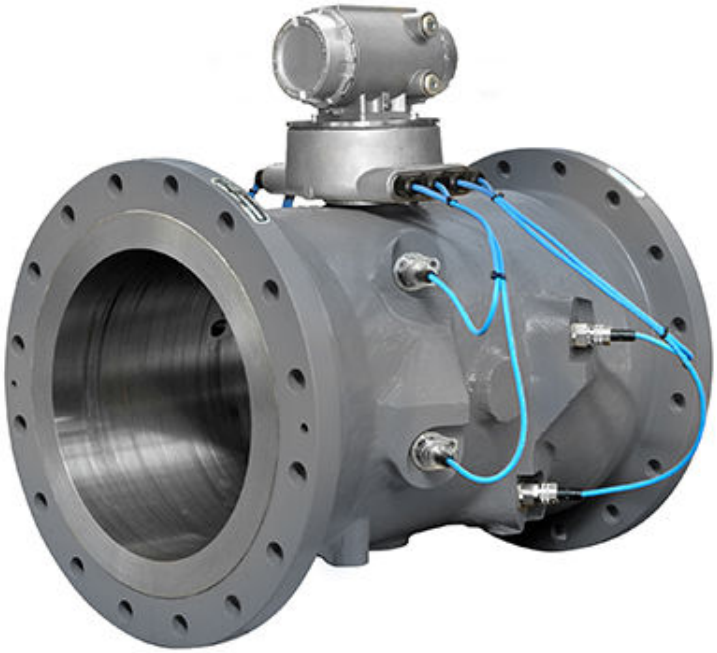
Operations Manual
00809-0200-3810, Rev AC
December 2023

Rosemount™ 3810 Series Liquid Ultrasonic Flow Meters



ROSEMOUNT™

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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 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 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 maintenance and troubleshooting manual.

Product data sheets and manuals are available on the Emerson website at 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 website at Emerson.com or by phoning the Emerson Customer Service department.

Contents

1 Start-up checklist

1.1 Checklist

During meter start-up, have the following equipment and information on hand:

Table 1-1: Meter start-up checklist

	Site pipe and ID drawings with elevations
	Site wiring diagrams
	Rosemount Liquid Ultrasonic Meter calibration data
	Rosemount Liquid 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 switch settings on transmitter CPU Module.
	Start MeterLink™.
	Establish flow in the meter (at least 4 ft/s 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 signal strength • Check for good signal strength (usually shown as “SNR”) or, Signal to Noise Ratio. • Check for reasonably correct flow profile.
	Go to **Logs/Reports** → **Maintenance Logs/Reports** to 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 and digital output variables, frequency full scale, analog outputs, local display configuration and temperature and pressure analog inputs scaling and alarm limits.
	Save another Maintenance Log (this is your ***As Left*** record).

1.2 Cybersecurity and network communications

In order to mitigate cybersecurity risks, configure the 3810 electronics TCP/IP communications 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** → **Communication Settings** dialog in MeterLink. Both can be disabled for additional security, but log collection will not be possible in this configuration.
2. Leave the Telnet port disabled. This port is not required for any communications to field devices or MeterLink. Beginning with Rosemount 3810 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 3810 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 start-up. 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 3810 Series Firmware v1.60 and later. Only give users privileges to perform their job functions. For more information, see Manage users 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. Must be installed following industry best practices for cybersecurity.

2 Initial communication set up

2.1 Set up 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: Emerson.com/meterlink.

2.1.1 MeterLink™ configuration utilities

MeterLink provides the following utilities to configure the meter's flow measurement units, meter output parameters, communications settings, output tests, waveforms, 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
  - HART® Outputs
  - Meter Corrections
  - Temperature and Pressure
  - Alarm Limits
  - Local Display
- Communications Settings
- Signal Analyzer
- Meter Information
- Manage Users
- Open Data Folder
- Tools

- Edit/Compare Configuration
- Waveform Viewer
- Outputs Test
- Transducer Swap-Out
- Set Transducer Type
- Reset Tracking
- Reset Velocity Estimation
- Override Velocity Estimation Update Time
- Locate Meter
- Program Download
- Communications Analyzer
- Warm Start Meter

2.1.2 Set up the meter directory

Set up the connection properties for your meter.

By default, the meter directory contains only one record named ***New Meter***, which is defaulted to connect to a Rosemount Liquid Ultrasonic Meter configured as shipped from the factory.

2.1.3 Create a new meter record

Procedure

1. Select **Insert**, **Insert Duplicate**, or **Add** from the ***File*** dropdown list to create a new record.
2. Set up the record by entering a **Short Desc**, **Meter Type**, and selecting the connection type(s) checkboxes: **Direct**, **Modem**, **Ethernet**.
   For each connection type selected, a button will be enabled at the bottom of the dialog with the same name.
3. Click these buttons to edit the connection properties for that connection method.
4. After choosing the connection properties, click **OK** to accept the changes or click **Cancel** to discard any changes and close the dialog.

2.1.4 Set up a direct connection

Procedure

1. Connect to the meter directly through one of the serial ports on the meter using one of the serial ports on your computer.
2. 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 remote terminal unit (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 dropdown list for which the meter hardware is configured. The default Baud Rates is 19200.

2.1.5 Modem connection

Set the following properties to connect to the meter via a modem:

Protocol and Comms Address Use the Protocol and Comms Address parameters in Set up a direct connection.

Modem Select the modem to use from the dropdown list. Only modems installed in Windows® show in the dropdown list. If the dropdown list is blank, then no modems have been installed for Windows®.

Note
Do not select Direct Connection or Communications cable between two computers for the modem. This is a NULL modem driver for direct connection to Rosemount Ultrasonic meters only. It will not work for the Modem connection.

MeterLink™ uses the Microsoft® Dial-up Networking for making modem and direct serial connections to a meter. Click **Modem Properties** to bring up the Dial-up networking entry MeterLink has created for this meter. Most of the information required is set up correctly by MeterLink.

Baud Rate Select the desired Baud Rate from the dropdown list.

Telephone # Enter the telephone number for the modem to which the meter is connected. Include digits to obtain to an outside line, if necessary. Inserting commas between the digits pauses the dialing rate. Each comma is approximately equal to two seconds.

Modem Properties Configures the properties associated with the modem.

MeterLink uses the Microsoft® Dial-up Networking for making modem and direct serial connections to a meter. Click **Modem Properties** to bring up the Dial-up networking entry MeterLink has created for this meter. Most of the information required is setup correctly by MeterLink. Click **OK** to accept the changes or click **Cancel** to discard any changes and return to the Meter Directory dialog box.

2.1.6 Ethernet connection

Set the following properties to configure the Rosemount ultrasonic meter hardware for Ethernet connectivity. Use the Direct, Modem, Ethernet and Ethernet 2 checkboxes for the desired communications methods.

Note
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 Liquid Ultrasonic meters or you can use `192.168.135.100` if DHCP is enabled in the meter (see Dynamic Host Configuration Protocol (DHCP) 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 (P/N 1-360-01-596) to a Rosemount Ultrasonic 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 central processing unit (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.

2.1.7 Ethernet initial connection steps

Procedure

1. Power up the meter.
2. Shut down 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 local area network (LAN) connector dynamic host configuration protocol (DHCP) server on the central processing unit (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® login prompt.
6. Verify the Ethernet connection status by the CPU module **LINK** LED. The desired color is solid green.
7. Launch MeterLink and create a new meter record.

2.2 Import a meter record

Procedure

Select **File** → **Import** from the ***Meter Directory*** dropdown list or click **Import**.

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, opens.

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.

2.3 Export a meter record

Use the **Export** command to save the current meter directory to a file. Select **File** → **Meter Directory** from the ***Meter Directory*** dropdown list 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. MeterLink™ exports the meter names, Comms Address, Interface, and Telephone numbers. It is necessary to recheck the connection properties and verify the communication parameters such as COM port, data bits, and parity are configured correctly.

2.4 Connect to the meter

Procedure

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

2.5 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 to establish a baseline to be used for the trending of the meter diagnostics and save the following logs and reports for the “As Found” settings (factory default):

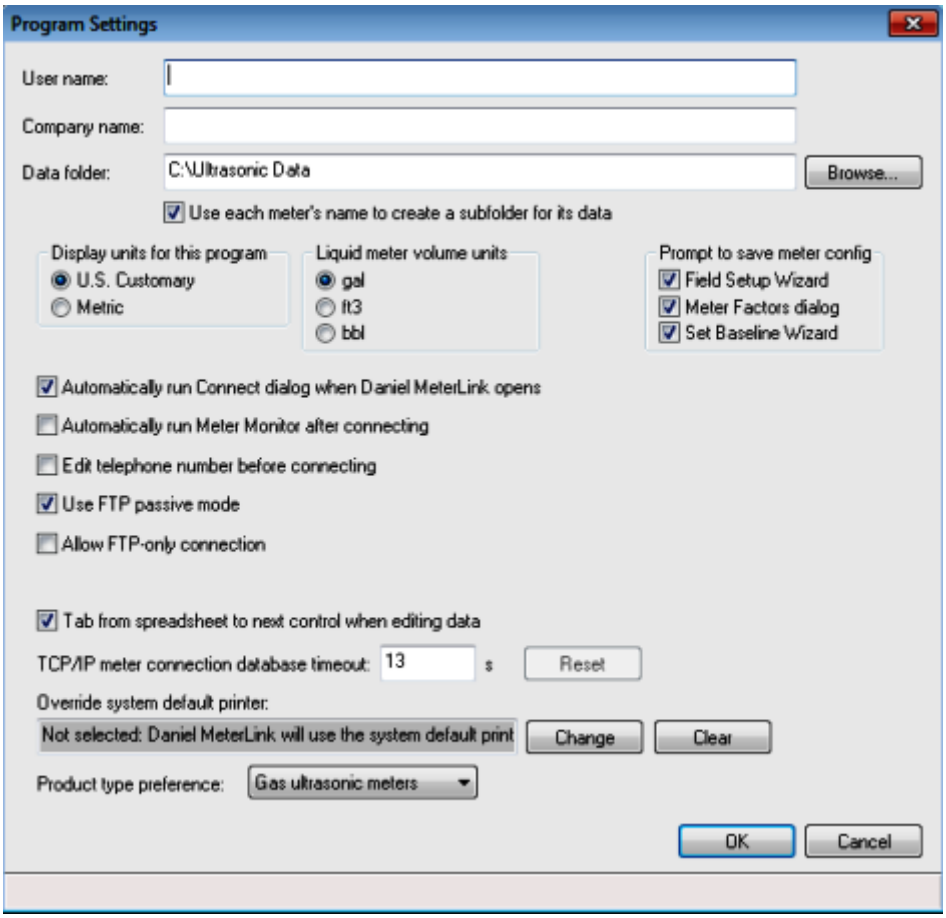
- ***Maintenance*** log
- ***System*** log
- Save your meter’s configuration file
- Use the **Tools** → **Edit/Compare Configuration** menu to display the dialog. Enable the **View All** or **Metrology** radio button and click **Read**.
- The ***All*** view displays the meter’s extended configuration 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 set up in **File** → **Program Settings**.

2.6 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 2-1: Program settings



- 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
- Edit telephone number before connecting with a modem
- Use FTP passive mode (client - server pot communications)
- FTP-only connection - used to download firmware to Rosemount Ultrasonic meters

- 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

2.7 Set up Modbus® communications

Rosemount 3810 Liquid 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 ASCII protocol with the following parameters:

Table 2-1: Modbus communication parameters

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

Refer to your flow computer user manual to set input/output (I/O) settings required to allow serial communication with the Rosemount 3810 Liquid Ultrasonic Flow Meters.

The Rosemount 3810 Liquid Ultrasonic Flow Meters support 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 Emerson website and select the Product page for the model of your meter: Emerson.com/automation.

Set up Modbus TCP parameters

If the meter firmware supports Modbus TCP slave functionality, the following controls will be available:

- **Modbus TCP unit identifier**: Enter the Modbus TCP unit identifier here. Valid values are 0-255.
- **Enable alternate Modbus TCP port**: The standard TCP port for Modbus TCP is port 502. This port is always enabled in a meter that supports Modbus TCP. By selecting this option, you can also enable Modbus TCP communications on a secondary TCP port specified by Alternate Modbus TCP port.
- **Alternate Modbus TCP port**: After selecting **Enable alternate modbus TCP port**, enter the alternate TCP port number here. Valid port numbers are from 1 to 65535. The meter will not allow some port numbers that are either used by the meter or are defined port numbers for other protocols. MeterLink™ will prompt you if it was not able to write the specified port number to the meter.

2.8 Set up HART® communications

Rosemount Ultrasonic Flow Meters are HART-capable devices utilizing the 4-20 mA 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 24 V 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 HART Field Device Specification (00825-0300-3810) for details.

Also, see AMS Device Manager and Field Communicator websites:

- Emerson.com/AMSDeviceManager
- Emerson.com/FieldCommunicators

2.9 Set up the meter in a DeltaV System

Rosemount 3810 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.

- Access the DeltaV website hyperlink:
  Emerson.com/DeltaV
- Click **Books Online** under Quick Links.
- Set up your user account and access the manual.

2.10 Manage users

Starting with Rosemount 3810 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.

2.10.1 User set up

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 set up in a meter. The following are the rules needed to successfully set up new users in a meter:

To set up new users in a meter:

Username

Usernames 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	Description
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 to be 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:
  - & (Ampersand)
  - * (Asterisk)
  - @ (At symbol)
  - \ (Backslash)
  - ^ (Caret-circumflex)
  -) (Close parenthesis)
  - } (Closing brace)
  -] (Closing bracket)

- : (Colon)
- , (Comma)
- $ (Dollar)
- = (Equals)
- ! (Exclamation mark)
- ` (Grave accent)
- > (Greater than)
- - (Hyphen)
- < (Less than)
- # (Number)
- { (Opening brace)
- [(Opening bracket)
- ((Open parenthesis)
- % (Percentage)
- . (Period)
- + (Plus)
- ? (Question mark)
- ; (Semicolon)
- / (Slash)
- " (Straight double quote)
- ' (Straight single quote or Apostrophe)
- ~ (Tilde)
- _ (Underscore)
- | (Vertical bar)

2.10.2 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 set up on one meter and easily transferred to others. These functions are also needed in the event a central processing unit (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.

2.10.3 Reset users

It is important to keep track of the login credentials for at least one use 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.

To delete all users and restore back the default administrative user:

Procedure

1. Connect 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 enter meter reset mode after 5 seconds, and remain in meter reset mode for up to two minutes or until a reset action is complete or the **Port A override** switch is moved to the **OFF** position.

   Tip
   Use a retractable ballpoint pen with the ballpoint 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 Flow measurement

3.1 Flow measurement principles

Rosemount 3810 Liquid Ultrasonic Flow Meters measure the transit times of ultrasonic pulses passing through the medium on two parallel planes. The measurement paths, referred to as “chords”, are angled to the pipe axis, and each chord has two transducers acting alternately as transmitter and receiver.

Figure 3-1 describes the flow measurement principle. 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.

Figure 3-1: Transit-time measurement principle

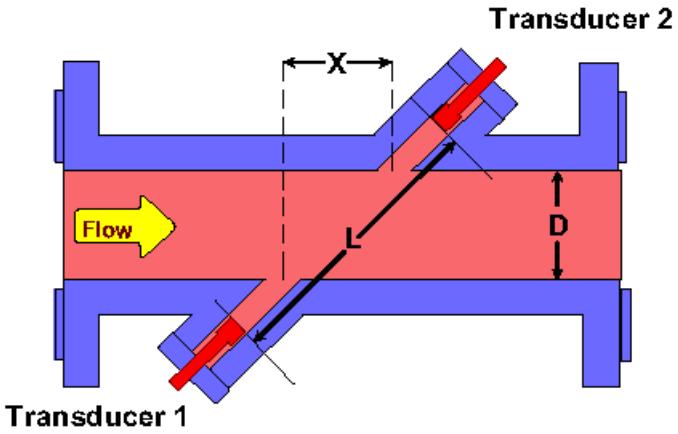
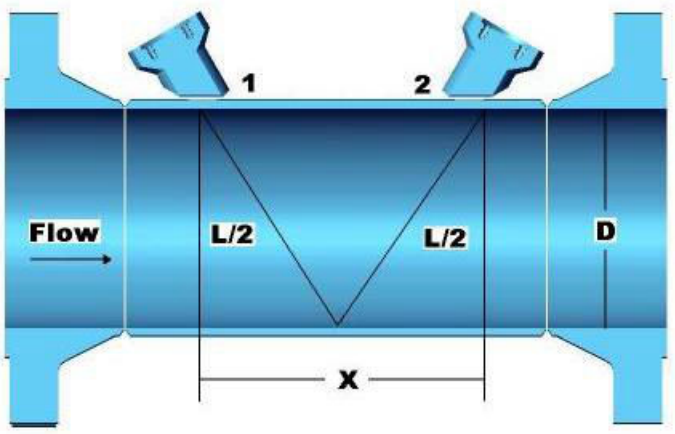


Figure 3-2: 3812 measurement principle

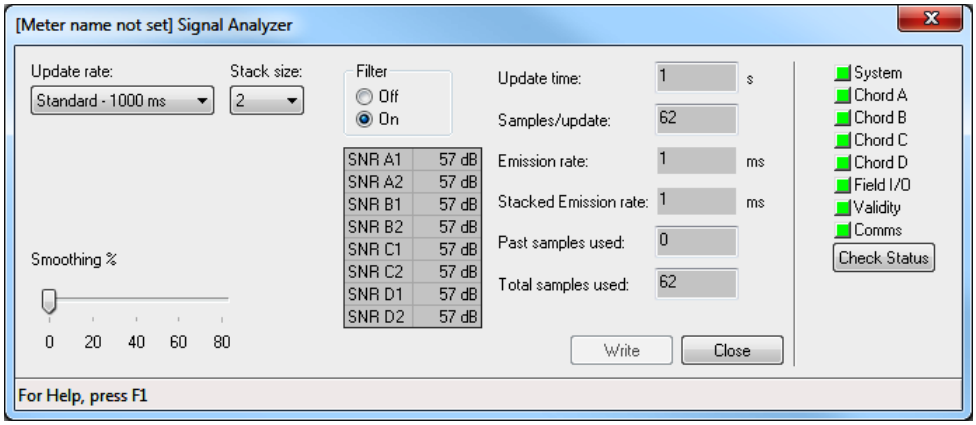


3.1.1 Transducer timing control

Transducer timing control, the performance of batch data collection and calculation updates in Rosemount 3810 Liquid Ultrasonic Flow Meters is affected by the following parameters:

- Signal processing
- Batch cycle processing

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



3.1.2 Terminology for flow measurement

- **Sequence** - A complete cycle of firing all enabled transducers in a single round of transducer operation. For example, when all eight transducers of the Rosemount 3814 Liquid Ultrasonic Flow Meter have been fired in a single round of operation, it signifies the completion of one sequence.
- **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 number 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 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**). Emerson recommends 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**.
- **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.

3.1.3 Signal processing

Signal processing for transit time measurement

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.

3.1.4 Stacking

Transducer firing method

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 2.

Care should be taken when turning off stacking and it is recommended to consult with Emerson Customer Support 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.

3.1.5 Filtering

Frequency bandpass filter

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 and disabled via the Filter data point (TRUE = enable filtering, FALSE = disable filtering).

Meters are configured by default with filtering disabled. Emerson recommends the default Filter setting, which is the **OFF** position.

Care should be taken when enabling and disabling filtering and it is recommended to consult with Emerson Customer Support 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.

3.1.6 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 3-1. The Standard batch update period is the default. The actual batch update period is readable via the **BatchUpdatePeriod** data point.

