: bytes=32 time << 10ms TTL=64
```

```
etc.
```

If the meter is not reachable, then you will see something like:

```
Pinging 192.168.135.100 with 32 bytes of data:
```

```
Request Timed Out etc.
```

Q3. How do I connect to multiple meters via Ethernet when they are on the same LAN?

A3. Before connecting multiple meters via Ethernet on a LAN, each meter must be configured with a unique user-specified IP address (following the initial communication quick start instructions in [MeterLink utilities](#)). Contact your IT department for valid IP addresses for your LAN and Gateway address if required. Once a meter's IP address is configured, the meter may be connected to the intranet LAN and accessed using that IP address.

3410 Series meters connected to an intranet LAN should not have their DHCP servers enabled.

Q4. How do I connect to multiple meters via Ethernet when they are on the same hub but not connected to an intranet LAN?

A4. The PC may receive its IP address from an external DHCP server; in this case, one and only one meter must have its DHCP server enabled. This DHCP server will serve up to 10 IP addresses to PCs attempting to talk to all meters on the hub.

Before connecting multiple meters via Ethernet on a hub, each meter must be configured with a unique user-specified IP address (following the initial communication quick start instructions in [MeterLink utilities](#)). Assign each meter on the hub a unique IP address within the range 192.168.135.150 through 192.168.135.254. The Gateway address for each meter maybe left unconfigured as 0.0.0.0. Once a meter's IP address is configured, the meter may be connected to the hub and accessed using that IP address.

C.2 Mechanical/Electrical troubleshooting

This section is meant to assist site maintenance and operations personnel trained in the operation of the ultrasonic flow meter and knowledgeable in basic mechanical and electronic/electrical troubleshooting techniques, using lap top computers as well as digital volt/ohm meters. Great care should be taken not to "short out" a given electronic/electrical circuit when Troubleshooting.

Table C-1: Mechanical/Electrical troubleshooting

Problem	Solution(s)
No power the unit	<ul style="list-style-type: none"> • Check for correct voltage (AC or DC) to the input of the Field Connection Board. (See Rosemount™ 3410 Series engineering drawings, System Wiring Diagram). • Check the main power source for blown fuse or tripped circuit breaker. Reference your "as built" installation drawings for your location. • Check the fuses on the Field Connection Board. Reference fuse F1 and F2 locations.
Cannot communicate with MeterLink™ program	<ul style="list-style-type: none"> • Ensure that the meter is properly powered. • Ensure that the computer cable is properly connected to the proper terminals (see Rosemount™ 3410 Series engineering drawings) for the connector. • Verify that the communication parameters of the MeterLink program are set correctly. See MeterLink utilities of this manual for instructions on configuring communications.
One or more of the chords is not indicating a reading (reporting zeros)	<ul style="list-style-type: none"> • Check for loose connections at the cable connectors. See Rosemount™ 3410 Series engineering drawings. • Check the resistance of the transducers (should be approximately 1-2 Ω). • Problem also may be caused by a bad Acquisition board or interconnect cable. See Rosemount™ 3410 Series engineering drawings for more information. • Check system status in MeterLink™, Meter → Monitor for any flagged errors. • Check the CPU board LEDs.
Waveform contains an excessive amount of noise	<p>Increase the StackSize until noise level decreases (settings can be 1 (none), 2, 4, 8, or 16). If increasing the StackSize is not successful, try turning on the filter or consult with Flow Lifecycle Services for Rosemount products if you are unsure of how stacking a signal can effect the meter's operation. Refer to Technical Support under the Help menu of MeterLink for contact information.</p>
Connected communication line to the flow computer but no signal is received	<ul style="list-style-type: none"> • Check for loose connections at the flow meter and the flow computer (see Rosemount™ 3410 Series engineering drawings). • Check the CPU Module, Field Connection board and the Power Supply wiring. Ensure the terminal block wiring and connectors are making good contact.
Communicating with meter but all chords display failures	<ul style="list-style-type: none"> • Verify that the resistance of transducers is within Specification (1-2 Ω). • Check the Acquisition board. • Check the interconnect cables between the base enclosure and the transmitter enclosure.

Table C-1: Mechanical/Electrical troubleshooting (continued)

Problem	Solution(s)
Chord is not indicating	<ul style="list-style-type: none">• Check the resistance of the failed transducer.• If Chord A is not indicating, change the transducer cables from Chord D to chord A.• If Chord D then fails, the transducers are bad on Chord A.• The same test procedure can be accomplished by swapping Chords B and C if a chord fails in either chord. <hr/> <p>Note Note that the outside chord cables cannot be exchanged with inner chord cables.</p> <hr/>

D Flow Rate charts

D.1 Summary charts for Flow rate

Table D-1: Flow rate summary charts

Flow Rates (MSCFH) Based upon 100 ft/s										
PSIG	4	6	8	10	12	16	20	24	30	36
100	247	561	971	1 532	2 174	3 432	5 398	7 807	12 607	18 154
200	468	1 065	1 845	2 908	4 127	6 515	10 248	14 822	23 935	34 467
300	696	1 584	2 743	4 325	6 137	9 690	15 240	22 043	35 596	51 258
400	931	2 118	3 668	5 782	8 206	12 955	20 377	29 472	47 593	69 534
500	1 172	2 667	4 619	7 282	10 334	16 315	25 661	37 114	59 934	86 305
600	1 421	3 232	5 597	8 823	12 522	19 770	31 095	44 973	72 626	104 582
700	1 676	3 813	6 602	10 409	14 772	23 322	36 682	53 055	85 677	123 374
800	1 938	4 409	7 635	12 036	17 082	26 968	42 417	61 349	99 070	142 661
900	2 207	5 021	8 694	13 706	19 452	30 710	48 302	69 861	112 816	162 455
1000	2 482	5 646	9 777	15 414	21 875	31 536	54 320	78 565	126 872	182 696
1100	2 763	6 286	10 885	17 161	24 355	38 451	60 475	87 471	141 254	203 405
1200	3 050	6 939	12 015	18 943	26 883	42 443	66 756	96 551	155 917	224 521
1300	3 341	7 602	13 164	20 753	29 453	46 500	73 137	105 781	170 822	245 983
1400	3 637	8 274	14 327	22 587	32 055	50 608	79 599	115 127	185 915	267 718
1500	3 935	8 953	15 504	24 442	34 688	54 765	89 137	124 583	201 184	289 706
1600	4 235	9 635	16 685	26 305	37 331	58 938	93 700	134 076	216 515	311 781
1700	4 536	10 231	17 871	28 175	39 986	63 128	99 291	143 608	231 908	333 948
1800	4 839	11 002	19 052	30 036	42 627	67 298	105 850	153 094	247 227	356 006
1900	5 134	11 681	20 226	31 888	45 255	71 448	112 376	162 534	262 471	377 958
2000	5 429	12 350	21 386	33 716	47 849	75 543	118 818	171 851	277 516	399 623

Flow Rates (MSCFH) Based upon 30 M/s										
kPag	4	6	8	10	12	16	20	24	30	36
1000	9.67	22.01	38.11	60.07	85.27	134.6	211.7	306.2	494.5	712.1
1500	14.22	32.34	56.00	88.27	125.3	197.8	311.1	450.0	726.7	1046
2000	18.85	42.89	74.28	117.1	166.2	262.4	412.7	596.9	963.9	1388
2500	23.59	53.67	92.94	146.5	207.9	328.3	516.4	746.9	1206	1737
3000	28.43	64.68	112.0	176.5	250.6	392.6	622.3	900.0	1453	2093
3500	33.37	75.92	131.5	207.2	294.1	464.4	730.4	1056	1706	2457
4000	38.41	87.39	151.3	238.5	338.6	534.6	840.8	1216	1964	2828
4500	43.56	99.10	171.6	270.5	384.0	606.2	953.5	1379	2227	3207

Flow Rates (MSCFH) Based upon 30 M/s										
5000	48.81	111.1	192.3	303.1	430.3	679.3	1068	1545	2495	3593
5500	54.17	123.2	213.4	336.4	477.4	753.8	1186	1715	2796	3987
6000	59.62	135.6	234.9	370.2	525.5	829.7	1305	1887	3048	4389
6500	65.17	148.3	256.8	404.7	574.5	907.0	1427	2063	3332	4798
7000	70.82	161.1	279.0	439.8	624.3	985.6	1550	2242	3621	5214
7500	76.56	174.2	301.6	475.4	674.8	1065	1676	2424	3914	5636
8000	82.38	187.4	324.6	511.6	726.2	1146	1803	2608	4212	6065
8500	88.28	200.9	347.8	548.2	778.2	1229	1932	2795	4513	6499
9000	94.25	214.4	371.3	585.3	830.9	1312	2063	2984	4818	6939