Table 3-1: Actual meter update period

SpecBatchUpddtPeriod	Stacksize				
	1 (None)	2	4	8	16
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

3.2 Smoothing

Smoothing output

The Rosemount Liquid Ultrasonic Flow Meter introduces 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).

3.3 Acquisition mode

Signal acquisition

The Rosemount 3810 Series Liquid Ultrasonic Flow Meter has two modes of normal operation: Acquisition and Measurement. The Acquisition mode is used to acquire the ultrasonic signals. This mode is entered upon powering up 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 **VelHold** 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 meter operation mode is indicated by the **IsAcqMode** data point. When `TRUE`, the meter is in the Acquisition mode; when `FALSE`, the meter is in the Measurement mode.

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**) to determine the signal search range.

3.3.1 Re-acquisition mode

Re-acquire transducer signals

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 **PctGood**[A1..D2] is less than **MinPctGood**.

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

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 0.0.

3.4 Chord average flow 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).

Note
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 flow velocity and sound velocity measured by the chord as shown in Equation 3-1 and Equation 3-2.

Equation 3-1: Chord Average Flow

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

Equation 3-2: Chord Speed of Sound

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

3.4.1 Average Flow Velocity

The average velocity is calculated as the average sound velocity of the active chords as shown in the equation below:

Equation 3-3: Average Flow Velocity

$$C_{Avg} = \frac{\sum_{ActiveChords} \bullet C_{Chord}}{NumActiveChords}$$

C_{Avg} =	Average sound velocity (m/s)
C_{Chord} =	Chord average sound velocity (m/s) (**SndVelA**...**SndVelD**)
NumActiveChords =	Number of active chords

3.4.2 Average 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 below.

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
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 3-4. 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 3-4: Chord Proportion Calculation

$$Prop_{chord} = \frac{V_{chord}}{V_{AvgWtd}}$$

$Prop_{chord}$ =	chord proportion (dimensionless)
V_{chord} =	chord velocity (m/s) (**FlowVelA** ... **FlowVelD**)
V_{AvgWtd} =	average weighted liquid flow velocity (m/s) (**AvgWtdFlowVel**)

3.4.3 Update chord proportion bin data values

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 3-5 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 3-5: Updating chord proportion bin data values

$$AvgVelChordBin_{n+1} = \frac{AvgVelChordBin_n(NumVals - 1) + V_{Chord}}{NumVals}$$

$$AvgPropChordBin_{n+1} = \frac{AvgPropChordBin_n(NumVals - 1) + Prop_{Chord}}{NumVals}$$

$AvgVel_{ChordBin_{n+1}}$ =	chord bin (n+1)th average velocity (m/s)
$AvgVel_{ChordBin_n}$ =	chord bin nth average velocity (m/s)
NumVals =	update factor data point (dimensionless) (NumVals)
V_{Chord} =	(current-batch) chord average flow velocity (m/s) (FlowVelA … FlowVelD)
$AvgProp_{ChordBin_{n+1}}$ =	chord bin (n+1)th average proportion value (dimensionless)
$AvgProp_{ChordBin_n}$ =	chord bin nth average proportion value (dimensionless)
$Prop_{Chord}$ =	(current-batch) chord proportion (dimensionless)

3.5 Volumetric flow rate values

The Rosemount Liquid Ultrasonic Flow Meter provides two volumetric flow rate values: raw and flow-condition.

The flow-condition volumetric flow rate can include pressure and/or temperature-expansion correction for meter body expansion.

Note
A positive volumetric flow rate indicates flow in the forward direction whereas a negative volumetric flow rate indicates flow in the reverse direction.

3.5.1 Raw volumetric flow rates

Equation 3-6: Raw Volumetric Flow Rate

$$Q_{Raw} = V_{CustomerCal} \times \left[\frac{\pi D_m^2}{4}\right] \times 3600 s/hr$$

Q_{Raw}=	“raw” volumetric flow rate (m^3/h) (Q^{Meter})
$V_{CustomerCal}$=	customer-calibrated average flow velocity (m/s) (AvgFlow)
π =	geometric constant, pi (dimensionless) (3.14159…)
D_{in}=	pipe inside diameter (m) (PipeDiam)

3.5.2 Flow-condition volumetric flow rate

The flow-condition volumetric flow rate is the result of applying expansion correction to the raw volumetric flow rate as shown in the following equation, 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 (**CutRate**) is the specified low-flow velocity threshold (**ZeroCut**) converted to a volumetric flow rate.

Equation 3-7: Flow condition volumetric flow rate

$$Q_{Flow} = (Q_{Raw})(ExpCorr_P)(ExpCor_T)$$

Q_{Flow}= flow-condition volumetric flow rate (m^3/h) (**Q^{Flow}**)

Q_{Raw} = "raw" volumetric flow rate (m^3/h) (**Q^{Meter}**)

$ExpCorr_P$ = expansion correction factor due to pressure (dimensionless) (**ExpCorrPressure**)

$ExpCorr_T$ = expansion correction factor due to temperature (dimensionless) (**ExpCorrTemperature**)

3.5.3 Pressure 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).

Equation 3-8: Pressure Expansion Correction

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

$ExpCorr_P$= expansion correction factor due to pressure (dimensionless) (**ExpCorrPressure**)

ß = pipe strain per unit stress ($MPaa^{-1}$) (**StrainPerUnitStress**)

$P_{abs,f}$= flow-condition absolute pressure (MPaa) (**AbsFlowPressure**)

P_{ref}= reference absolute pressure (MPaa) (0.101325 MPaa)

Equation 3-9: Pressure-effect strain per unit stress

$$\beta = \frac{\left[D_{out}^2(1+\upsilon)\right] + \left[D_{in}^2(1-2\upsilon)\right]}{E \bullet \left(D_{out}^2 - D_{in}^2\right)}$$

ß = 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**)

υ = Poisson's Ratio (dimensionless) (**PoissonsRatio**)

E = Young's Modulus of elasticity (MPaa) (**YoungsModulus**)

3.5.4 Temperature 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 the Equation 3-10.

Equation 3-10: Temperature Expansion Correction

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

$ExpCorr_T$ = 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**)

3.5.5 Reynolds number calculation

Reynolds Number is a dimensionless value that represents the nature of the liquid flow within the pipe. Reynolds Number is calculated as shown in Equation 3-11.

Equation 3-11: Reynolds Number

$$\mathrm{Re} = \left(\frac{4}{\pi}\right)\frac{Q_{Raw}\rho\left(\rho_f T_f\right)}{3600 * \mathrm{D_{in}}\mu}$$

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

π = geometric constant, pi (dimensionless) (3.14159...)

Q_{Raw} = "raw" volumetric flow rate (m^3/h) (**QMeter**)

$P(P_f T_f)$ = fluid mass density at the flow condition (specified via **SpecRhoMixFlow**) (kg/m^3) (**RhoMixFlow**)

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

μ = dynamic viscosity (Pa•s) (**Viscosity**)

3.5.6 Volume forward and reverse accumulators

Flow rate forward and reverse volume accumulators

The Rosemount 3810 Series Liquid Ultrasonic Flow Meter provides forward and reverse volume accumulators for both of the two volumetric flow rate values: raw and flow-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 m^3 is stored as 12345 m^3 for the integer portion and 0.750 m^3 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 listed in Table 3-2 below:

Table 3-2: Non-volatile volume accumulator data points

Volumetric Flow Rate Type	Forward flow direction		Reverse flow direction	
	Integer	Fraction	Integer	Fraction
Raw	PosVolUncorr	PosVolUncorrFrac	NegVolUncorr	NegVolUncorrFrac
Flow-condition	PosVolFlow	PosVolFlowFrac	NegVolFlow	NegVolFlowFrac

3.6 3810 Series liquid flow meter diagnostics

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.

Note
This is only applicable to 3814, 4-path meter types.

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 a 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 ±0.05 for 3814 meters and 1.0 for 3812 meters.

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 (3814) and Profile factor. A value of 0 degrees indicates no appreciable swirl.

Reverse flow detection

Reverse flow direction is detected if the meter has accumulated a reverse flow volume greater than a user-configurable limit set in the Reverse Flow Volume Limit. See Reverse flow alarm to configure the volume limit.

4 Configurations

4.1 Calibration methods

Factory calibration and user-defined calibration

The Rosemount 3810 Series Liquid Ultrasonic Flow Meter uses two calibration corrections:

- Factory Calibration
- Customer Calibration

In this methodology, the "Factory Calibration" values are set by Emerson at the factory and are not expected to be modified; the "Customer Calibration" values are expected to be set as the result of a user flow calibration (if desired).

4.1.1 Factory calibration method

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 for the meter's "As left" configuration settings.

⚠ CAUTION

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

The factory calibrated flow velocity is the result of applying a third-order polynomial equation to the average weighted flow velocity as shown in Equation 4-1.

Equation 4-1: Factory-Calibrated Average Flow Velocity

$$V_{FactoryCal} = A_0 + A_1^{V_{AvgWtd}} + A_2^{V^2_{AvgWtd}} + A_3^{V^3_{AvgWtd}}$$

$V_{FactoryCal}$ =	factory-calibrated average flow velocity (m/s) (**FactoryCalVel**)
V_{AvgWtd} =	average weighted flow velocity (m/s) (**AvgWtdFlowVel**)
A_0 =	factory-calibration 0th order coefficient (m/s) (FwdA0 or RevA0)
A_1 =	factory-calibration 1st order coefficient (dimensionless) (**FwdA1 or RevA1**)
A_2 =	factory-calibration 2nd order coefficient (s/m) (**FwdA2 or RevA2**)
A_3 =	factory-calibration 3rd order coefficient (s^2/m^2) (**FwdA3 or RevA3**)

Note
The meter provides a set of factory calibration coefficients for each flow direction.

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

Table 4-1: Factory calibration coefficients

MeterLink™ Display Name	Data Points, Options and Guidelines
Forward A0	Data points affected: • FwdA0 Options: • Enter a value (m/s or ft/s) within the range [-1,1 m/s]. Guidelines: • This value must only be modified under direction of Emerson representative.
Forward A1	Data points affected: • FwdA1 Options: • Enter a value (dimensionless) within the range [0.95,1.05]. Guidelines: • This value should only be modified under direction of Emerson representative.
Forward A2	Data points affected: • FwdA2 Options: • Enter a value (s/m or s/ft) within the range [-0.1,0.1 s/m]. Guidelines: • This value should only be modified under direction of Emerson representative.
Forward A3	Data points affected: • FwdA3 Options: • Enter a value (s^2/m^2 or s^2/ft^2) within the range [-0.1,0.1 s^2/m^2]. Guidelines: • This value should only be modified under direction of Emerson representative.
Reverse A0	Data points affected: • RevA0 Options: • Enter a value (m/s or ft/s) within the range [-1,1 m/s]. Guidelines: • This value should only be modified under direction of Emerson representative.

Table 4-1: Factory calibration coefficients *(continued)*

MeterLink™ Display Name	Data Points, Options and Guidelines
Reverse A1	Data points affected: • RevA1 Options: • Enter a value (dimensionless) within the range [0.95,1.05]. Guidelines: • This value should only be modified under direction of Emerson representative.
Reverse A2	Data points affected: • RevA2 Options: • Enter a value (s/m or s/ft) within the range [-0.1,0.1 s/m]. Guidelines: • This value should only be modified under direction of Emerson representative.
Reverse A3	Data points affected: • RevA3 Options: • Enter a value (s^2/m^2 or s^2/ft^2) within the range [-0.1,0.1 s^2/m^2]. Guidelines: • This value should only be modified under direction of Emerson representative.

4.1.2 Customer calibration method

The Rosemount 3810 Series Liquid Ultrasonic Flow Meter offers forward and reverse meter factors for Customer Calibration. The Customer Calibration method to use is selected via the **CalMethod** data point with None (0) being the default value (i.e., do not apply any meter factor).

Equation 4-2: Customer-Calibrated Average Flow Velocity

$$V_{CustomerCal} = V_{FactoryCal}$$

$V_{CustomerCal}$= Customer-calibrated average flow velocity (m/s) (**AvgFlow**)

$V_{FactoryCal}$ = Factory-calibrated average flow velocity (m/s) (**FactoryCalVel**)

In order for the appropriate meter factor to be applied, the **CalMethod** data point must be set to “Meter Factor” (3). In that case, the meter shall apply the appropriate meter factor as shown in the following equation:

Equation 4-3MeterFactor: Customer-Calibrated Average Flow Velocity (MeterFactor)

$$V_{CustomerCal} = V_{FactoryCal} \times MtrFctr$$

$V_{CustomerCal}$ = Customer-calibrated average flow velocity (m/s) (**AvgFlow**)

$V_{FactoryCal}$ = Factory-calibrated average flow velocity (m/s) (**FactoryCalVel**)

MtrFctr = Meter factor (dimensionless) where **MtrFctr** = **FwdMtrFctr** if **FactoryCalVel** ≥ 0, **RevMtrFctr** otherwise

Select the desired Customer Calibration by configuring the data point listed in the Table 4-2 ; from the MeterLink™ `Calibration - Meter Factors` page.

Table 4-2: Customer Calibration

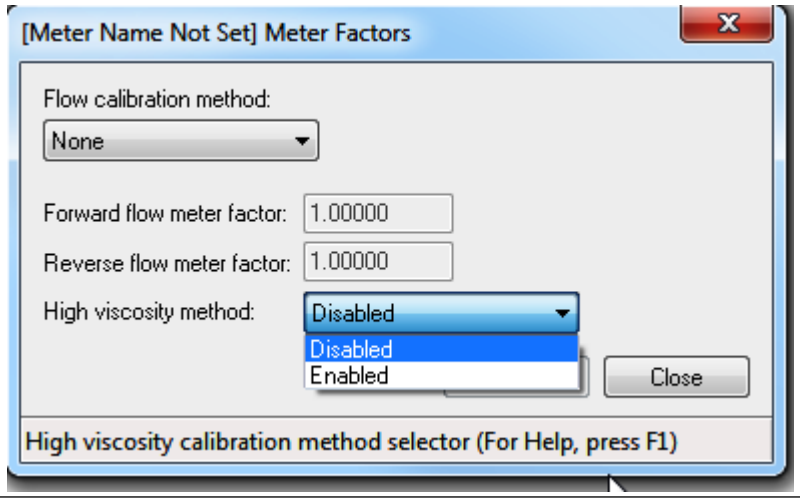
MeterLink Display Name	Data Points, Options and Guidelines
Flow calibration method	Data points affected: CalMethod Options: • None (0) • Meter Factor (3) • High Viscosity Method (Disabled - default) (Enabled) Guidelines: This value should only be modified under direction of Emerson Representative.

Note
Should your high viscosity meter need to be re-calibrated, contact Emerson Customer Support.

4.1.3 High viscosity calibration method

If High Viscosity Method is set to “Enabled”, then the linear flow velocity is a result of applying the zero calibration high viscosity flow offset (**FwdA0HighViscosity** or **RevA0HighViscosity**) and the high viscosity piecewise linearization meter factor (**LinearMtrFctrHighViscosity**) to the average weighted flow velocity (**AvgWtdFlowVel**).

Figure 4-1: Configure High Viscosity Method



High viscosity meter factors

Table 4-3: Piecewise linearization forward high viscosity meter factors

PWL High forward viscosity meter factors	3810 Series datapoint
Piecewise linearization forward high viscosity meter factor 1	FwdMtrFctrHighViscosity1
Piecewise linearization forward high viscosity meter factor 2	FwdMtrFctrHighViscosity2
Piecewise linearization forward high viscosity meter factor 3	FwdMtrFctrHighViscosity3
Piecewise linearization forward high viscosity meter factor 4	FwdMtrFctrHighViscosity4
Piecewise linearization forward high viscosity meter factor 5	FwdMtrFctrHighViscosity5
Piecewise linearization forward high viscosity meter factor 6	FwdMtrFctrHighViscosity6
Piecewise linearization forward high viscosity meter factor 7	FwdMtrFctrHighViscosity7
Piecewise linearization forward high viscosity meter factor 8	FwdMtrFctrHighViscosity8
Piecewise linearization forward high viscosity meter factor 9	FwdMtrFctrHighViscosity9
Piecewise linearization forward high viscosity meter factor 10	FwdMtrFctrHighViscosity10
Piecewise linearization forward high viscosity meter factor 11	FwdMtrFctrHighViscosity11
Piecewise linearization forward high viscosity meter factor 12	FwdMtrFctrHighViscosity12

Table 4-4: Piecewise linearization reverse high viscosity meter factors

PWL reverse High viscosity meter factors	3810 Series datapoint
Piecewise linearization reverse high viscosity meter factor 1	RevMtrFctrHighViscosity1
Piecewise linearization reverse high viscosity meter factor 2	RevMtrFctrHighViscosity2
Piecewise linearization reverse high viscosity meter factor 3	RevMtrFctrHighViscosity3
Piecewise linearization reverse high viscosity meter factor 4	RevMtrFctrHighViscosity4
Piecewise linearization reverse high viscosity meter factor 5	RevMtrFctrHighViscosity5
Piecewise linearization reverse high viscosity meter factor 6	RevMtrFctrHighViscosity6
Piecewise linearization reverse high viscosity meter factor 7	RevMtrFctrHighViscosity7

Table 4-4: Piecewise linearization reverse high viscosity meter factors *(continued)*

PWL reverse High viscosity meter factors	3810 Series datapoint
Piecewise linearization reverse high viscosity meter factor 8	RevMtrFctrHighViscosity8
Piecewise linearization reverse high viscosity meter factor 9	RevMtrFctrHighViscosity9
Piecewise linearization reverse high viscosity meter factor 10	RevMtrFctrHighViscosity10
Piecewise linearization reverse high viscosity meter factor 11	RevMtrFctrHighViscosity11
Piecewise linearization reverse high viscosity meter factor 12	RevMtrFctrHighViscosity12

Table 4-5: Zero calibration high viscosity offset parameters

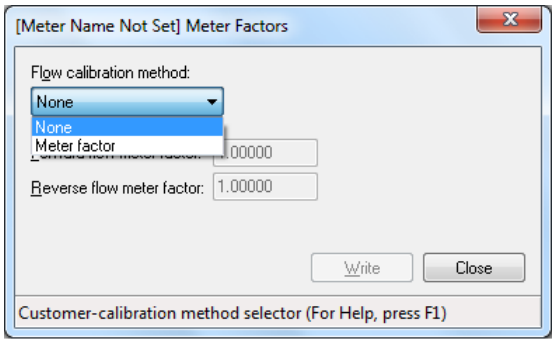
Zero calibration parameter	3810 Series datapoint
Zero calibration high viscosity forward flow offset	FwdA0HighViscosity
Zero calibration high viscosity reverse flow offset	RevA0HighViscosity

4.1.4 Calibrate the meter factors

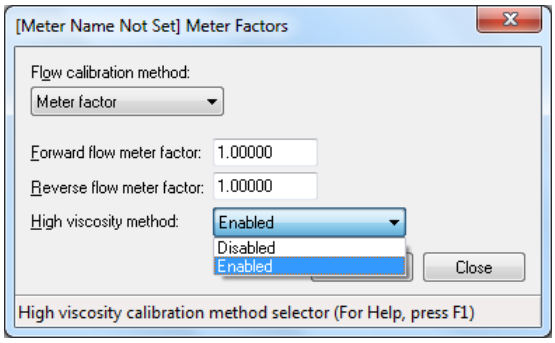
Calibrate Meter factor parameters

Procedure

1. Use the **Calibration** → **Meter Factors** menu and select **Flow Calibration Method** → **Meter Factor** from the dropdown menu.
2. Enter the appropriate forward and reverse meter factors and click `Write` to send the factors to the meter.