9500	100.28	228.1	395.1	622.7	883.9	1396	219	3175	5127	7382
10000	106.36	242.0	419.0	660.4	937.5	1480	2328	3367	5437	7830

Flow Rates (MMSCFD) Based upon 100 ft/s										
PSIG	4	6	8	10	12	16	20	24	30	36
100	5.9	13.5	23.3	36.8	52.2	82.4	129.5	187.4	302.6	435.7
200	11.3	25.6	44.3	69.8	99.0	156.4	245.9	355.7	574.4	827.2
300	16.8	38.0	65.8	103.8	147.3	232.6	365.8	529.0	854.3	1 230
400	22.4	50.8	88.0	138.8	196.9	310.9	489.0	707.3	1 142	1 645
500	28.2	64.0	110.8	174.8	248.0	391.6	615.9	890.7	1 438	2 071
600	34.2	77.6	134.3	211.8	300.5	474.5	746.3	1 079	1 743	2 510
700	40.3	91.5	158.5	29.8	354.5	559.7	880.4	1 273	2 056	2 961
800	46.6	105.8	183.2	288.9	410.0	647.2	1 018	1 472	2 378	3 424
900	53.1	120.5	208.7	328.9	466.8	737.0	1 159	1 677	2 708	3 899
1000	59.7	135.5	234.6	369.9	525.0	828.9	1 304	1 886	3 045	4 385
1100	66.5	150.9	261.2	411.9	584.5	922.8	1 451	2 099	3 390	4 882
1200	73.4	166.5	288.4	454.6	645.2	1 019	1 602	2 317	3 742	5 389
1300	80.4	182.4	315.9	498.1	706.9	1 116	1 755	2 539	4 100	5 904
1400	87.5	198.6	343.8	542.1	769.3	1 215	1 910	2 763	4 462	6 425
1500	94.7	214.9	372.1	586.6	832.5	1 314	2 067	2 990	4 828	6 953
1600	101.9	231.3	400.4	631.3	896.0	1 415	2 225	3 218	5 196	7 483
1700	109.1	247.7	428.9	676.2	959.7	1 515	2 383	3 447	5 566	8 015
1800	116.4	264.0	457.2	720.9	1 023	1 615	2 540	3 674	5 933	8 544
1900	126.5	280.3	485.4	765.3	1 086	1 715	2 697	3 901	6 299	9 071
2000	130.6	296.4	513.3	809.2	1 148	1 813	2 852	4 142	6 660	9 591

Flow Rates (MMSCMD) Based upon 30 M/s										
kPag	4	6	8	10	12	16	20	24	30	36

Flow Rates (MMSCMD) Based upon 30 M/s										
1000	0.232	0.528	0.915	1.442	2.046	3.231	5.082	7.350	11.869	17.091
1500	0.341	0.776	1.344	2.119	3.007	4.748	7.468	10.801	17.441	25.116
2000	0.453	1.029	1.783	2.810	3.989	6.297	9.904	14.325	23.133	33.311
2500	0.566	1.288	2.231	3.516	4.991	7.879	12.393	17.924	28.946	41.682
3000	0.682	1.552	2.688	4.237	6.014	9.495	14.935	21.600	34.882	50.230
3500	0.801	1.821	3.155	4.973	7.059	11.145	17.530	25.354	40.943	58.958
4000	0.922	2.097	3.632	5.725	8.126	12.830	20.179	29.186	47.131	67.869
4500	1.045	2.378	4.119	6.492	9.215	14.549	22.883	33.097	53.447	76.963
5000	1.171	2.664	4.615	7.239	10.326	16.302	25.641	37.086	59.889	86.240
5500	1.300	2.957	5.121	7.789	11.459	18.091	28.454	41.154	66.458	95.699
6000	1.431	3.254	5.637	8.347	12.612	19.912	31.319	45.298	73.150	105.336
6500	1.564	3.557	6.162	9.713	13.787	21.767	34.236	49.517	79.964	115.148
7000	1.700	3.866	6.696	10.555	14.982	23.653	37.203	53.808	86.893	125.126
7500	1.837	4.179	7.239	11.410	16.196	25.570	40.218	58.168	93.934	135.265
8000	1.977	4.497	7.789	12.278	17.428	27.515	43.277	62.592	101.078	145.553
8500	2.119	4.819	8.347	13.157	18.676	29.485	46.376	67.075	108.318	155.978
9000	2.262	5.145	8.912	14.047	19.939	31.479	49.512	71.611	115.642	166.524
9500	2.407	5.474	9.482	14.945	21.214	33.492	52.679	76.191	123.038	177.175
10000	2.553	5.805	10.056	15.851	22.500	35.522	55.871	80.808	130.494	187.911

E Write-protected configuration

E.1 Parameters for Write-protected configuration

This appendix contains a table of configuration parameters that are write-protected against changes when the CPU Board WRITE PROT. switch is in the **ON** position. The data points in [Table E-1](#) are applicable for Rosemount 3410 Series Firmware v1.06 and later.

Table E-1: Write-protected configuration parameters

Write-protected configuration parameters
AbnormalProfileDetectionLmt
Address
AlarmDef
AO1ActionUponInvalidContent
AO1Content
AO1Dir
AO1FullScaleEnergyRate
AO1FullScaleMassRate
AO1FullScaleVolFlowRate
AO1MaxVel
AO1MinVel
AO1TrimCurrent
AO1TrimGainExtMeasCurrent
AO1TrimZeroExtMeasCurrent
AO2ActionUponInvalidContent
AO2Content
AO2Dir
AO2FullScaleEnergyRate
AO2FullScaleMassRate
AO2FullScaleVolFlowRate
AO2MaxVel
AO2MinVel
AO2TrimCurrent
AO2TrimGainExtMeasCurrent
AO2TrimZeroExtMeasCurrent
ArgonComponentIndex
AtmosphericPress
AvgDlyA
AvgDlyB

Table E-1: Write-protected configuration parameters (continued)

Write-protected configuration parameters
AvgDlyC
AvgDlyD
AvgSoundVelHiLmt
AvgSoundVelLoLmt
BatchSize
BlockageTurbulenceLmtA
BlockageTurbulenceLmtB
BlockageTurbulenceLmtC
BlockageTurbulenceLmtD
CalMethod
ChordInactvA
ChordInactvB
ChordInactvC
ChordInactvD
City
ColocMeterMode
ContractHour
CRange
DeviceNumber
DI1IsInvPolarity
DitherEnable
DltChk
DltDlyA
DltDlyB
DltDlyC
DltDlyD
DO1AContent
DO1AIsInvPolarity
DO1BContent
DO1BIsInvPolarity
DO2AContent
DO2AIsInvPolarity
DO2BContent
DO2BIsInvPolarity
EmRateDesired
EnableExpCorrPress

Table E-1: Write-protected configuration parameters (continued)

Write-protected configuration parameters
EnableExpCorrTemp
EnablePressureInput
EnableTemperatureInput
FireSeq
FlowAnalysisHighFlowLmt
FlowAnalysisLowFlowLmt
FlowDir
FlowPOrTsrcUponAlarm
FODO1Mode
FODO1Source
FODO2Mode
FODO2Source
FODO3Mode
FODO3Source
FODO4Mode
FODO4Source
FODO5Mode
FODO5Source
FODO6Mode
FODO6Source
Freq1BPhase
Freq1Content
Freq1Dir
Freq1FeedbackCorrectionPcnt
Freq1FullScaleEnergyRate
Freq1FullScaleMassRate
Freq1FullScaleVolFlowRate
Freq1MaxFrequency
Freq1MaxVel
Freq1MinVel
Freq2BPhase
Freq2Content
Freq2Dir
Freq2FeedbackCorrectionPcnt
Freq2FullScaleEnergyRate
Freq2FullScaleMassRate