3. For High Viscosity applications, use the **Calibration** → **Meter Factors** menu and select **Flow Calibration Method** → **Meter Factor** from the dropdown menu.
   - Select High Viscosity Method `Enabled` from the dropdown menu. See High viscosity calibration method for additional configuration parameters.



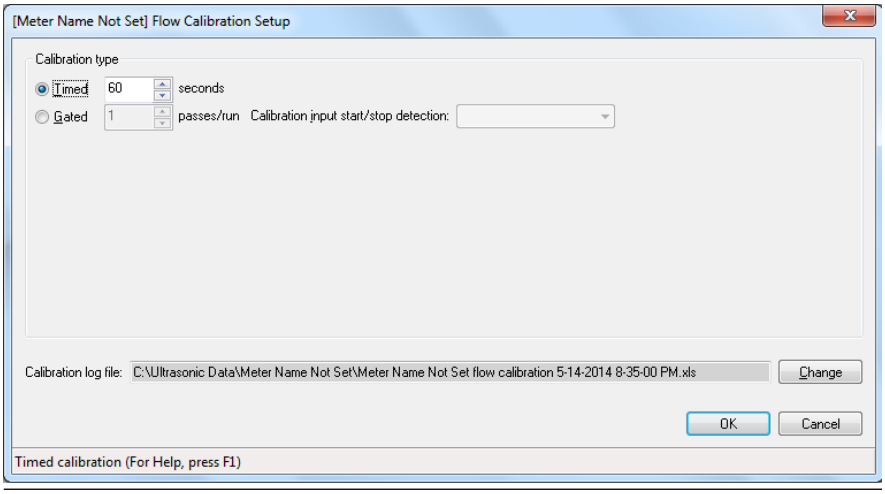
4. Click **Close** to exit the dialog box. If you made changes, click the **Write** button to apply the changes.
5. After the meter is configured, set the **WRITE PROT.** switch on the CPU Module to the ON position to write-protect the meter's configuration.

4.1.5 Configure the flow calibration parameters

Procedure

1. Use the **Calibration** → **Flow Calibration** menu and select **Flow Calibration Type** (timed or gated). 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.
   a) Click **Timed** calibration for the meter to record the volume through the meter over a user specified period of time for a calibration run. Use the spin buttons or type in the number of passes of a prover to make a run.

Figure 4-2: Timed Flow Calibration Setup dialog



   b) Click **Change** to change the folder location where the Calibration Log file is saved.

2. Click **Gated** and use the spin buttons or type in the number of passes of a for prover to make a 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.
3. Select the Calibration input start/stop detection from one of the following options:

Figure 4-3: Edge gated, active high:

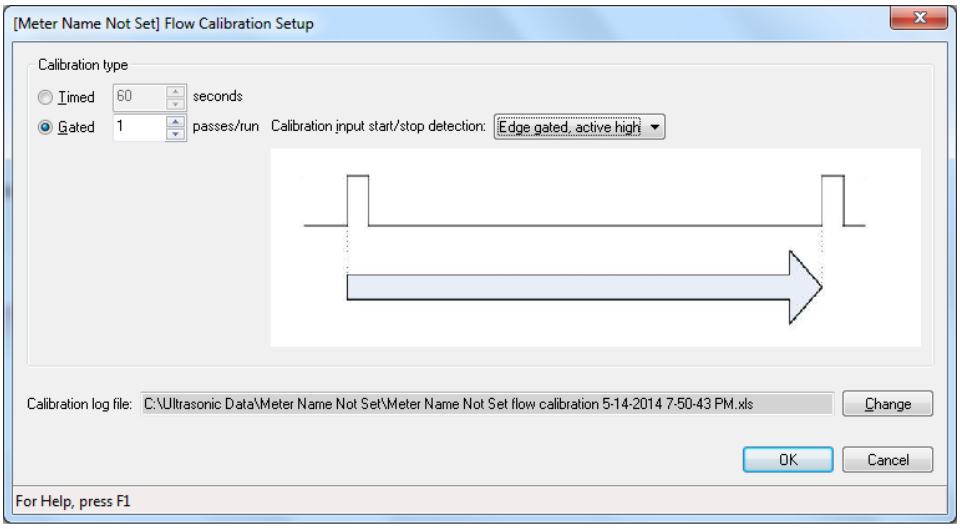


Figure 4-4: Edge gated, active low:

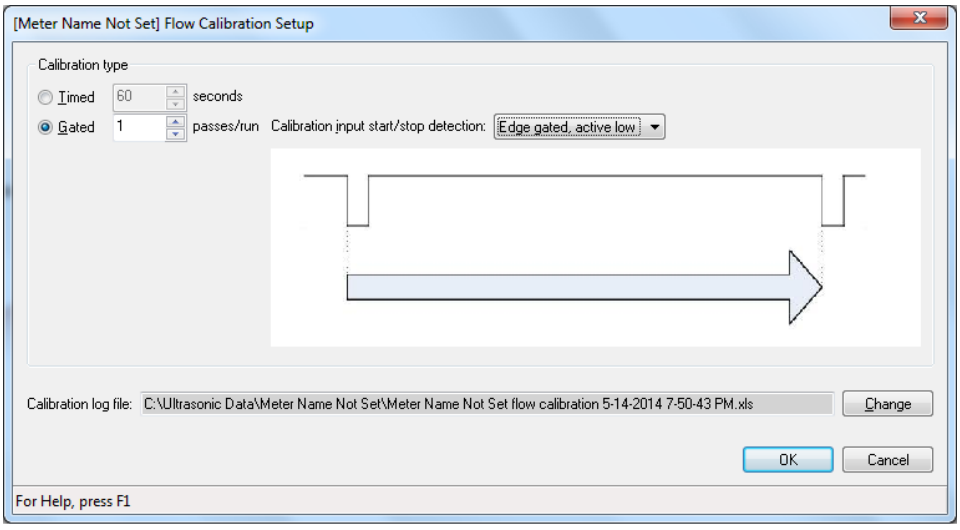


Figure 4-5: State gated, active high:

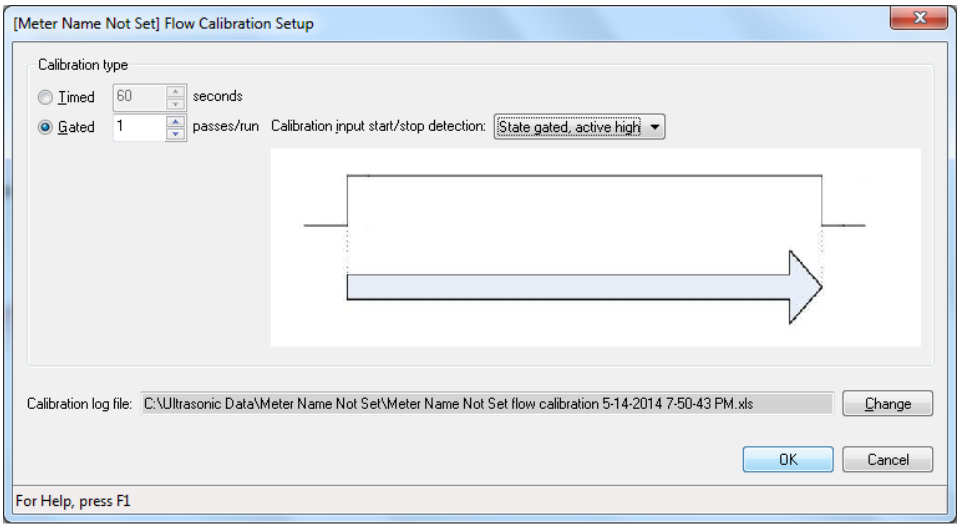
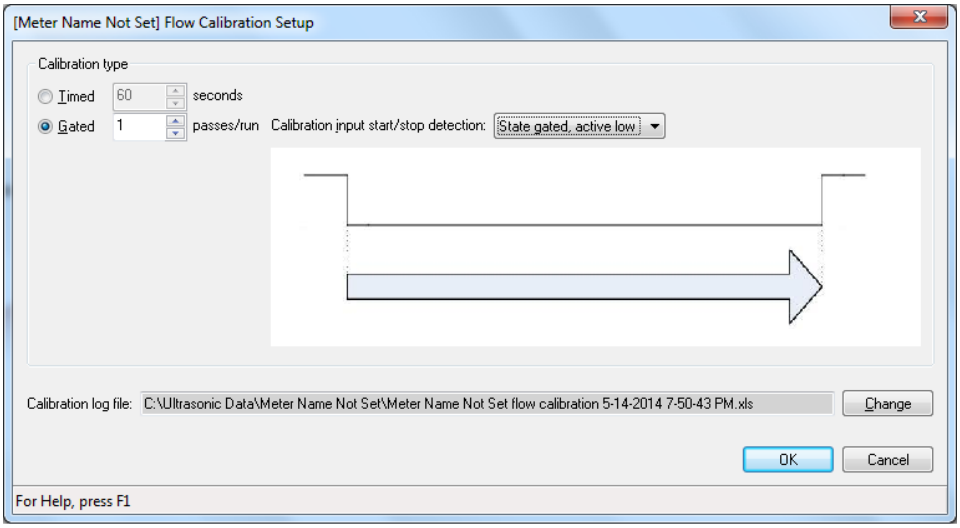


Figure 4-6: State gated, active low:



4. Click OK to apply the selected parameters.
   A Microsoft Excel® file is generated and the calibration log report can be saved or appended to an existing file.
5. Click **Cancel** to close the dialog box without making changes. If you made changes, click the **Write** to apply the changes.
6. After the flow calibration parameters are configured, set the WRITE PROT. switch on the CPU Module to the ON position to write-protect the configuration.

4.1.6 Zero calibration

Calibration menu

The Zero Calibration dialog allows you to zero a Rosemount Liquid Ultrasonic meter that is in a no flow condition.

When the dialog is displayed, MeterLink™ will start reading and charting the flow velocity measured by the meter. The status LEDs will also be updated to report any warnings or alarms.

Zero flow calibration

Prerequisites

Before Performing a Calibration:

- If this is a first time start up of a meter, run enough flow through the meter to remove any trapped air from the meter and from the face of the transducers before blocking in the meter.
- Ensure the entire volume of the meter is full of the process fluid.
- Allow enough time after blocking in the meter before starting the calibration to ensure there is no flow through the meter.
- The meter velocity reported by MeterLink™ should be stable and very close to zero flow.

Calibration options

Before starting the zero calibration, you can adjust Zero time which is the length of time the MeterLink collects data from the meter for the calibration. Lowering this value can increase the chance of passing the calibration but may produce a lower quality calibration. Increasing this value may decrease the chance of passing the calibration but may improve the quality of the calibration. Four minutes is the recommended amount of time to perform a zero calibration. The time can be adjusted from 2 minutes to 10 minutes.

Select Generate report after writing zero calibration to meter if you want an Excel® report of the “As Found” and “As Left” calibration parameters. The meter's extended configuration data points are included in the report. All the data collected during the calibration will also be saved to the meter. This option is only available if Microsoft® Excel® is installed on the computer running MeterLink. If you do not select this option or it is not available, the calibration parameter changes are still recorded in the meter's Archive Audit log.

The extended configuration includes some read-only data points that help describe the meter's configuration. Read-only data points are displayed with a gray background for reference only and cannot be changed. The extended configuration data points are viewable in the Maintenance Logs Report, Archive Logs Report, Flow Calibration, Zero Calibration dialogs and the Edit/Compare Configuration tool.

Performing a calibration

Procedure

1. Use the **Calibration** → **Zero Calibration** menu.
2. Start the calibration by clicking **Start Zero**. The calibration will start and run for the period of time set in Zero time.
   The average flow velocity is the value used to adjust the **FwdA0** and **RevA0** coefficients in the meter so they remove the offset flow under no flow conditions.
3. The Estimated maximum deviation is also calculated to help verify the meter is in no flow and is used to set pass/fail criteria for the calibration.
   An error will be generated if the Estimated maximum deviation is greater than 0.002 ft/sec or 0.0006 m/sec.

4. Once the calibration completes and no errors were encountered, click **Write to Meter** to send the changes to the meter.
   If errors were reported after the calibration, the calibration cannot be written to the meter.
5. If you selected to generate a report, MeterLink displays a dialog asking you if you want to display the report once created.
6. Click **Stop Zero**, at any time during a calibration, to abort the calibration.
7. Click **Discard** once a calibration completes with no errors, to cancel the calibration and setup the dialog to perform a new calibration.
8. Click **Close** to close the Zero Calibration dialog.

4.1.7 Triggered Delta Volumes

The "triggered delta volume" feature provides the ability to measure total liquid flow volume 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** and **TrigDeltaNegVolFlow**) 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 volume 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 95 (**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 1482 (**DoUpdtTrigDeltaVols**) to 1 (`TRUE`).
- Read trigger Modbus register 1482 (**DoUpdtTrigDeltaVols**) in a loop until it is read as 0 (`FALSE`) indicating that the delta volumes have been updated.
- Read trigger Modbus register 1482 (**DoUpdtTrigDeltaVols**) in a loop until it is read as 0 (`FALSE`) indicating that the delta volumes have been updated.
- Read trigger Modbus register 1482 (**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 4-4: Triggered delta volume

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

where

DeltaVolume = Triggered delta volume (forward or reverse, flow-condition or base-condition) (m^3 or ft^3) (**TrigDeltaPosVolFlow**, **TrigDeltaNegVolFlow**, **TrigDeltaPosVolBase**, **TrigDeltaNegVolBase**)

Overflow = Triggered delta volume overflow integer value (forward or reverse, flow-condition or base-condition) ($1e^9m^3$ or $1e^9ft.^3$)

Lower = Triggered delta volume lower integer value (forward or reverse, flow-condition or base-condition) (m^3 or $ft.^3$)

Repeat **"PERIODIC LOOP"**.

4.2 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 of 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.

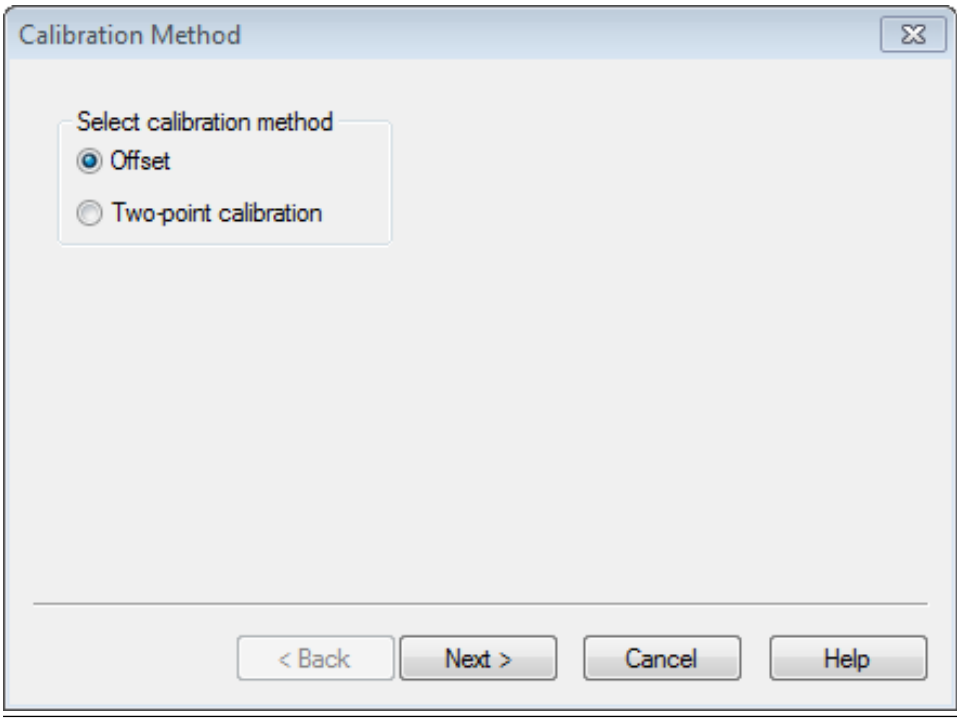
Procedure

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 4-7: 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 will display asking to change the configuration to use the live input.
6. Enable the **WRITE PROT.** switch on the CPU Module to write-protect the configuration.

Table 4-6: Calibrate analog inputs and outputs

MeterLink™ Display name	Data Points, options and guidelines
Current output Output setting	Data points affected: • **AO1TestModeOutputPercent** Options: • 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). Guidelines • The specified test value takes effect within one batch period of clicking the **Start** button.
Current output Start (Stop) AO1	Data points affected: • **IsAO1EnableTest** Options: • Click on the **StartAO1** button to enter the test mode (TRUE). **Note** The **Start** button will become the **Stop** button after clicking on it. • Click on the **StopAO1** button to exit the test mode (FALSE). **Note** The **Stop** button will become the **Start** button after clicking on it. Guidelines • The specified test value takes effect within one batch period of clicking the **Start** button.
Current output Output setting	Data points affected: • **AO2TestModeOutputPercent** Options: • 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). Guidelines • The specified test value takes effect within one batch period of clicking the **Start** button. **Note** The **AO2** is only available with CPU module, part number 1-360-03-010.

Table 4-6: Calibrate analog inputs and outputs *(continued)*

MeterLink™ Display name	Data Points, options and guidelines
	Data points affected: • **IsAO2EnableTest** Options: • Click on the **StartAO2** button to enter the test mode (TRUE). **Note** The **Start** button will become the **Stop** button after clicking on it. • Click on the **StopAO2** button to exit the test mode (FALSE). **Note** The **Stop** button will become the **Start** button after clicking on it. Guidelines • The specified test value takes effect within one batch period of clicking the **Start** button.

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.

4.3 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, Profile Factor)
- Frequency output 1B is the B Phase of Frequency output 1
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate, Profile Factor)
- 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)

- Digital output 1B is based on Digital output1B content (Frequency Output 1 Validity, Flow Direction)
- Digital output 2A is based on Digital output 2A content (Frequency Output 2 Validity, Flow Direction)
- Digital output 2B is based on Digital output 2B content (Frequency Output 2 Validity, Flow Direction)

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, Profile Factor)
- 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, Profile Factor)
- 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)
- Digital output 1B is based on Digital output1B content (Frequency Output 1 Validity, Flow Direction)
- Digital output 2A is based on Digital output 2A content (Frequency Output 2 Validity, Flow Direction)
- Digital output 2B is based on Digital output 2B content (Frequency Output 2 Validity, Flow Direction)

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:

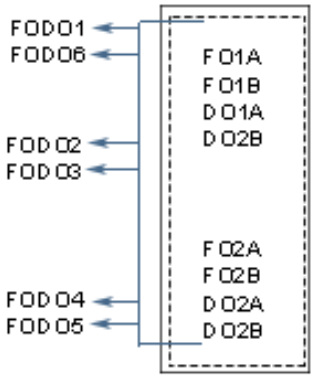
- Lag forward, Lead reverse (Phase B lags Phase A while reporting forward flow, leads Phase A while reporting reverse flow)
- Lead forward, Lag reverse (Phase B leads Phase A while reporting forward flow, lags Phase A while reporting reverse flow)

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.