Table E-1: Write-protected configuration parameters (continued)

Write-protected configuration parameters
Freq2FullScaleVolFlowRate
Freq2MaxFrequency
Freq2MaxVel
Freq2MinVel
FwdA0
FwdA1
FwdA2
FwdA3
FwdBaselineAvgFlow
FwdBaselineComment
FwdBaselineCrossFlow
FwdBaselineFlowPressure
FwdBaselineFlowTemperature
FwdBaselineProfileFactor
FwdBaselineSwirlAngle
FwdBaselineSymmetry
FwdBaselineTime
FwdBaselineTurbulenceA
FwdBaselineTurbulenceB
FwdBaselineTurbulenceC
FwdBaselineTurbulenceD
FwdC0
FwdC1
FwdC2
FwdC3
FwdFlwRt<1..12>
FwdMtrFctr<1..12>
GasPropertiesSrcSel
GasPropertiesSrcSelGCAlarm
GCBaud
GCCommTimeout
GCDesiredStreamTimeout
GCDisabledComponentIndex
GCHeatingValueType
GCHeatingValueUnit
GCModbusID

Table E-1: Write-protected configuration parameters (continued)

Write-protected configuration parameters
GCProtocol
GCSerialPort
GCStreamNumber
H2ComponentIndex
H2SComponentIndex
HCH_Method
HighPressureAlarm
HighTemperatureAlarm
InputPressureUnit
IsC6PlusAutoDetectionEnabled
IsDiagnosticChordEnabled
IsFreq1BZeroedOnErr
IsFreq2BZeroedOnErr
IsGasCompositionValidationEnabled
IsoButaneComponentIndex
IsoPentaneComponentIndex
LA
LB
LC
LD
LinearExpansionCoef
LiquidDetectionSDevCrossFlowLmt
LiquidDetectionSDevProfileFactorLmt
LiquidDetectionSDevSymmetryLmt
LiveFlowPressureGain
LiveFlowPressureOffset
LiveFlowTemperatureGain
LiveFlowTemperatureOffset
LowFlowLmt
LowPressureAlarm
LowTemperatureAlarm
MaxHoldTm
MaxInputPressure
MaxInputTemperature
MaxNoDataBatches
MaxNoise

Table E-1: Write-protected configuration parameters (continued)

Write-protected configuration parameters
MeterHousingLength<A..D>
MeterMaxVel
MeterName
MeterSerialNumber
MinChord
MinHoldTime
MinInputPressure
MinInputTemperature
MinPctGood
MinSigQty
N2ComponentIndex
NegSpan
NonNormalModeTimeout
NPentaneComponentIndex
NumVals
PBase
PipeDiam
PipeOutsideDiameter
Pk1Pct
Pk1Thrsh