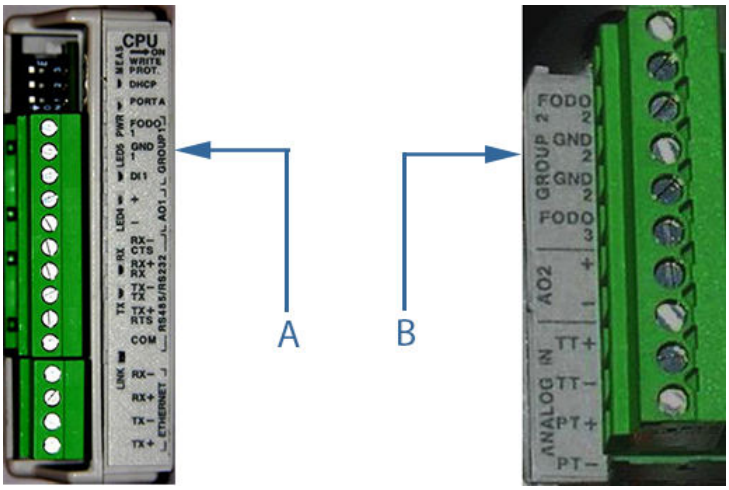
Maximum frequency for the frequency outputs

- 1000 Hz
- 5000 Hz

Frequency/Digital output		Source configuration
Frequency/Digital Output 1 Frequency/Digital Output 2 Frequency/Digital Output 3 Frequency/Digital Output 4 Frequency/Digital Output 5 Frequency/Digital Output 6	• Frequency output 1A • Frequency output 1B • Digital output 1A • Digital output 1B • Frequency output 2A • Frequency output 2B • Digital output 2A • Digital output 2B	

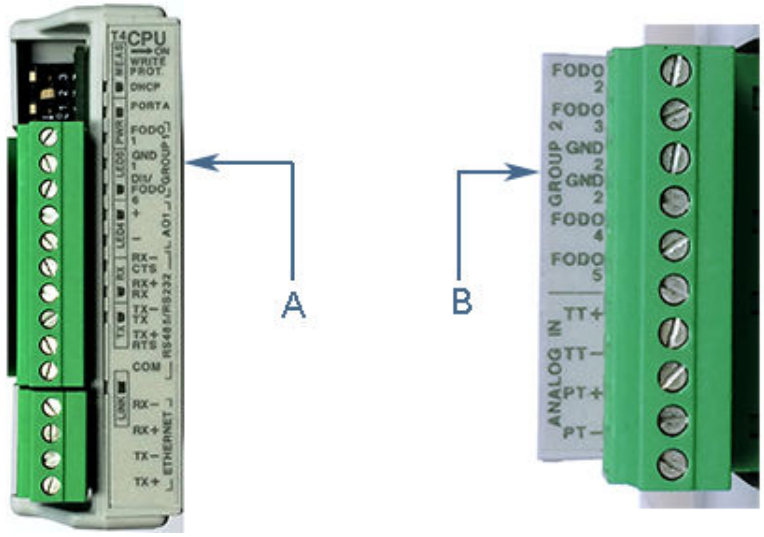
Output for FODO1 and Digital Input 1 (Group 1 on the CPU Module) share a common ground and have 50 V isolation. FODO2 and FODO3 (Group 2 on the CPU Module) share a common ground and have 50 V isolation. This allows an output to be connected to a different flow computer. The outputs are opto-isolated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

Figure 4-8: 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 4-9: 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)

4.4 Configure digital input/outputs

Digital input

The Rosemount 3810 Liquid Ultrasonic Flow Meters provides one digital input (referred to as DI1). The polarity of the input is configured via the **DI1IsInvPolarity** data point as follows:

- 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 configuration function for the digital output. 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.

4.5 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.
- Rosemount™ Liquid Ultrasonic meters will also allow you to set the outputs for Profile Factor.

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).

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. 0 Hz) 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.

4.6 Outputs test mode

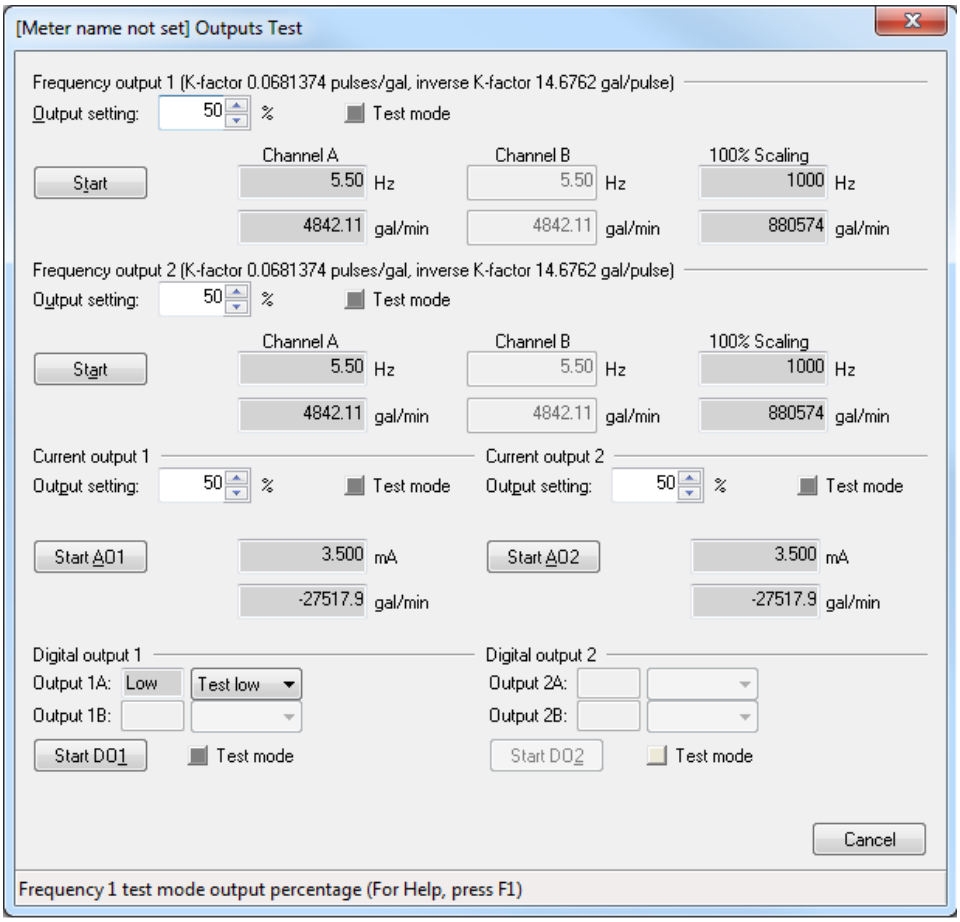
The Rosemount 3810 Liquid Ultrasonic Flow Meters provides a mode of operation for testing the frequency, current (analog) and digital output signals. Entering, configuring, and exiting this mode is accomplished by setting data points using the **MeterLink Tools → Outputs Test**.

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.

Procedure

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

Figure 4-10: Meter Outputs Test Page



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

2. 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 3810 Liquid 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.

   For Rosemount 3810 Liquid 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.

3. 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.

Note
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.

Note
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.

Once the Test mode LED turns green, the output values displayed represent the values the outputs are driving under test.

4. 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.

Note
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.

Note
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.

Once the Test mode LED turns green, the value displayed for the outputs will represent the values the outputs are driving under test.

5. 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.
6. 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.

4.7 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) .

4.7.1 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, Average flow velocity, Average speed of sound, Pressure and Temperature
- ***Fourth -*** select from the following variables: Uncorrected flow rate, Average flow velocity, Average speed of sound, Pressure and Temperature

4.7.2 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.

4.7.3 Configure the HART® units

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

- Volume units
- Average speed of sound
- Flow rate time units
- Velocity
- Pressure
- Temperature

4.8 Configure meter corrections

4.8.1 Temperature expansion correction

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

4.8.2 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).

4.9 Configure temperature and pressure

4.9.1 Flow-condition temperature and pressure

The flow-condition pressure and temperature are used by the Rosemount 3810 Series Liquid Ultrasonic Flow Meter for various calculations such as:

- Expansion correction

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)

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).

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 one of the following:

- Last good value (0)
- 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 3810 Series Liquid 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).

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 the following table:

Table 4-7: 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 **LiveFlowTemperature)**
	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 unchanged
		Fixed	Fixed data point **(SpecFlowPressure** or **SpecFlowTemperature)**

(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 below:

Equation 4-5: Flow-condition absolute flow pressure

$$P_{abs,f} = P_f + P_{Atmosphere} InputPressureUnit = False(Gage)$$
$$P_{abs,f} = P_f InputPressureUnit = True(Absolute)$$

where

***Pabs,f*=** flow-condition absolute pressure (MPaa) (**AbsFlowPressure**)

***Pf*=** flow-condition pressure (MPag if **InputPressureUnit**=FALSE, MPaa if **InputPressureUnit**=TRUE) (**FlowPressure**)

$P_{Atmosphere}$= (specified) atmospheric pressure (MPaa) (**AtmosphericPress**)

4.9.2 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 4 mA). 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.

4.9.3 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 4 mA). 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.

4.10 Configure reverse flow alarm

Reverse flow alarm

Selecting Enable will configure the meter to generate a reverse flow alarm if it accumulates more volume in the reverse direction than what is set in the Volume limit.

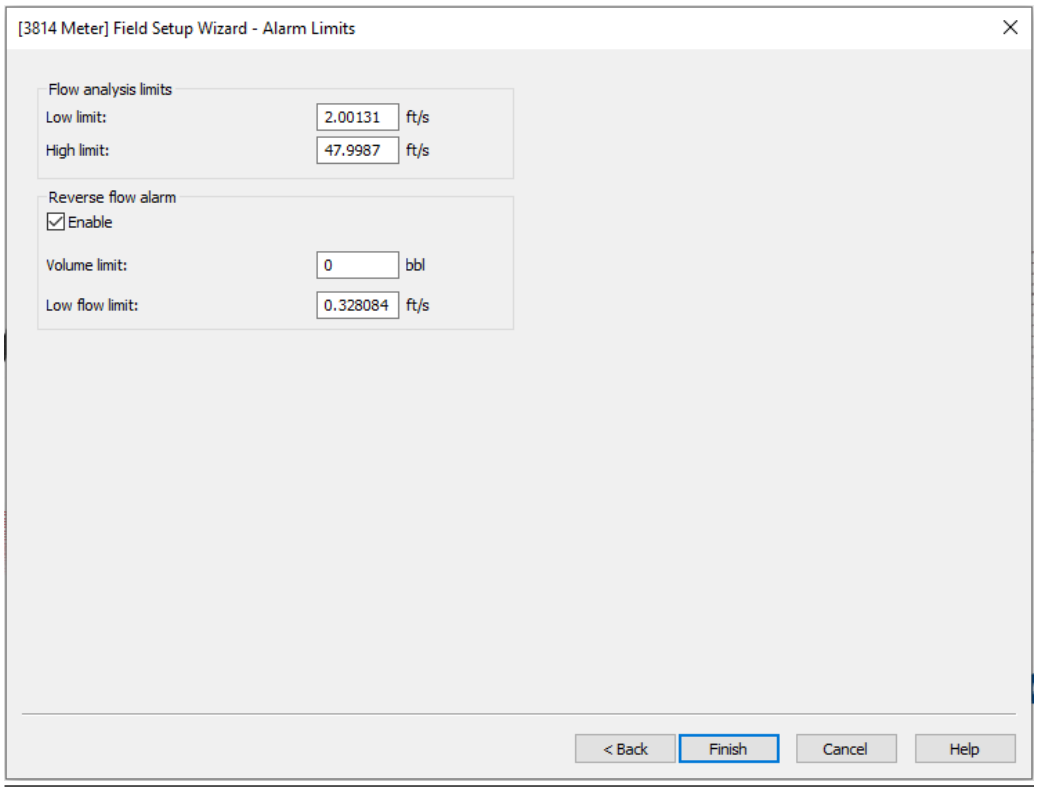
For flow to be counted as reverse flow for this check, it must be flowing at a velocity about Low flow limit. This low flow limit is different from the Volume cut-off threshold below which flow in not counted as flow for volume accumulation. Every time the flow direction changes from forward to reverse, the reverse flow accumulated volume is reset to zero.

If the meter is a bi-directional meter, this alarm should not be enabled in order to avoid this alarm becoming active during periods of expected reverse flow.

Alarm limits are specified by the reverse flow volume limit (**ReverseFlowVolLmt** data point) and by the reverse flow detection zero flow cutoff (**ReverseFlowDetectionZeroCut** data point).

View alarm limits must be selected on the Field Setup Wizard - Startup page to configure this alarm.

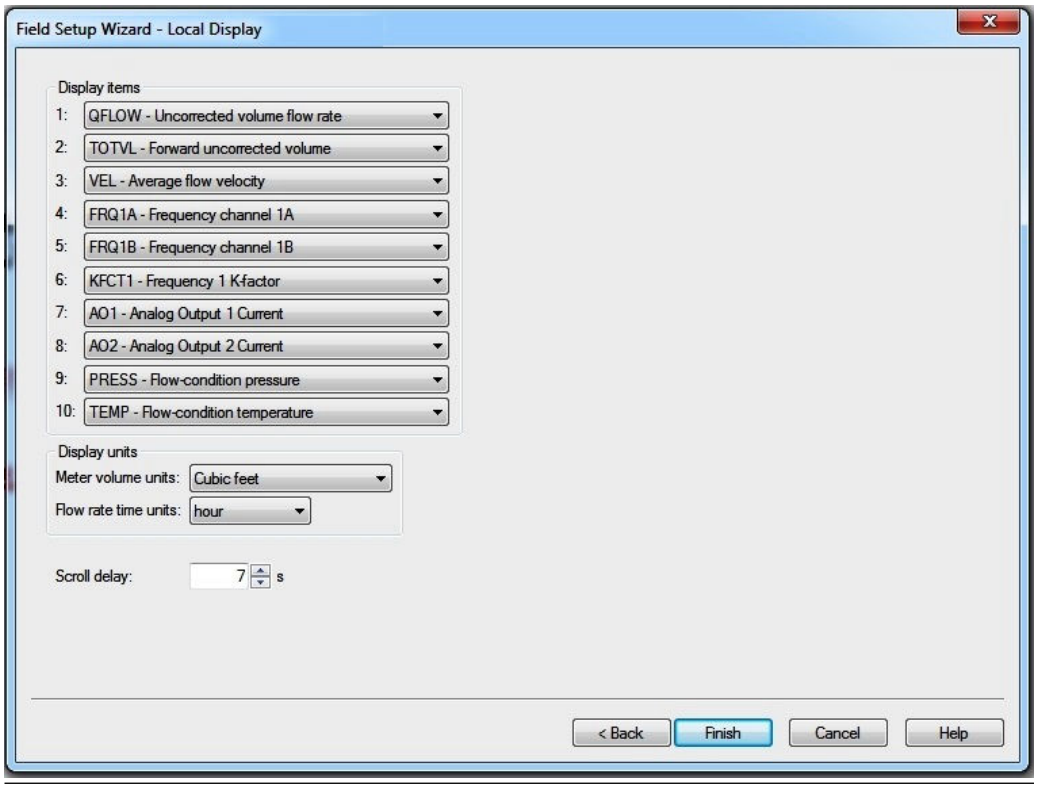
Figure 4-11: Reverse flow alarm



4.11 Configure local display parameters

Configure the parameters for the local display. Use the Field Setup Wizard dropdown menu in the Display Items list box and select or modify the Display items, the Display units and the Scroll delay.

Figure 4-12: Local display parameters



Configure display items

Local Display label description	Valid units
QFLOW - Uncorrected volume flow rate	• BBL - Barrels • GAL - Gallons • L - Liters • CM - Cubic Meters • MCM - Thousand Cubic Meters • GAL - Gallons • CM - Cubic Meters
TDYVL - Current day's forward uncorrected volume	• +BBL - Barrels • +GAL - Gallons • +L - Liters • +CM - Cubic Meters • +MCM - Thousand Cubic Meters

Local Display label description	Valid units
TDYVL - Current day's reverse uncorrected volume	• -BBL - Barrels • -GAL - Gallons • -L - Liters • -CM - Cubic Meters • -MCM - Thousand Cubic Meters
YSTVL - Previous day's forward uncorrected volume	• +BBL - Barrels • +GAL - Gallons • +L - Liters • +CM - Cubic Meters • +MCM - Thousand Cubic Meters
YSTVL - Previous day's reverse uncorrected volume	• -BBL - Barrels • -GAL - Gallons • -L - Liters • -CM - Cubic Meters • -MCM - Thousand Cubic Meters
TOTVL - Forward uncorrected volume	• +BBL - Barrels • +GAL - Gallons • +L - Liters • +CM - Cubic Meters • +MCM - Thousand Cubic Meters
TOTVL - Reverse uncorrected volume	• -BBL - Barrels • -GAL - Gallons • -L - Liters • -CM - Cubic Meters • -MCM - Thousand 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

Local Display label description	Valid units
KFCT1 - Frequency 1 K-factor	• BBL - Barrels • GAL - Gallons • L - Liters • CM - Cubic Meters • MCM - Thousand Cubic Meters
FRQ2A - Frequency channel 2A	• HZ - Hertz
FRQ2A - Frequency channel 2B	• HZ - Hertz
KFCT2 - Frequency 2 K-factor	• BBL - Barrels • GAL - Gallons • L - Liters • CM - Cubic Meters • MCM - Thousand Cubic Meters
AO1 - Analog Output 1 current	• MA - Milliamperes
AO2 - Analog Output 2 current	• MA - Milliamperes

Note
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 display.

Configure display units

The Meter volume units displayed are either U.S. Customary or Metric. To modify the Display Units, configure the Meter units system in the Field Setup Wizard – General Page.

- U.S. Customary volume unit selections are:
  - Barrels
  - Gallons
- Metric volume unit selections are:
  - Cubic meters
  - Cubic liters
- Display units preceded by a plus or minus sign indicate forward and reverse flow direction, as shown in the table below.
- The Local Display Flow rate time units are modifiable by selecting the dropdown menu and clicking the time unit in the list box.
- Valid flow rate time units selections are:
  - second
  - minute
  - hour
  - day

Configure scroll delay

The Scroll Delay is the time interval for the selected display items to be shown on the Local Display. The default scroll delay setting is five seconds. Click the spin box up or down arrow to increase or decrease the length of time an item displays.

1. Select Finish to write the configuration settings to the meter.
2. Save the meter configuration file, collect a Maintenance log and Waveforms to document the “As Left” settings.

4.12 Configure users

Rosemount 3810 Series Firmware v1.60 and later require user authentication to connect to the meter with MeterLink™.

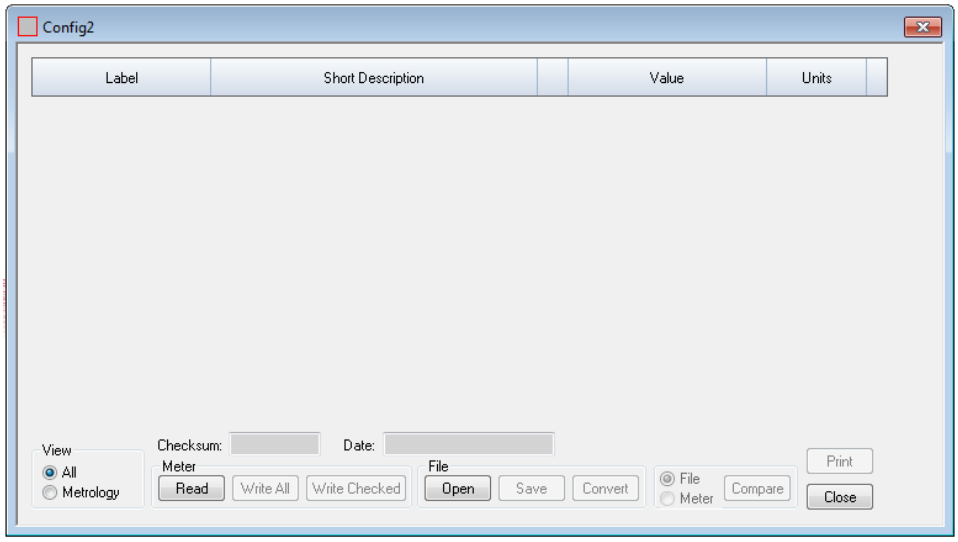
Meters ship from the factory with a single default user named administrator. The default password is Administrator-XXXXX where XXXXX is the non-zero padded CPU serial number which can be found on a label on the CPU Module. It is highly recommended to change this password on meter startup for cybersecurity 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 user.

4.13 Save the configuration

Procedure

1. Use the MeterLink™ **Tools** → **Edit/Compare Configuration** menu.
2. Enable the **View** All radio button to display the Extended configuration.
   This includes some read-only data points that help describe the meters configuration. Read-only datapoints are displayed for reference only and cannot be changed. They are displayed with a gray background for reference only and cannot be changed. The extended configuration data points are viewable in the Maintenance Logs Report, Archive Log Report, Flow Calibration, Zero Calibration dialogs and the Edit/Compare Configuration tool.
3. Enable the **View** Metrology radio button to display only the metrology portion of the configuration.
   The Metrology View includes the following parameters:
   - Path dimensions
   - Pipe diameter
   - Transducer delay parameters
   - Zero flow calibration coefficients
   - Flow calibration coefficients
4. Click the **Read** button to display the meter's configuration parameters.

Figure 4-13: Edit/Compare Configuration



5. Click **Save** to open the Save As dialog box.
   A default name is provided based on the meter name, time, and date the configuration was collected. By default, all files are saved in the Data folder directory defined under Program Settings. You may change the name and directory location if desired. The entire configuration is saved to file.

5 Logs/Reports

5.1 Archive logs

The Rosemount™ 3810 Series Liquid Ultrasonic Flow Meters provides five types of data logs:

- Daily log
- Hourly log
- Audit log
- Alarm log
- System log

From Rosemount 3810 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 (For more information, refer to Options for reading daily and/or hourly log records).

5.1.1 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™ 3810 Series Liquid 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** → **Liquid 3810 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 5-1: Daily log data points

Data point	Content	Log action
PosVolFlow		TOTALIZE and SNAPSHOT
NegVolFlow		TOTALIZE and SNAPSHOT
AccumFlowTime		TOTALIZE
DailyMacro1		MACRO
bit 0	IsQFlowInvalid	
bit 1	Unused	
bit 2	Unused	
bit 3	Unused	
bit 4	IsEstimatedFlowVelocityInUse	
bit 5	IsTooFewOperChords	
bit 6	Unused	
bit 7	Unused	
bit 8	Unused	
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	

Table 5-1: Daily log data points *(continued)*

Data point	Content	Log action
bit 18	Unused	
bit 19	Unused	
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	D11	
bit 30	IsWarmStartReq	
bit 31	IsClkInvalid	
DailyMacro2		MACRO
bit 0	Unused	
bit 1	Unused	
bit 2	Unused	
bit 3	Unused	
bit 4	Unused	
bit 5	IsReverseFlowDetected	
bit 6	Unused	
bit 7	Unused	
bit 8	Unused	
bit 9	Unused	
bit 10	Unused	
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	

Table 5-1: Daily log data points *(continued)*

Data point	Content	Log action
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		MACRO
bits 0 - 3	DidDltTmChkFail<A..D>	
bits 4 -7	Unused	
bits 8 - 11	IsSigQltyBad<A..D>	
bits 12 - 15	Unused	
bits 16 - 19	DidExceedMaxNoise<A..D>	
bits 20 - 23	Unused	
bits 24 - 27	IsSNRTooLow<A..D>	
bits 28 - 31	Unused	
DailyMacro5		MACRO
bits 0 - 3	DidDltTmChkFail<A..D>	
bits 4 -7	Unused	
bits 8 - 11	IsSigDistorted<A..D>	
bits 12 - 15	Unused	
bits 16 - 19	IsPeakSwitchDetected<A..D>	
bits 20 - 23	Unused	

Table 5-1: Daily log data points *(continued)*

Data point	Content	Log action
bits 24 - 27	IsSigClipped<A..D>	
bits 28 - 31	Unused	
DailyMacro6		MACRO
bits 0 - 3	IsMeasSndSpdRange<A..D>	
bits 4 -7	Unused	
bits 8 - 11	IsStackingIncomplete<A..D>	
bits 12 - 31	Unused	
ProfileFactor		FLOW_GATED
SwirlAngle		FLOW_GATED
Symmetry		FLOW_GATED
CrossFlow		FLOW_GATED
Turbulence<A..D>		FLOW_GATED
SndVel<A..D>		FLOW_GATED
SpdSndSpread		AVERAGE
AvgSndVel		FLOW_GATED
SndVelDiff<A..D>		FLOW_GATED
AGA10SndVel		FLOW_GATED
ColocMeterTH2VsTH1AvgSndVelPctDiff		FLOW_GATED
FlowVel<A..D>		FLOW_GATED
AvgFlow		FLOW_GATED
FlowVelRatio<A..D>		AVERAGE
PctGood<A1..D2>		AVERAGE
Gain<A1..D2>		AVERAGE
SNR<A1..D2>		AVERAGE
NoiseAmplitude<A1..D2>		AVERAGE
QFlow		FLOW_GATED
ColocMeterTH2VsTH1QFlowPctDiff		FLOW_GATED
FlowTemperature		FLOW_GATED
ExpCorrTemperature		FLOW_GATED
FlowPressure		FLOW_GATED
ExpCorrPressure		FLOW_GATED
AbsFlowPressure		FLOW_GATED
Viscosity		FLOW_GATED
CnfgChksumValue		SNAPSHOT
CnfgChksumDate		SNAPSHOT

Hourly log

The Rosemount™ 3810 Series Liquid Ultrasonic Flow 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 (see the help topic for any data point in MeterLink. Click **Help → Liquid 3810 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 5-2: Hourly log data points

Data point	Content	Log action
PosVolFlow		TOTALIZE and SNAPSHOT
NegVolFlow		TOTALIZE and SNAPSHOT
AccumFlowTime		TOTALIZE
HourlyMacro1		MACRO
bit 0	IsQFlowInvalid	
bit 1	Unused	
bit 2	Unused	
bit 3	Unused	
bit 4	IsEstimatedFlowVelocityInUse	
bit 5	IsTooFewOperChords	
bit 6	Unused	
bit 7	Unused	
bit 8	Unused	
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	Unused	
bit 19	Unused	

Table 5-2: Hourly log data points *(continued)*

Data point	Content	Log action
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	D11	
bit 30	IsWarmStartReq	
bit 31	lsClkInvalid	
HourlyMacro2		MACRO
bit 0	Unused	
bit 1	Unused	
bit 2	Unused	
bit 3	Unused	
bit 4	Unused	
bit 5	IsReverseFlowDetected	
bit 6	Unused	
bit 7	Unused	
bit 8	Unused	
bit 9	Unused	
bit 10	Unused	
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	

Table 5-2: Hourly log data points *(continued)*

Data point	Content	Log action
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	
DailyMacro4		MACRO
bits 0 - 3	DidDltTmChkFail<A..D>	
bits 4 -7	Unused	
bits 8 - 11	IsSigQltyBad<A..D>	
bits 12 - 15	Unused	
bits 16 - 19	DidExceedMaxNoise<A..D>	
bits 20 - 23	Unused	
bits 24 - 27	IsSNRTooLow<A..D>	
bits 28 - 31	Unused	
HourlyMacro5		MACRO
bits 0 - 3	DidDltTmChkFail<A..D>	
bits 4 -7	Unused	
bits 8 - 11	IsSigDistorted<A..D>	
bits 12 - 15	Unused	
bits 16 - 19	IsPeakSwitchDetected<A..D>	
bits 20 - 23	Unused	
bits 24 - 27	IsSigClipped<A..D>	
bits 28 - 31	Unused	

Table 5-2: Hourly log data points *(continued)*

Data point	Content	Log action
HourlyMacro6		MACRO
bits 0 - 3	IsMeasSndSpdRange<A..D>	
bits 4 -7	Unused	
bits 8 - 11	IsStackingIncomplete<A..D>	
bits 12 - 31	Unused	
ProfileFactor		FLOW_GATED
SwirlAngle		FLOW_GATED
Symmetry		FLOW_GATED
CrossFlow		FLOW_GATED
Turbulence<A..D>		FLOW_GATED
SndVel<A..D>		FLOW_GATED
SpdSndSpread		AVERAGE
AvgSndVel		FLOW_GATED
SndVelDiff<A..D>		FLOW_GATED
ColocMeterTH2VsTH1AvgSndVelPctDiff		FLOW_GATED
FlowVel<A..D>		FLOW_GATED
AvgFlow		FLOW_GATED
FlowVelRatio<A..D>		AVERAGE
PctGood<A1..D2>		AVERAGE
Gain<A1..D2>		AVERAGE
SNR<A1..D2>		AVERAGE
NoiseAmplitude<A1..D2>		AVERAGE
QFlow		FLOW_GATED
ColocMeterTH2VsTH1QFlowPctDiff		FLOW_GATED
FlowTemperature		FLOW_GATED
ExpCorrTemperature		FLOW_GATED
FlowPressure		FLOW_GATED
ExpCorrPressure		FLOW_GATED
AbsFlowPressure		FLOW_GATED
Viscosity		FLOW_GATED
CnfgChksumValue		SNAPSHOT
CnfgChksumDate		SNAPSHOT

Audit log

The Rosemount 3810 Liquid 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 through 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. The points are grouped and, within each group, are listed alphabetically.

The groupings are as follows:

- Calibration
- Chord Proportions
- Co-located meter
- Communications
- Data Logging
- Expansion Correction
- Flow analysis
- Frequency, Digital, and Analog Signals
- General
- HART®
- 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 5-3: Audit log calibration group monitored data points

Data group	Data point
	AvgDly<A..D> CalFlag CalMethod DltDly<A..D> Fwd<A0..A3> FwdA0HighViscosity FwdFlwRt<1..12> FwdMtrFactr FwdMtrFactr<1..12> FwdMtrFctrHighViscosity<1..12> FwdProfileFactor<1..12> HighViscosityMethod L<A..D> MeterHousingLength<A..D> PipeDiam Rev<A0..A3> RevA0HighViscosity RevFlwRt<1..12> RevMtrFctr<1..12> RevMtrFctr RevMtrFctrHighViscosity<1..12> RevProfileFactor<1..12> SystemDelay Wt<A..D> X<A..D> XdcrHousingLength<A..D> XdcrHousingSerialNumber<A..D> ZeroFlowCalReqControl ZeroFlowCalReqDuration

Table 5-4: Audit log Chord proportions group monitored data points

Data group	Data point
	LowFlowLmt NumVals PropUpdtSeconds ResetProp

Table 5-5: Audit log collocated meter group monitored data point

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

Table 5-6: Audit log communication group monitored data point

Data group	Data point
	BaudPort<A..C> CommRspDlyPort<A..C> CommTCPMaxDatagramSizePort<A..C> CommTimeoutPort<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 5-7: Audit log data logging group monitored data point

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

Table 5-8: Audit log Expansion correction group monitored data point

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

Table 5-9: Audit log Flow analysis group monitored data point

Data group	Data point
	FlowAnalysisHighFlowLmt FlowAnalysisLowFlowLmt ReverseFlowDetectionZeroCut ReverseFlowVolLmt SwirlAngleLmt

Table 5-10: Audit log frequency, digital, and analog group monitored data , section 1

Data group	Data point
	AO1ActionUponInvalidContent AO1Content AO1CurrentTrimGain AO1CurrentTrimZero AO1Dir AO1FullScaleVolFlowRate AO1TestModeOutputPercent AO1TrimCurrent AO1TrimGainExtMeasCurrent AO1TrimZeroExtMeasCurrent AO1ZeroScaleVolFlowRate AO2ActionUponInvalidContent AO2Content AO2CurrentTrimGain AO2CurrentTrimZero AO2Dir AO2FullScaleVolFlowRate AO2TestModeOutputPercent AO2TrimCurrent AO2TrimGainExtMeasCurrent AO2TrimZeroExtMeasCurrent AO2ZeroScaleVolFlowRate DI1IsInvPolarity DI1Mode DO1AContent ... DO1BContent DO1AIsInvPolarity ... DO1BIsInvPolarity DO1PairTestEnable DO2AContent ... DO2BContent DO2AIsInvPolarity... DO2BIsInvPolarity DO2PairTestEnable FODO1Mode FODO1Source FODO2Mode FODO2Source FODO3Mode FODO3Source FODO4Mode FODO4Source FODO5Mode FODO5Source FODO6Mod FODO6Source

Table 5-11: Audit log frequency, digital, and analog group monitored data , section 2

Data group	Data point
	Freq1BPhase Freq1Content Freq1Dir Freq1FeedbackCorrectionPcnt Freq1FullScaleVolFlowRate Freq1MaxFrequency Freq1TestModeOutputPercent Freq1ZeroScaleVolFlowRate Freq2BPhase Freq2Content Freq2Dir Freq2FeedbackCorrectionPcnt Freq2FullScaleVolFlowRate Freq2MaxFrequency Freq2TestModeOutputPercent Freq2ZeroScaleVolFlowRate IsAO1EnableTest IsAO2EnableTest IsDI1ForCalActiveLow IsDI1ForCalStateGated IsFreq1BZeroedOnErr IsFreq1EnableTest IsFreq2BZeroedOnErr IsFreq2EnableTest

Table 5-12: 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 SimFileName SSMax SSMin UnitsSystem UserChanged VelHold VolFlowRateTimeUnit VolUnitMetric VolUnitUS XdcrFiringSync XdcrMaintenanceGainRange XdcrMaintenanceSNRRange XdcrType ZeroCut

Table 5-13: Audit log HART® data group monitored data point

Data group	Data point
	HARTDate HARTDescriptor HARTDeviceFinalAssyNum HARTLengthUnit HARTLongTag HARTMessage HARTMinNumPreambles HARTNumPreambleBytesFromSlave HARTPollingAddress HARTPressureUnit HARTQVContent HARTRateTimeUnit HARTSlot0Content HARTSlot1Content HARTSlot2Content HARTSlot3Content HARTTag HARTTemperatureUnit HARTTVContent HARTVelUnit HARTViscosityUnit HARTVolUnit HARTYoungsModulusPressureUnit IsHARTSlaveEnabled

Table 5-14: Audit log indicators group monitored data point

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

Table 5-15: Audit log local display group monitored data point

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

Table 5-16: Audit log meter information group monitored data point

Data group	Data point
	Address City CPUBdBootLoaderSwVer CPUBdSwVer FileSysVer MeterName MeterSerialNumber OSVer StateAndCountry StationName UserScratch1 UserScratch2

Table 5-17: 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 MaxInputTemperature MinInputPressure MinInputTemperature

Table 5-18: Audit log Reynolds number calculation group monitored data point

Data group	Data point
	Viscosity

Table 5-19: Audit log signal processing group monitored data point

Data group	Data point
	BatchPercentSmoothing BatchSize CRange DltChkSI EmRateActual EmRateDesired Filter FireSeq GainHighLmt GainLowLmt MaxHoldTm MaxNoise MinHoldTime MinSigQlty NegSpan Pk1Pct Pk1Thrsh PkPlsWdthSI PosSpanSI SampInterval SampPerCycle SetXdcrType SndSpdChkMaxVel SndSpdChkMinVel SNRatio SpecBatchUpdtPeriod StackEmRateActual StackEmRateDesired StackSize TmDevFctr1 TmDevLow1SI XdcrFreq XdcrNumDriveCycles

Table 5-20: 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 5-21: Audit log Fixed data points

Data group	Data point
Fixed value configuration data points, which are written by external client like a 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 the following data points.	
Inputs	SpecFlowTemperature SpecFlowPressure

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.

5.1.2 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).

There are two statuses associated with alarms: set and cleared. An alarm is set when the data point is at or exceeds its alarm limit. An alarm is cleared when the data point is within its alarm limit(s).

The Rosemount™ 3810 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 **AlarmTurnOffHysteresisTimeSpan** 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 5-22: Alarm log monitored data points

Data point	Low alarm limit	High alarm limit
GainA1, GainA2, GainB1, GainB2, GainC1, GainC2, GainD1, GainD2,	GainLowLmt	GainHighmit
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 5-23: Alarm log Boolean alarm limit

Data point	Boolean alarm unit
IsClkInvalid	TRUE
SpecFlowTemperature	TRUE
SpecFlowPressure	TRUE
PressureInvalid	TRUE
TemperatureInvalid	TRUE
IsAcqModuleError	TRUE
AvgFlow	TRUE

Table 5-23: Alarm log Boolean alarm limit *(continued)*

Data point	Boolean alarm unit
IsMeterVelAboveMaxLmt	TRUE
AvgSndVel	TRUE
IsAvgSoundVelRangeErr	TRUE
QMeterValidity	FALSE
QFlowValidity	FALSE
DidColdStart	TRUE
IsMeasSndSpdRange<A..D>	TRUE
IsAcqMode	TRUE
IsTooFewOperChords	TRUE
IsHardFailed<A..D>	TRUE
Freq1DataValidity	FALSE
Freq2DataValidity	FALSE
SysTemp	TRUE
SysVoltage2V5	TRUE
SysVoltage3V3	TRUE
IsHourlyLogFull	TRUE
IsDailyLogFull	TRUE
IsAuditLogFull	TRUE
IsSystemLogFull	TRUE
IsAcqModuleIncompatible	TRUE
LiveFlowPressure	TRUE
LiveFlowTemperature	TRUE
AO1IsSaturated	TRUE
AO2IsSaturated	TRUE
AO1DataValidity	FALSE
AO2DataValidity	FALSE
HARTTVValidity	FALSE
HARTQVValidity	FALSE
HARTSlot0Validity	FALSE
HARTSlot1Validity	FALSE
HARTSlot2Validity	FALSE
HARTSlot3Validity	FALSE
AreSwComponentsCompatible	TRUE
IsAcqModuleErrorLatched	TRUE
IsAcqModeLatched	TRUE
IsTooFewOperChordsLatched	TRUE

Table 5-23: Alarm log Boolean alarm limit *(continued)*

Data point	Boolean alarm unit
TemperatureInvalidLatched	TRUE
PressureInvalidLatched	TRUE
IsMeterVelAboveMaxLmtLatched	TRUE
IsAvgSoundVelRangeErrLatched	TRUE
IsReverseFlowDetected	TRUE
ReverseFlowVol	TRUE
IsReverseFlowDetectedLatched	TRUE
SysVoltage1V2	TRUE
SysVoltage1V	TRUE
SysVoltageAcqModule1V2	TRUE
SysVoltageAcqModule2V5	TRUE
SysVoltageAcqModule3V3	TRUE
SysTempAcqModule	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 3810 Series Liquid 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 through 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 three times within 60 seconds, that system message is suppressed until that message's frequency drops below the 3 times-per-60 seconds rate. The system log records indicate when a system message suppression has started and ended.

5.1.3 Reading log records

Rosemount 3810 Series Ultrasonic Flow Meter log records are read using the MeterLink **Logs/Reports** → **Meter Archive Logs** screen.

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.

5.1.4 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 5-1 lists the daily log data points and Table 5-2 lists the hourly log data points.

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

5.1.5 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.

5.1.6 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, including:
  - Daily Log
  - Hourly Log
  - Alarm Log
  - Audit Log
  - System Log
  - 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.

1. 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.
2. 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 will be marked as 'read'.
3. 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.