Pk1Wdth
PoissonsRatio
PosSpan
ReadWriteModePort<A..C>
RefPressExpCoef
RefPressureGr
RefPressureMolarDensity
RefTemperatureGr
RefTemperatureHV
RefTemperatureMolarDensity
RefTempLinearExpCoef
RevA0
RevA1
RevA2
RevA3
RevBaselineAvgFlow

Table E-1: Write-protected configuration parameters (continued)

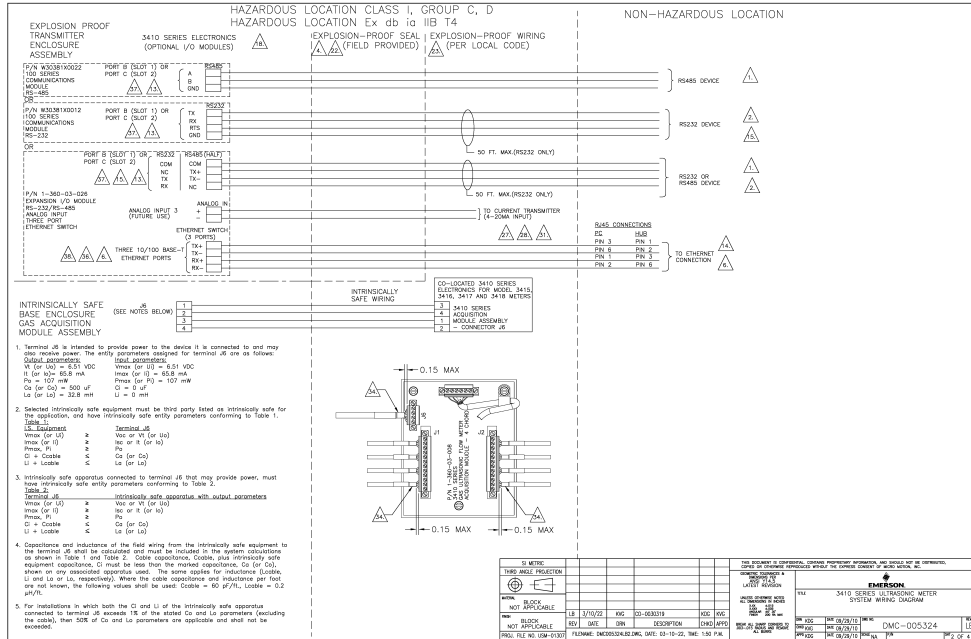
Write-protected configuration parameters
RevBaselineComment
RevBaselineCrossFlow
RevBaselineFlowPressure
RevBaselineFlowTemperature
RevBaselineProfileFactor
RevBaselineSwirlAngle
RevBaselineSymmetry
RevBaselineTime
RevBaselineTurbulenceA
RevBaselineTurbulenceB
RevBaselineTurbulenceC
RevBaselineTurbulenceD
RevC0
RevC1
RevC2
RevC3
ReverseFlowDetectionZeroCut
ReverseFlowVollmt
RevFlwRt<1..12>
RevMtrFctr<1..12>
SampInterval
SampPerCycle
SndSpdChkMaxVel
SndSpdChkMinVel
SndVelCompErrLimit
SNRatio
SpecBatchUpdtPeriod
SSMax
SSMin
StackEmRateDesired
StateAndCountry
StationName
Tamp
TampHi
TampLo
TampSen

Table E-1: Write-protected configuration parameters (continued)

Write-protected configuration parameters
TampWt
TBase
TmDevFctr1
TmDevLow1
Tspe
TspeHi
TspeLmt
TspeLo
TspeSen
TspeWt
Tspf
TspfHi
TspfLo
TspfMatch
TspfSen
TspfWt
UnitsSystem
VelHold
VolFlowRateTimeUnit
VolUnitMetric
VolUnitUS
WallRoughness
XA
XB
XC
XD
XdcrAssyComponent1Length<A1..D2>
XdcrAssyComponent1SerialNumber<A1..D2>
XdcrAssyComponent2Length<A1..D2>
XdcrAssyComponent2SerialNumber<A1..D2>
XdcrAssyComponent3Length<A1..D2>
XdcrAssyComponent3SerialNumber<A1..D2>
XdcrAssyComponent4Length<A1..D2>
XdcrAssyComponent4SerialNumber<A1..D2>
XdcrFiringSync
XdcrFreq

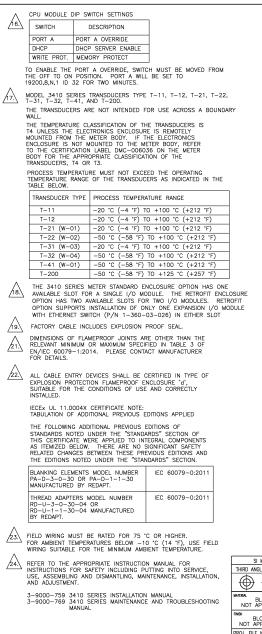
Table E-1: Write-protected configuration parameters *(continued)*

Write-protected configuration parameters
XdcrNumDriveCycles
YoungsModulus
ZeroCut

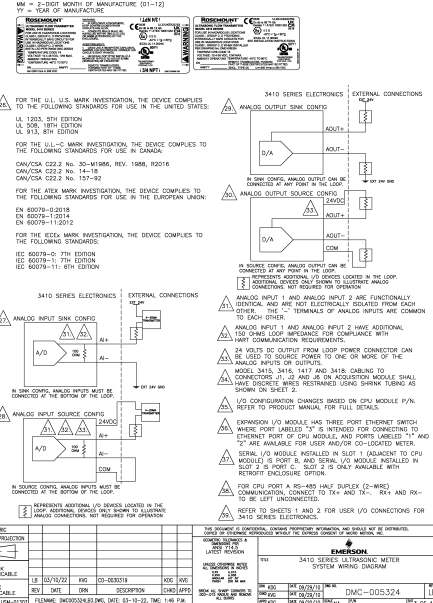


NOTES:

- MAX LENGTH OF RS-485 WIRING IS 2,000 FT.