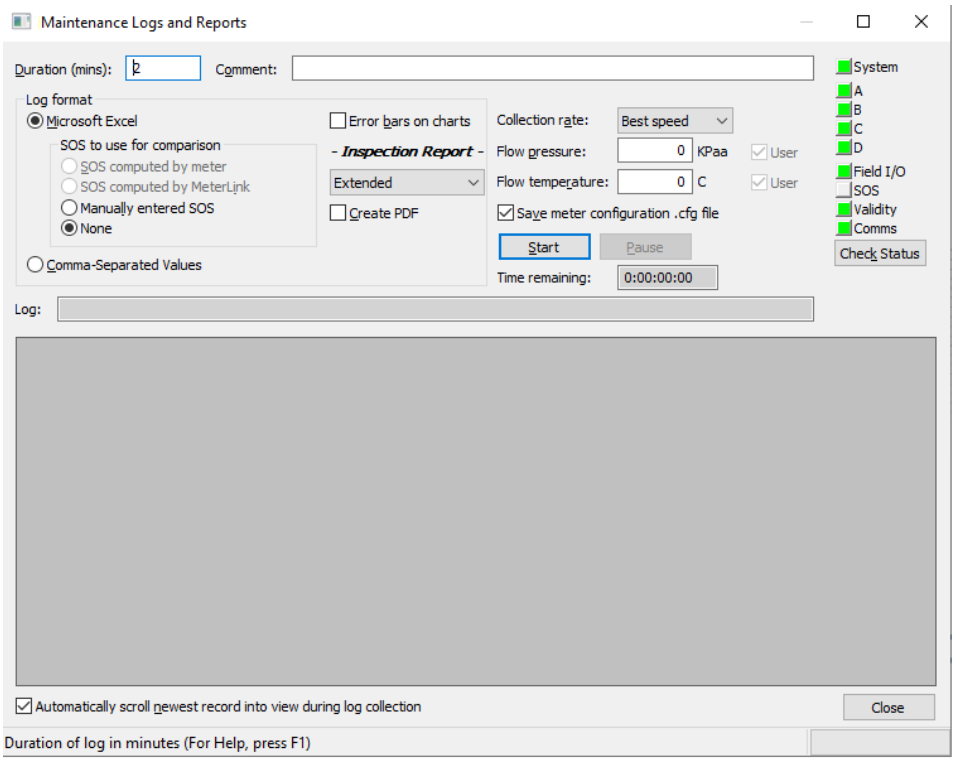
5.1.7 Collecting logs

To collect Maintenance and Trend Logs for meter diagnostics:

Procedure

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

Figure 5-1: Liquid Maintenance Logs



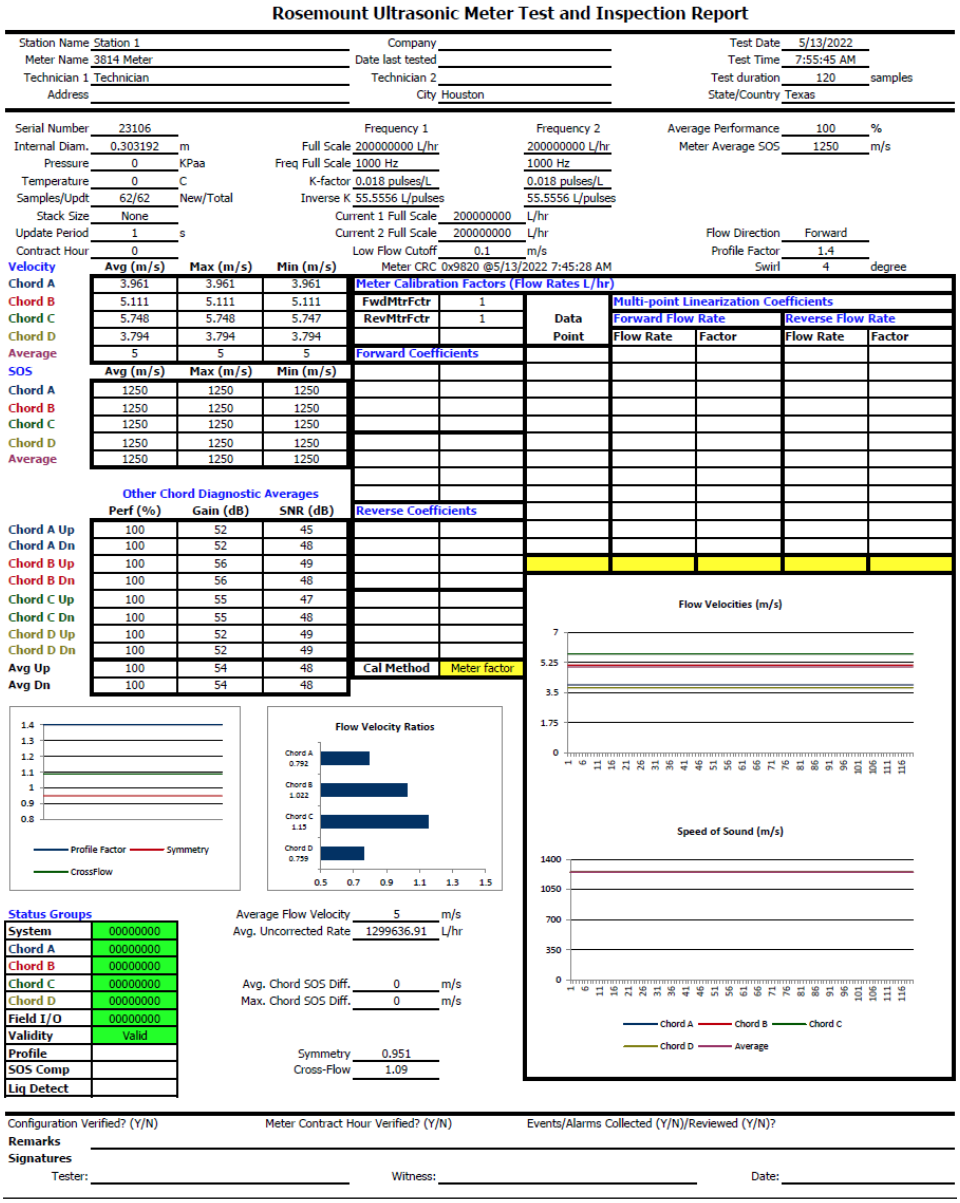
3. Set the log collection Duration (mins) (2 minutes is the default value which is normally adequate to capture a good snapshot of the meter's current diagnostic parameters). To get a good representation of the meter performance, it is recommended that there be at least 30 records (lines of data). The 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 3810 Series Liquid 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 5-2: Microsoft® Excel ® report view toolbar

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

Figure 5-3: Microsoft® Excel ® inspection report view



Rosemount Ultrasonic Meter Test and Inspection Report

Station Name	Station 1	Company		Test Date	5/13/2022
Meter Name	3814 Meter	Date last tested		Test Time	7:55:45 AM
Technician 1	Technician	Technician 2		Test duration	120 samples
Address		City	Houston	State/Country	Texas

			Frequency 1	Frequency 2		
Serial Number	23106				Average Performance	100 %
Internal Diam.	0.303192	m	Full Scale	200000000 L/hr	200000000 L/hr	Meter Average SOS 1250 m/s
Pressure	0	KPaa	Freq Full Scale	1000 Hz	1000 Hz	
Temperature	0	C	K-factor	0.018 pulses/L	0.018 pulses/L	
Samples/Updt	62/62	New/Total	Inverse K	55.5556 L/pulses	55.5556 L/pulses	
Stack Size	None		Current 1 Full Scale	200000000	L/hr	
Update Period	1	s	Current 2 Full Scale	200000000	L/hr	Flow Direction Forward
Contract Hour	0		Low Flow Cutoff	0.1	m/s	Profile Factor 1.4
			Meter CRC	0x9820 @5/13/2022 7:45:28 AM		Swirl 4 degree

Velocity	Avg (m/s)	Max (m/s)	Min (m/s)
Chord A	3.961	3.961	3.961
Chord B	5.111	5.111	5.111
Chord C	5.748	5.748	5.747
Chord D	3.794	3.794	3.794
Average	5	5	5

SOS	Avg (m/s)	Max (m/s)	Min (m/s)
Chord A	1250	1250	1250
Chord B	1250	1250	1250
Chord C	1250	1250	1250
Chord D	1250	1250	1250
Average	1250	1250	1250

Other Chord Diagnostic Averages	Perf (%)	Gain (dB)	SNR (dB)
Chord A Up	100	52	45
Chord A Dn	100	52	48
Chord B Up	100	56	49
Chord B Dn	100	56	48
Chord C Up	100	55	47
Chord C Dn	100	55	48
Chord D Up	100	52	49
Chord D Dn	100	52	49
Avg Up	100	54	48
Avg Dn	100	54	48

Meter Calibration Factors (Flow Rates L/hr)		
FwdMtrFctr	1	
RevMtrFctr	1	
Forward Coefficients		
Reverse Coefficients		
Cal Method	Meter factor	

Data Point	Multi-point Linearization Coefficients			
	Forward Flow Rate		Reverse Flow Rate	
	Flow Rate	Factor	Flow Rate	Factor

Status Groups	
System	00000000
Chord A	00000000
Chord B	00000000
Chord C	00000000
Chord D	00000000
Field I/O	00000000
Validity	Valid
Profile	
SOS Comp	
Liq Detect	

Average Flow Velocity 5 m/s
Avg. Uncorrected Rate 1299636.91 L/hr

Avg. Chord SOS Diff. 0 m/s
Max. Chord SOS Diff. 0 m/s

Symmetry 0.951
Cross-Flow 1.09

Configuration Verified? (Y/N) Meter Contract Hour Verified? (Y/N) Events/Alarms Collected (Y/N)/Reviewed (Y/N)?

Remarks

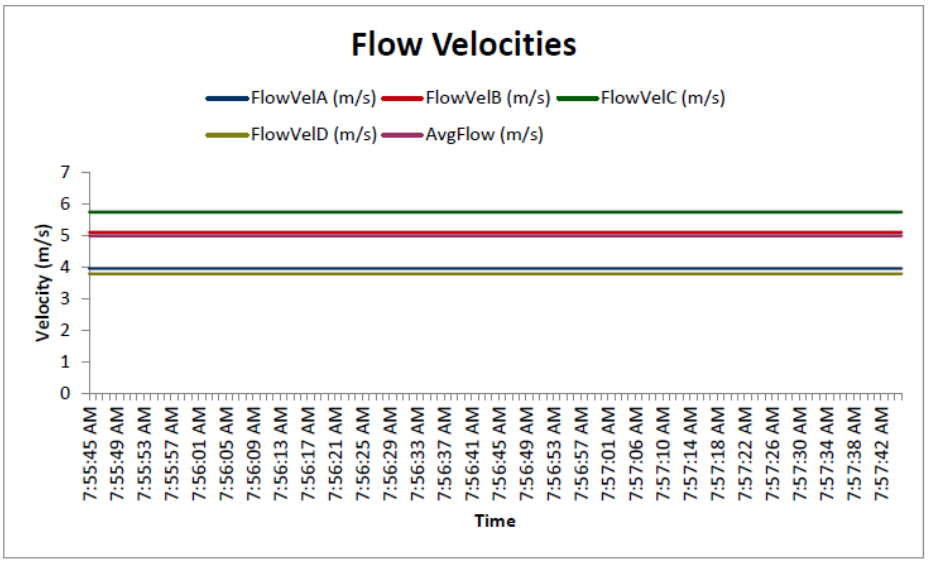
Signatures

Tester: Witness: Date:

11. **Charts** is the view of charted data.

Figure 5-4: Microsoft® Excel ® charts view

Meter Name: 3814 Meter **Log started:** 5/13/2022 7:55:45 AM **Duration:** 2 minutes **# samples:** 120
Company Name:
Comment:



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

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

	A	B	C	D	E	F
1	Reg #	Label	Short Description	Value	Units	Access
2	201	DeviceNumber	Meter device number	3814 - Four-path		RW
3	3	MeterName	Meter name	3814 Meter		RW
4	6	MeterSerialNumber	Meter serial number	23106		RW
5	188	StationName	Station name	Station 1		RW
6	189	Address	Station address			RW
7	190	City	City	Houston		RW
8	191	StateAndCountry	State and country	Texas		RW
9	186	UserScratch1	User scratch point 1	Not set		RW
10	187	UserScratch2	User scratch point 2	Not set		RW
11	41	Eth1IPAddr	Ethernet port IP address	10.211.211.110		RW
12	42	Eth1SubnetMask	Ethernet port subnet mask	255.255.0.0		RW
13	1353	Eth1DftGatewayAddr	Ethernet default gateway address	10.211.211.1		RW
14	1946	Eth1AltModbusPort	Alternate TCP port used for Modbus TCP	0		RW
15	1945	Eth1ModbusID	Ethernet port Modbus address	255		RW
16	3812	Eth1ModbusReadWriteMode	Modbus TCP slave read and write mode	Modbus TCP slave read-write mode		RW
17	3813	Eth1AltModbusReadWriteMode	Modbus TCP alternate port slave read and write mode	Modbus TCP slave disabled		RW
18	3741	FTPServerControlPort	FTP server control port	0		RW
19	3739	HTTPServerPort	TCP port used for HTTP server	80		RW
20	3731	MaxConnDBAPI	Maximum number of DB API connections	10		RW
21	45	PortAMapfilePt	Comm Port A mapfile name	Map.txt		RW
22	2107	DriverSelectionPortA	Hardware protocol on Port A	RS-232		RW
23	47	BaudPortA	Communication Port A baud rate	19200	bits/s	RW
24	49	ModbusIDPortA	Comm Port A Modbus address	32		RW
25	50	CommRspDlyPortA	Comm Port A response delay	0	ms	RW
26	51	RTSOffDelayPortA	Comm Port A handshaking RTS off delay time	0	ms	RW
27	52	RTSOnDelayPortA	Comm Port A handshaking RTS on delay time	0	ms	RW
28	56	CommTimeoutPortA	Comm Port A communication timeout value	4	s	RW
29	3814	ProtocolPortA	Serial port A protocol(s) allowed	PPP (for MeterLink) or Modbus ASCII/RTU		RW
30	3718	ReadWriteModePortA	Serial port A read and write mode	Read-write mode		RW
31	57	IsHWFlowControlEnabledPortA	Enables comm port A hardware flow control	Disabled		RW
32	58	PortBMapfilePt	Comm Port B mapfile name	Map1.txt		RW
33	2422	DriverSelectionPortB	Hardware protocol on Port B	RS-232		RW
34	60	BaudPortB	Communication Port B baud rate	19200	bits/s	RW
35	62	ModbusIDPortB	Comm Port B Modbus address	32		RW
36	63	CommRspDlyPortB	Comm Port B response delay	0	ms	RW
37	69	CommTimeoutPortB	Comm Port B communication timeout value	4	s	RW
38	3815	ProtocolPortB	Serial port B protocol(s) allowed	PPP (for MeterLink) or Modbus ASCII/RTU		RW
39	3719	ReadWriteModePortB	Serial port B read and write mode	Read-write mode		RW
40	1665	PortCMapfilePt	Comm Port C mapfile name	Map2.txt		RW
41	2423	DriverSelectionPortC	Hardware protocol on Port C	RS-232		RW
42	73	BaudPortC	Communication Port C Slave mode baud rate	19200	bits/s	RW
43	75	ModbusIDPortC	Comm Port C Slave mode Modbus address	32		RW
44	76	CommRspDlyPortC	Comm Port C response delay	0	ms	RW

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

Figure 5-6: 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 (KPaa)	SystemStatus	FlowVelA (m/s)	FlowVelB (m/s)	FlowVelC (m/s)	FlowVelD (m/s)	AvgFlow (m/s)
2	5/13/2022	7:55:45 AM	1299624.6	1299624.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
3	5/13/2022	7:55:46 AM	1299615.1	1299615.1	0	0	0x00000000	3.961	5.111	5.747	3.794	5
4	5/13/2022	7:55:47 AM	1299643.8	1299643.8	0	0	0x00000000	3.961	5.111	5.748	3.794	5
5	5/13/2022	7:55:48 AM	1299664.6	1299664.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
6	5/13/2022	7:55:49 AM	1299624.6	1299624.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
7	5/13/2022	7:55:50 AM	1299615	1299615	0	0	0x00000000	3.961	5.111	5.747	3.794	5
8	5/13/2022	7:55:51 AM	1299643.6	1299643.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
9	5/13/2022	7:55:52 AM	1299664.5	1299664.5	0	0	0x00000000	3.961	5.111	5.748	3.794	5
10	5/13/2022	7:55:53 AM	1299624.3	1299624.3	0	0	0x00000000	3.961	5.111	5.748	3.794	5
11	5/13/2022	7:55:54 AM	1299615.1	1299615.1	0	0	0x00000000	3.961	5.111	5.747	3.794	5
12	5/13/2022	7:55:55 AM	1299643.3	1299643.3	0	0	0x00000000	3.961	5.111	5.748	3.794	5
13	5/13/2022	7:55:56 AM	1299664.4	1299664.4	0	0	0x00000000	3.961	5.111	5.748	3.794	5
14	5/13/2022	7:55:57 AM	1299624.4	1299624.4	0	0	0x00000000	3.961	5.111	5.748	3.794	5
15	5/13/2022	7:55:58 AM	1299615.3	1299615.3	0	0	0x00000000	3.961	5.111	5.747	3.794	5
16	5/13/2022	7:55:59 AM	1299643.3	1299643.3	0	0	0x00000000	3.961	5.111	5.748	3.794	5
17	5/13/2022	7:56:00 AM	1299664.6	1299664.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
18	5/13/2022	7:56:01 AM	1299624.6	1299624.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
19	5/13/2022	7:56:02 AM	1299615.1	1299615.1	0	0	0x00000000	3.961	5.111	5.747	3.794	5
20	5/13/2022	7:56:03 AM	1299643.8	1299643.8	0	0	0x00000000	3.961	5.111	5.748	3.794	5
21	5/13/2022	7:56:04 AM	1299664.6	1299664.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
22	5/13/2022	7:56:05 AM	1299624.6	1299624.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
23	5/13/2022	7:56:06 AM	1299615	1299615	0	0	0x00000000	3.961	5.111	5.747	3.794	5
24	5/13/2022	7:56:07 AM	1299643.6	1299643.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
25	5/13/2022	7:56:08 AM	1299664.5	1299664.5	0	0	0x00000000	3.961	5.111	5.748	3.794	5
26	5/13/2022	7:56:09 AM	1299624.3	1299624.3	0	0	0x00000000	3.961	5.111	5.748	3.794	5
27	5/13/2022	7:56:10 AM	1299615.1	1299615.1	0	0	0x00000000	3.961	5.111	5.747	3.794	5
28	5/13/2022	7:56:11 AM	1299643.3	1299643.3	0	0	0x00000000	3.961	5.111	5.748	3.794	5
29	5/13/2022	7:56:12 AM	1299664.4	1299664.4	0	0	0x00000000	3.961	5.111	5.748	3.794	5
30	5/13/2022	7:56:13 AM	1299624.4	1299624.4	0	0	0x00000000	3.961	5.111	5.748	3.794	5
31	5/13/2022	7:56:14 AM	1299615.3	1299615.3	0	0	0x00000000	3.961	5.111	5.747	3.794	5
32	5/13/2022	7:56:15 AM	1299643.3	1299643.3	0	0	0x00000000	3.961	5.111	5.748	3.794	5
33	5/13/2022	7:56:16 AM	1299664.6	1299664.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
34	5/13/2022	7:56:17 AM	1299624.6	1299624.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5
35	5/13/2022	7:56:18 AM	1299615.1	1299615.1	0	0	0x00000000	3.961	5.111	5.747	3.794	5
36	5/13/2022	7:56:19 AM	1299643.8	1299643.8	0	0	0x00000000	3.961	5.111	5.748	3.794	5
37	5/13/2022	7:56:20 AM	1299664.6	1299664.6	0	0	0x00000000	3.961	5.111	5.748	3.794	5

5.1.8 Collect meter archive logs

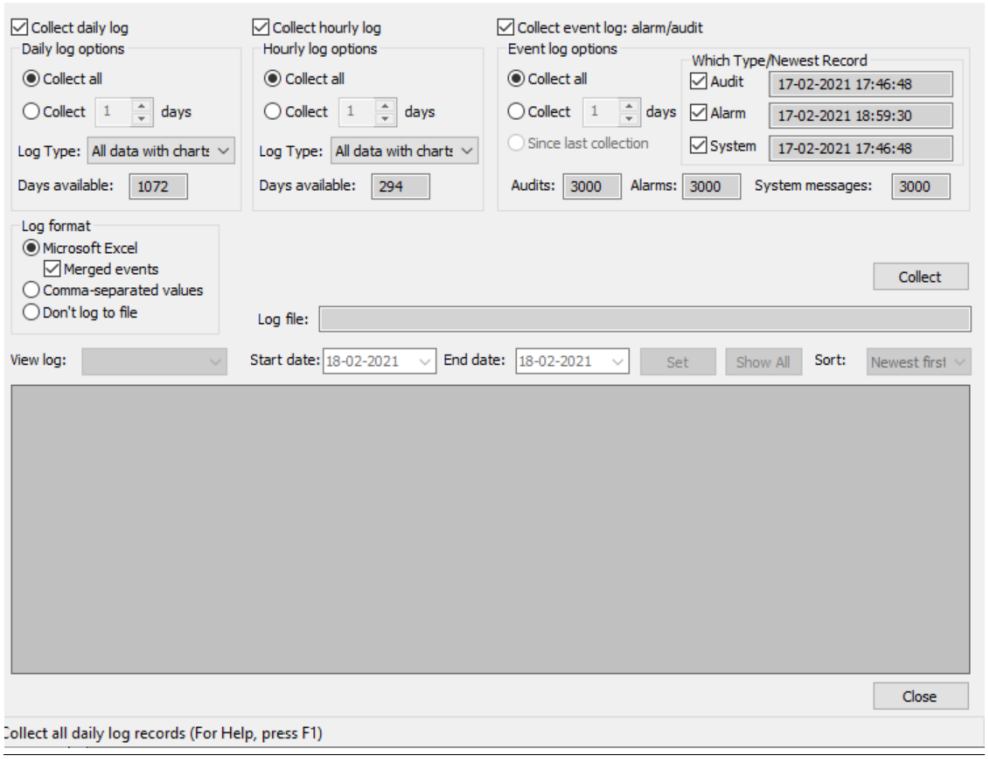
This utility allows you to collect historical log information from an ultrasonic meter. This dialog box is only available while connected to a meter.