- ETHERNET OR RS-485 IS THE PREFERRED COMMUNICATIONS INTERFACE. OPTIONALLY, RS-232 MAY BE USED FOR SHORT DISTANCES (NO FT.).
- ETHERNET PORTS ARE 10/100 BASE-T. THE PORTS ARE FUNCTIONAL THROUGHOUT THE LIFE OF THE DEVICE.
- AN EXPLOSION-PROOF SEAL IS REQUIRED WITHIN 457 MM (18 INCHES) OF THE ENCLOSURE.
- TRANSDUCER CABLE IS 20 AWG SHIELDED PAIR 20 AWG DRAIN BRAIDED SHIELD TENSILE STRENGTH OR EQUIVALENT, 10 FT. MAX.
- FOR OPTIMUM DIAGNOSTIC INTERFACE, WIRING ETHERNET PORT IS RECOMMENDED.
- INTRINSICALLY SAFE WIRING SHALL BE INSTALLED IN ACCORDANCE WITH CANADIAN STANDARDS FOR THE NATIONAL ELECTRICAL CODE OF RULE 18-086 OF THE CANADIAN ELECTRICAL CODE.
- DIGITAL INPUT 1 (DI1) IS CONTACT CLOSURE ONLY.
- TRANSDUCER PAINS REQUIRED
- TRANSDUCER TYPE PROCESS TEMPERATURE RANGE
- 3410 SERIES METERS STANDARD ENCLOSURE OPTION HAS ONE AVAILABLE SLOT FOR A SINGLE I/O MODULE. THE REMOVAL ENCLOSURE OPTION HAS TWO AVAILABLE SLOTS FOR TWO I/O MODULES. REMOVAL OPTION SUPPORTS INSTALLATION OF ONLY ONE EXPANSION I/O MODULE WITH ETHERNET SWITCH (P/N 1-360-03-028) IN EITHER SLOT.
- FACTORY CABLE INCLUDES EXPLOSION PROOF SEAL.
- COMPONENTS OF FLAMEPROOF CONTACTS ARE OTHER THAN THE DESIGNATED PART NUMBER SPECIFIED IN TABLE 2 OF EN/IC 60079-1:2014. PLEASE CONTACT MANUFACTURER FOR DETAILS.
- ALL CABLE ENTRY DEVICES SHALL BE CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE OF THE EQUIPMENT FOR THE CONDITIONS OF USE AND CORRECTLY RETULED.
- ISLAND 11,000KVA CERTIFICATE NOTE.
- REVIEW OF ADDITIONAL PREVIOUS EDITIONS APPLIED TO THIS DOCUMENT.
- THE FOLLOWING ADDITIONAL PREVIOUS EDITIONS OF STANDARDS NOTED UNDER THE "STANDARDS" SECTION OF THIS DOCUMENT WERE APPLIED TO ORIGINAL COMPONENTS AS LISTED BELOW. THERE ARE NO SIGNIFICANT SAFETY RELATED CHANGES FROM THESE PREVIOUS EDITIONS AND THE LISTING NOTED UNDER THE "STANDARDS" SECTION.
- ISSUING ELEMENTS MODEL NUMBER: IE 60079-0-2011 PA-2-30-30 OR PA-(1)-1-30 MANUFACTURED BY ROSEMOUNT.
- INWARD ADAPTER MODEL NUMBER: IE 60079-0-2011 80-10-1-30-04-04 MANUFACTURED BY ROSEMOUNT.
- FIELD WIRING MUST BE RATED FOR 75 °C OR HIGHER. FOR AMBIENT TEMPERATURES BELOW 10 °C (14 °F), USE FIELD WIRING SUITABLE FOR THE AMBIENT TEMPERATURE.
- REFER TO THE APPROPRIATE INSTRUCTION MANUAL FOR INSTALLATION AND SAFETY INCLUDING FUTURE WIRE SERVICE, USE, ASSEMBLY AND DISMANTLING, MAINTENANCE, INSTALLATION, AND REVISIONS.
- 3-800-758 3410 SERIES INSTALLATION AND TROUBLESHOOTING MANUAL.



EMERGENCY STOP (E-STOP) SWITCH



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