Procedure

1. Select the checkboxes for the types of logs you want to collect, as well as the other options.

   All of the logs will be collected into a single Archive log file.

Figure 5-7: Meter Archive Logs



The Log format can be selected as either Microsoft® Excel, comma-separated values, or **Don't log to file** by selecting the appropriate radio button.

Note
The **Don't log to file** option does not save any of the log data to file; it only displays it on the screen.

2. Click **Collect**.
3. In the **Save As** dialog box, a default name based on the meter name, type of logs collected, and PC date and tiime is provided. If you choose, you can modify the default name and location for the file.

6 Tools commands utility

6.1 Tools menu

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

Table 6-1: Tools menu commands

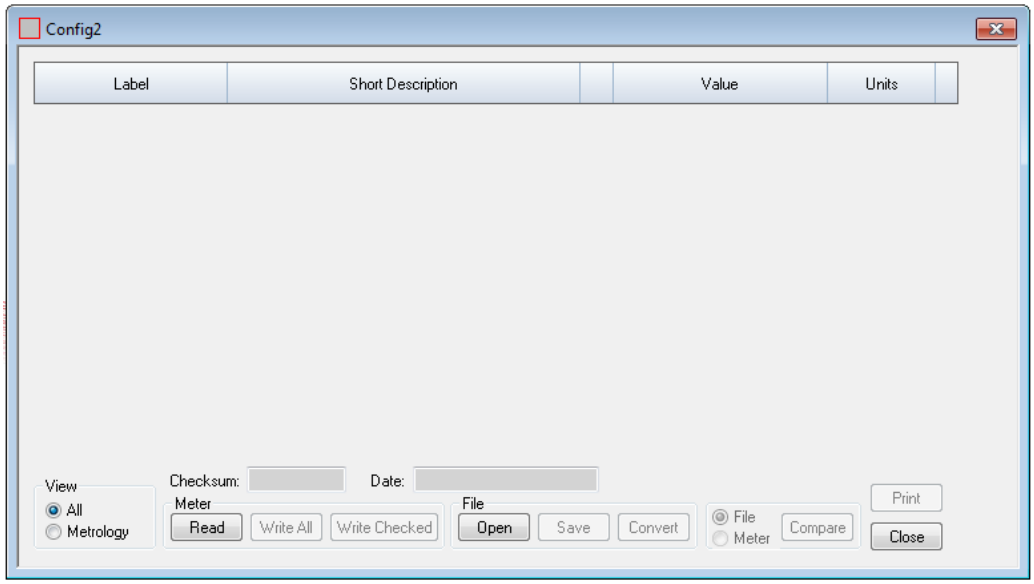
Edit/Compare Configuration	Open, edit, and compare configurations from files and meters
Edit/Compare Configuration	Open, edit, and compare configurations from files and meters.
Waveform Viewer	Collect, view, save, print ultrasonic waveforms from meter or file.
Outputs Test	Test frequency, current, and 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 heath 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.

6.1.1 Edit/Compare Configuration parameters

This MeterLink™ command utility is used to:

- Open
- Edit
- Compare configurations from files and meters
- Write parameter changes to the meter

Figure 6-1: Edit/Compare configuration parameters



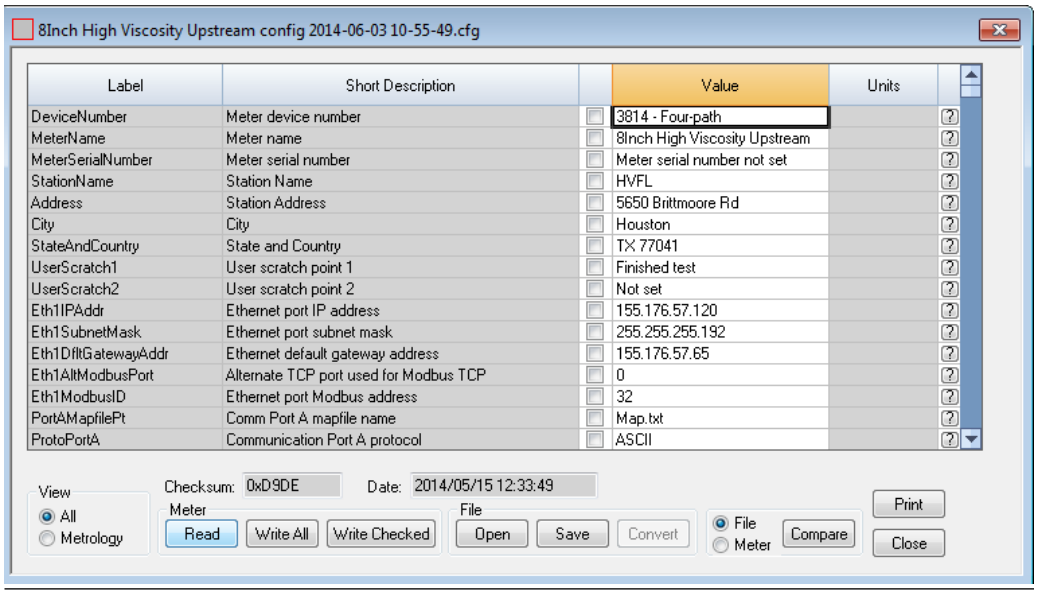
Edit the meter's configuration parameters

Prerequisites

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

Figure 6-2: Edit/Compare configuration parameters

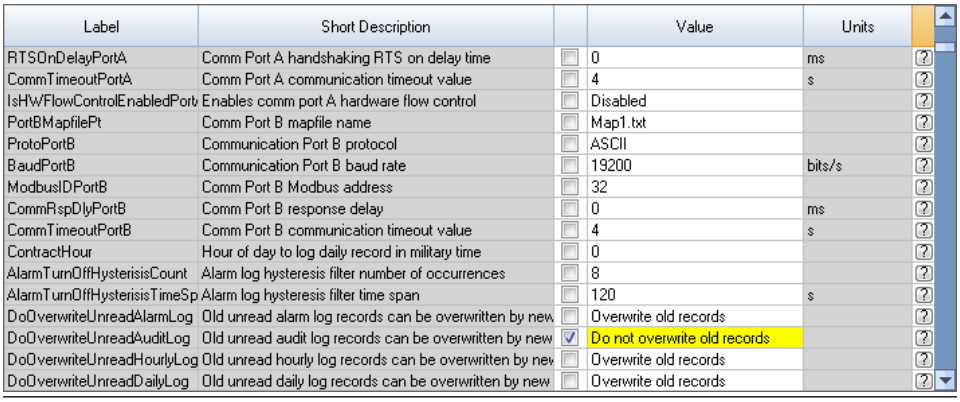


Procedure

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.

   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 6-3: Configuration changes



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

   a. **Exclude registers that are typically different**: Includes items that could change regularly. A complete list is defined in *reg_list_compare_config_exclude.txt* found under the installation directory for MeterLink™.

   b. **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.

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

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 **File** → **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 **Tools** → **Edit/Compare Configuration** dialog box. Upgrade the electronics on the meter.
    b) Connect to the new meter electronics and open the **Tools** → **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.

Waveform viewer for transducer waveforms

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:

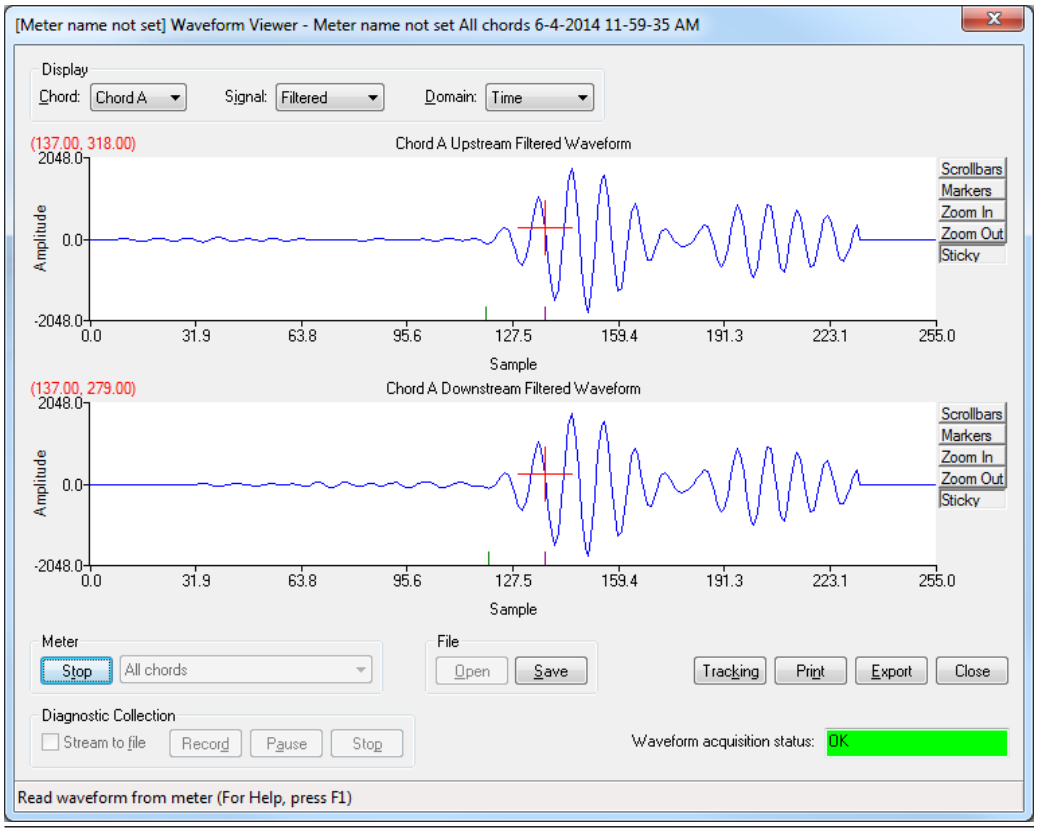
- **Raw** - The sampled waveform received by the transducer (with gain applied).
- **Stacked** - The result of applying stacking to the raw signal(s). Note that when stacking is not used (**StackSize** is set to 1), the stacked signal is the same as the raw signal.

- **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 check box. This utilizes the Rosemount 3810 Liquid 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 6-4: 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 6-5: 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 dropdown menu and click **Read**. Selections include:
   - All Chords
   - Chord A
   - Chord B
   - Chord C
   - Chord D

   Note
   Chords C and D are available for 4-Path Liquid meters.

2. MeterLink™ starts to continuously stream waveforms from the meter.

3. Click **Save** while streaming waveforms or click **Stop**.

   MeterLink 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 Microsoft Excel® file contains 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 Emerson 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 Emerson 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.

   Important
   There is no utility in MeterLink to playback these files. The files are only for use internally by Emerson on special diagnostic tools.

9. Clear the **Stream to file** checkbox to stop the waveform streaming mode and return 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.

10. 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** over the chart to display these commands or enter the keyboard command.

Table 6-2: 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 in 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.

6.1.2 Outputs test

Tools menu

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.

6.1.3 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 transducer housings have to be replaced for a chord.

Refer to the *Rosemount 3814 Series Liquid Ultrasonic Flow Meters Maintenance and Troubleshooting Manual* (P/N 00809-0100-3814, Sections 3.3) or the *Rosemount 3812 Series Liquid Ultrasonic Flow Meters Maintenance and Troubleshooting Manual* (P/N 00809-0100-3812 , Sections 3.6) for detailed instructions for replacing the transducer housings and setting the parameters for the parts you replaced.

6.1.4 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.

6.1.5 Warm start the 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.

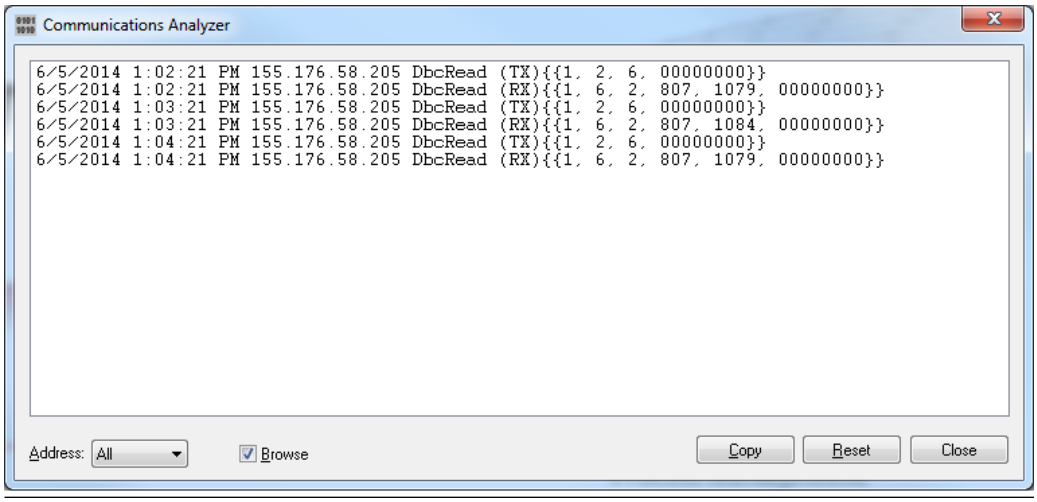
A warm start is the same restart as when power is removed and reapplied to the meter. No configuration or archive log history is lost. Some configuration changes require a restart of the meter for the changes to take effect. Click **No** to close the dialog.

6.1.6 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 6-6: Tools menu 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.
4. Click **Close** to close the dialog and return to the MeterLink™ main page.

A Conversion factors

A.1 Conversion factor units of measurement

Table A-1: Conversion factor units of measurement

Conversion factor	Units of measurement
(°F-32)x(5/9)->°C (°C+273.15)->K	
1	K/°C
5/9	°C/°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
0.0254	m/in
10^{3}	dm^3/m^3
10^{-6}	m^3 /cc (=m^3/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/ BtuIT
10^{-3}	Pa•s/cPoise
1.488	Pa•s/(lb/(ft•s)

B Miscellaneous equations

B.1 Miscellaneous conversion factors

Use the following calculations:

- 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.

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

$$KFactor = \frac{(MaxFreq)(3600s/hr)^{*}}{FreqQ_{FullScale}}$$

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

$$InvKFactor = \frac{FreqQ_{FullScale}}{(MaxFreq)(3600s/hr^{**})}$$

KFactor	frequency “K-Factor” (pulses/m^3 or pulses/ft^3) (Freq1KFactor and Freq2KFactor)
InvKFactor	frequency “Inverse K-Factor” (m^3/pulse or ft^3/pulse) (Freq1InvKFactor and Freq2InvKFactor)
$FreqQ_{FullScale}$	frequency full-scale volumetric flow rate (m^3/h or ft^3/h) (Freq1FullScaleVolFlowRate and Freq2FullScaleVolFlowRate)
MaxFreq	maximum frequency (Hz = pulses/s) (Either 1000 or 5000 Hz) (Freq1MaxFrequency and Freq2MaxFrequency)

(*)TimeUnit: Time conversion factor depends on the VolFlowRate.

- volume/second = 1 s/s
- volume/minute = 60 s/m
- volume/hour = 3600 s/h

(**)Volume: Where the volume is selected via Units System data points.

VolInitUS

- Gallons
- Barrels

VolUnitMetric

- Cubic meters

C Troubleshooting communications: mechanical and electrical issues

C.1 Communications troubleshooting

Q1: Why won't the CPU Module LINK LED turn 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 Set up 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 Board switch S2-2 CLOSED). 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 will 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 adapterLocal 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 are advised to 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™ configuration 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.

Rosemount 3810 Series meters connected to an intranet LAN must 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™ configuration 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. Exercise great care as to not "short out" a given electronic/electrical circuit when troubleshooting.

Table C-1: Mechanical/Electrical troubleshooting

Problem	Solution(s)
No power the unit	• Check for correct voltage (AC or DC) to the input of the Field Connection Board. (See 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	• Ensure that the meter is properly powered. • Ensure that the computer cable is properly connected to the field connection board and check your interface pins (RS-485 or RS-232). • Verify that the communication parameters of the MeterLink program are set according to jumpers on the meter CPU board. See MeterLink™ configuration utilities of this manual for instructions on configuring communications.
One or more of the chords is not indicating a reading (reporting zeros)	• Check for loose connections at the cable connectors. See Engineering drawings. • Check the resistance of the transducers (Must be approximately 1-2 Ω). • Problem also may be caused by a bad Acquisition board or interconnect cable. See 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	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 Emerson Customer Support 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.
Connected communication line to the flow computer but no signal is received	• Check for loose connections at the flow meter and the flow computer (see 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	• 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.
Chord is not indicating	• 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. **Note** The outside chord cables cannot be exchanged with inner chord cables.

D Write-protected parameters

D.1 Write protected configuration parameters

The 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 D-1 are applicable for firmware v1.06 and later.

Table D-1: Write protected configuration parameters

AbnormalProfileDetectionLmt
Address
AlarmDef
AO1ActionUponInvalidContent
AO1Content
AO1Dir
AO1FullScaleEnergyRate
AO1FullScaleMassRate
AO1FullScaleVolFlowRate
AO1MaxVel
AO1MinVel
AO1TrimCurrent
AO1TrimGainExtMeasCurrent
AO1TrimZeroExtMeasCurrent
AO1ZeroScaleEnergyRate
AO1ZeroScaleMassRate
AO1ZeroScaleVolFlowRate
AO2ActionUponInvalidContent
AO2Content
AO2Dir
AO2FullScaleEnergyRate
AO2FullScaleMassRate
AO2FullScaleVolFlowRate
AO2MaxVel
AO2MinVel
AO2TrimCurrent
AO2TrimGainExtMeasCurrent
AO2TrimZeroExtMeasCurrent
AO2ZeroScaleEnergyRate
AO2ZeroScaleMassRate

Table D-1: Write protected configuration parameters *(continued)*

AO2ZeroScaleVolFlowRate
AsyncEnable
AtmosphericPress
AvgDlyA
AvgDlyB
AvgDlyC
AvgDlyD
AvgSoundVelHiLmt
AvgSoundVelLoLmt
BatchSize
BlockageTurbulenceLmtA
BlockageTurbulenceLmtB
BlockageTurbulenceLmtC
BlockageTurbulenceLmtD
CalMethod
ChordInactvA
ChordInactvB
ChordInactvC
ChordInactvD
City
ColocMeterMode
ContractHour
CRange
DailyLogInterval
DampEnable
DeviceNumber
DI1IsInvPolarity
DitherEnable
DltChk
DltDlyA
DltDlyB
DltDlyC
DltDlyD
DO1AContent
DO1AIsInvPolarity
DO1BContent
DO1BIsInvPolarity

Table D-1: Write protected configuration parameters *(continued)*

DO1PairTestEnable
DO2AContent
DO2AIsInvPolarity
DO2BContent
DO2BIsInvPolarity
DO2PairTestEnable
EmRateDesired
EnableExpCorrPress
EnableExpCorrTemp
EnablePressureInput
EnableTemperatureInput
Filter
FireSeq
FlowAnalysisHighFlowLmt
FlowAnalysisLowFlowLmt
FlowDir
FlowPOrTSrcUponAlarm
FODO1Mode
FODO1Source
FODO2Mode
FODO2Source
FODO3Mode
FODO3Source
Freq1BPhase
Freq1Content
Freq1Dir
Freq1FeedbackCorrectionPcnt
Freq1FullScaleEnergyRate
Freq1FullScaleMassRate
Freq1FullScaleVolFlowRate
Freq1MaxFrequency
Freq1MaxVel
Freq1MinVel
Freq1ZeroScaleEnergyRate
Freq1ZeroScaleMassRate
Freq1ZeroScaleVolFlowRate
Freq2BPhase

Table D-1: Write protected configuration parameters *(continued)*

Freq2Content
Freq2Dir
Freq2FeedbackCorrectionPcnt
Freq2FullScaleEnergyRate
Freq2FullScaleMassRate
Freq2FullScaleVolFlowRate
Freq2MaxFrequency
Freq2MaxVel
Freq2MinVel
Freq2ZeroScaleEnergyRate
Freq2ZeroScaleMassRate
Freq2ZeroScaleVolFlowRate
FTPServerControlPort
FwdA0
FwdA1
FwdA2
FwdA3
FwdFlwRt1
FwdFlwRt10
FwdFlwRt11
FwdFlwRt12
FwdFlwRt2
FwdFlwRt3
FwdFlwRt4
FwdFlwRt5
FwdFlwRt6
FwdFlwRt7
FwdFlwRt8
FwdFlwRt9
FwdMtrFctr1
FwdMtrFctr10
FwdMtrFctr11
FwdMtrFctr12
FwdMtrFctr2
FwdMtrFctr3
FwdMtrFctr4
FwdMtrFctr5

Table D-1: Write protected configuration parameters *(continued)*

FwdMtrFctr6
FwdMtrFctr7
FwdMtrFctr8
FwdMtrFctr9
HighViscosityMethod
HARTDate
HARTDescriptor
HARTDeviceFinalAssyNum
HARTLongTag
HARTMessage
HARTMinNumPreambles
HARTNumPreambleBytesFromSlave
HARTPollingAddress
HARTPressureUnit
HARTQVContent
HARTRateTimeUnit
HARTSlot0Content
HARTSlot1Content
HARTSlot2Content
HARTSlot3Content
HARTTag
HARTTemperatureUnit
HARTTVContent
HARTVelUnit
HARTVolUnit
HighPressureAlarm
HighTemperatureAlarm
HourlyLogInterval
HTTPServerPort
InputPressureUnit
IsAO1EnableTest
IsAO2EnableTest
IsFreq1BZeroedOnErr
IsFreq1EnableTest
IsFreq2BZeroedOnErr
IsFreq2EnableTest
IsTelnetServerEnabled

Table D-1: Write protected configuration parameters *(continued)*

LA
LB
LC
LD
LinearExpansionCoef
LiveFlowPressureCalCtrl
LiveFlowPressureGain
LiveFlowPressureOffset
LiveFlowTemperatureCalCtrl
LiveFlowTemperatureGain
LiveFlowTemperatureOffset
LowFlowLmt
LowPressureAlarm
LowTemperatureAlarm
MaxHoldTm
MaxInputPressure
MaxInputTemperature
MaxNoDataBatches
MaxNoise
MeterHousingLength<A..D>
MeterMaxVel
MeterName
MeterSerialNumber
MinChord
MinHoldTime
MinInputPressure
MinInputTemperature
MinPctGood
MinSigQlty
NegSpanSI
NonNormalModeTimeout
NumVals
PipeDiam
PipeOutsideDiameter
Pk1Pct
Pk1Thrsh
Pk1Wdth

Table D-1: Write protected configuration parameters *(continued)*

PoissonsRatio
PosSpanSI
PropUpdtBatches
RefPressExpCoef
RevA0
RevA1
RevA2
RevA3
RevC0
RevC1
RevC2
RevC3
ReverseFlowVolLmt
RevFlwRt1
RevFlwRt10
RevFlwRt11
RevFlwRt12
RevFlwRt2
RevFlwRt3
RevFlwRt4
RevFlwRt5
RevFlwRt6
RevFlwRt7
RevFlwRt8
RevFlwRt9
RevMtrFctr1
RevMtrFctr10
RevMtrFctr11
RevMtrFctr12
RevMtrFctr2
RevMtrFctr3
RevMtrFctr4
RevMtrFctr5
RevMtrFctr6
RevMtrFctr7
RevMtrFctr8
RevMtrFctr9

Table D-1: Write protected configuration parameters *(continued)*

SampInterval
SampPerCycle
SetXdcrType
SndSpdChkMaxVel
SndSpdChkMinVel
SndVelCompErrLimit
SNRatio
SpecBatchUpdtPeriod
SSMax
SSMin
StackEmRateDesired
StateAndCountry
StationName
SwirlAngleLmt
Tamp
TampHi
TampLo
TampSen
TampWt
TmDevFctr1
TmDevLow1
Tspe
TspeHi
TspeLmt
TspeLo
TspeSen
TspeWt
Tspf
TspfHi
TspfLo
TspfMatch
TspfSen
TspfWt
UnitsSystem
VelHold
VolFlowRateTimeUnit
VolUnitMetric

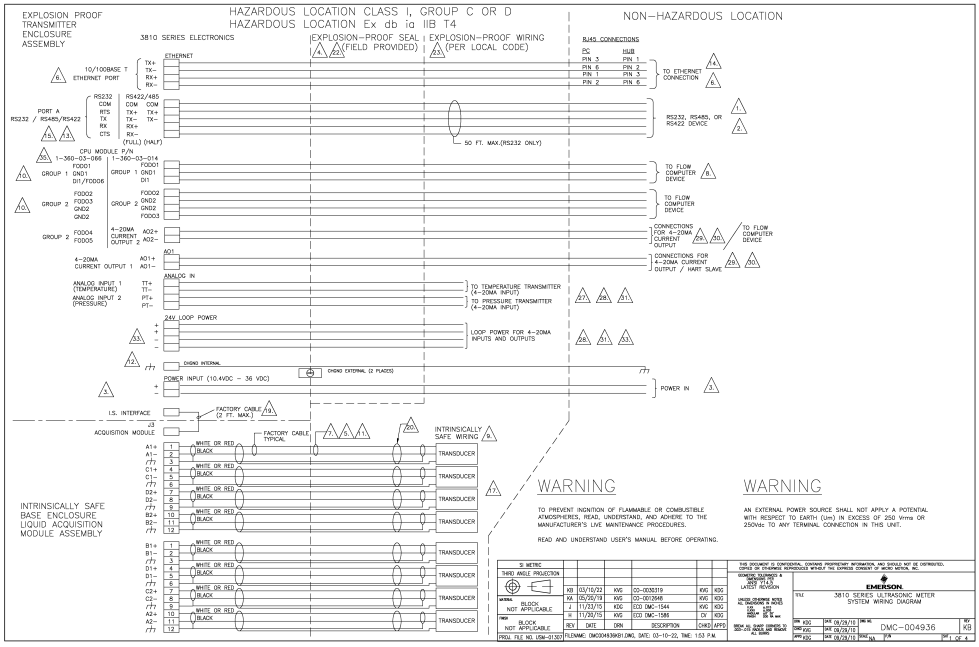
Table D-1: Write protected configuration parameters *(continued)*

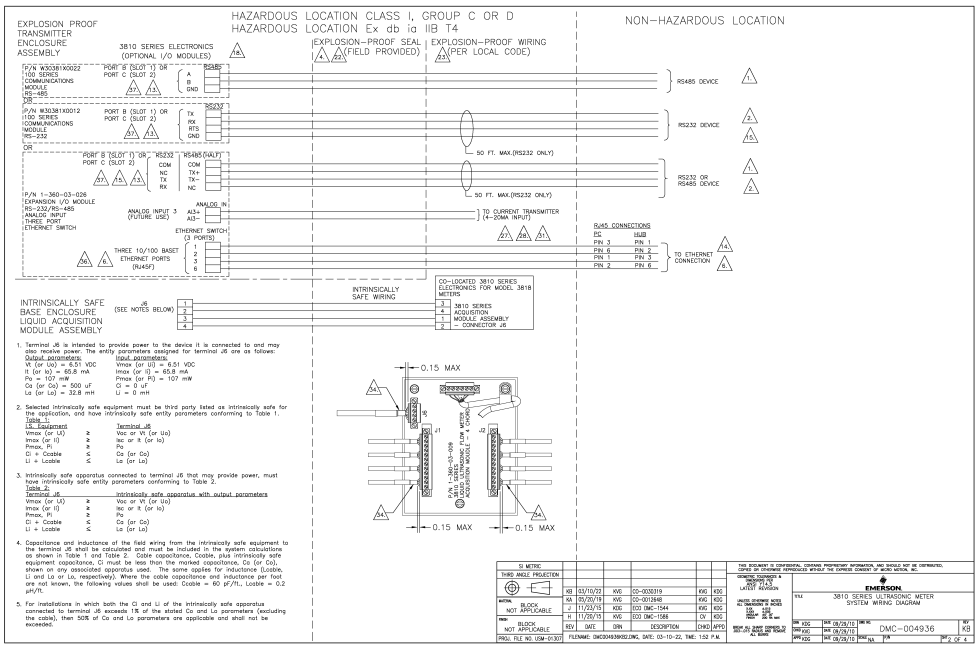
VolUnitUS
XA
XB
XC
XD
XdcrFiringSync
XdcrFreq
XdcrHousingLength<A..D>
XdcrHousingSerialNumber<A..D>
XdcrNumDriveCycles
XdcrType
YoungsModulus
ZeroCut

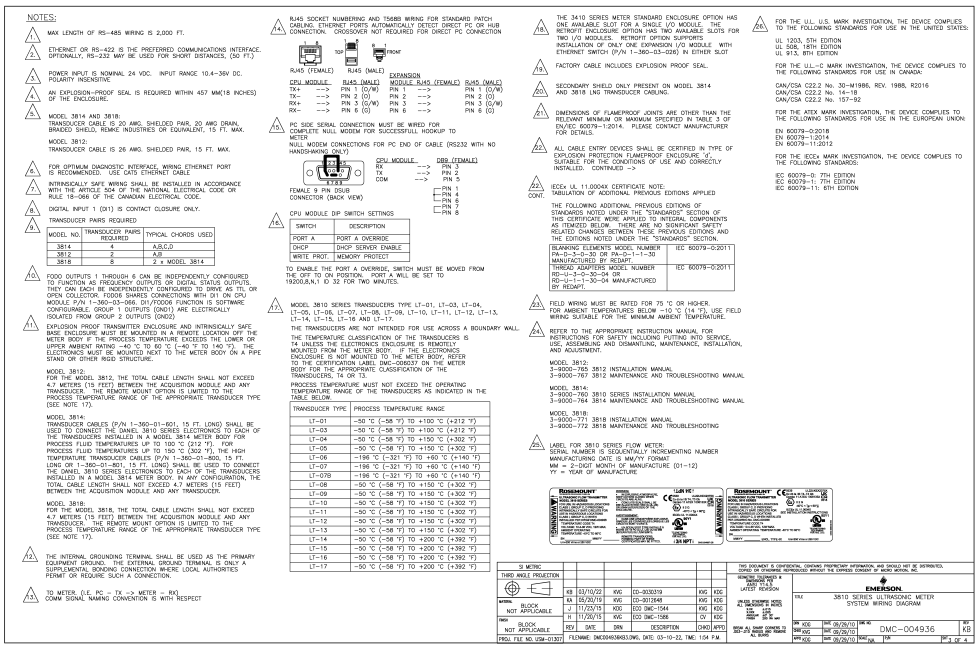
E Engineering drawings

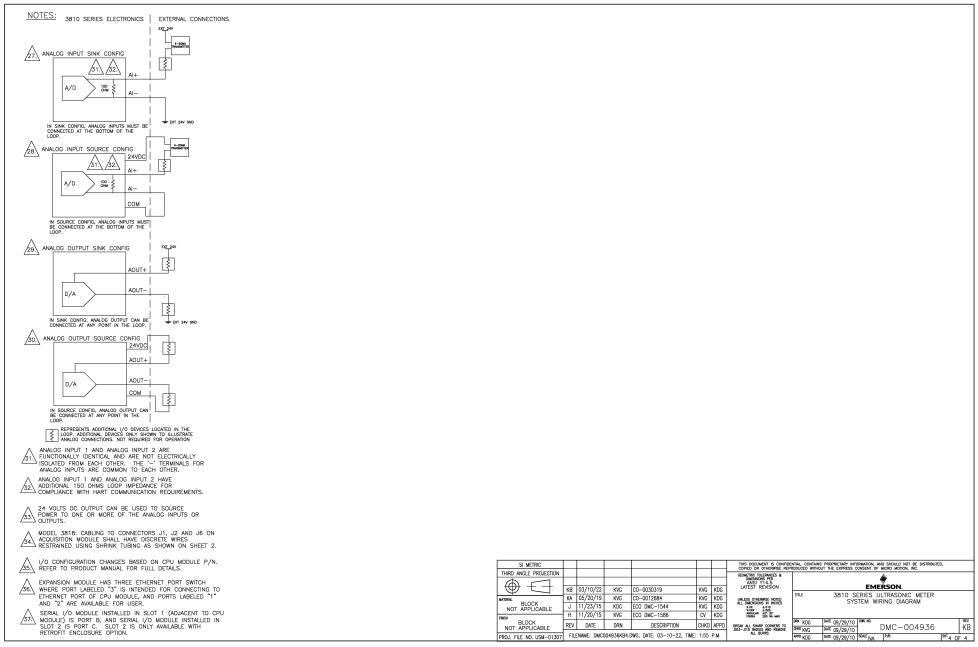
E.1 3810 Series Engineering drawings

DMC-004936	3810 Series Ultrasonic Meter System Wiring Diagram




HAZARDOUS LOCATION CLASS I, GROUP C OR D
HAZARDOUS LOCATION Ex db ia IIB T4
NON-HAZARDOUS LOCATION
EXPLOSION PROOF TRANSMITTER ENCLOSURE ASSEMBLY
3810 SERIES ELECTRONICS (OPTIONAL I/O MODULES)
EXPLOSION-PROOF SEAL (FIELD PROVIDED)
EXPLOSION-PROOF WIRING (PER LOCAL CODE)
RS485 DEVICE
RS232 DEVICE
50 FT. MAX.(RS232 ONLY)
RS232 OR RS485 DEVICE
TO CURRENT TRANSMITTER (4-20MA INPUT)
RJ45 CONNECTIONS
TO ETHERNET CONNECTION
INTRINSICALLY SAFE BASE ENCLOSURE LIQUID ACQUISITION MODULE ASSEMBLY
INTRINSICALLY SAFE WIRING
CO-LOCATED 3810 SERIES ELECTRONICS FOR MODEL 3818 METERS
0.15 MAX
0.15 MAX
0.15 MAX
SI METRIC
THIRD ANGLE PROJECTION
EMERSON.
3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM
DMC-004936
KB
PROG. FILE NO. USM-01307
FILENAME: DMC004936W02.DWG, DATE: 03-10-22, TIME: 1:54 P.M.
2 OF 4


NOTES:
MAX LENGTH OF RS-485 WIRING IS 2,000 FT.
ETHERNET OR RS-422 IS THE PREFERRED COMMUNICATIONS INTERFACE. OPTIONALLY, RS-232 MAY BE USED FOR SHORT DISTANCES, (50 FT.)
POWER INPUT IS NOMINAL 24 VDC. INPUT RANGE 10.4-36V DC. POLARITY INSENSITIVE
AN EXPLOSION-PROOF SEAL IS REQUIRED WITHIN 457 MM(18 INCHES) OF THE ENCLOSURE.
MODEL 3814 AND 3818:
TRANSDUCER CABLE IS 20 AWG, SHIELDED PAIR, 20 AWG DRAIN, BRAIDED SHIELD, REMKE INDUSTRIES OR EQUIVALENT, 15 FT. MAX.
MODEL 3812:
TRANSDUCER CABLE IS 26 AWG, SHIELDED PAIR, 15 FT. MAX.
FOR OPTIMUM DIAGNOSTIC INTERFACE, WIRING ETHERNET PORT IS RECOMMENDED. USE CAT5 ETHERNET CABLE
INTRINSICALLY SAFE WIRING SHALL BE INSTALLED IN ACCORDANCE WITH THE ARTICLE 504 OF THE NATIONAL ELECTRICAL CODE OR RULE 18-066 OF THE CANADIAN ELECTRICAL CODE.
DIGITAL INPUT 1 (DI1) IS CONTACT CLOSURE ONLY.
TRANSDUCER PAIRS REQUIRED
MODEL NO. | TRANSDUCER PAIRS REQUIRED | TYPICAL CHORDS USED
3814 | 4 | A,B,C,D
3812 | 2 | A,B
3818 | 8 | 2 x MODEL 3814
FODO OUTPUTS 1 THROUGH 6 CAN BE INDEPENDENTLY CONFIGURED TO FUNCTION AS FREQUENCY OUTPUTS OR DIGITAL STATUS OUTPUTS. EACH CAN EACH BE INDEPENDENTLY CONFIGURED TO DRIVE AS TTL OR OPEN COLLECTOR. FODO6 SHARES CONNECTIONS WITH DI1. ON CPU MODULE P/N 1-360-03-066, DI1/FODO6 FUNCTION IS SOFTWARE CONFIGURABLE. GROUP 1 OUTPUTS (GND1) ARE ELECTRICALLY ISOLATED FROM GROUP 2 OUTPUTS (GND2)
EXPLOSION PROOF TRANSMITTER ENCLOSURE AND INTRINSICALLY SAFE BASE ENCLOSURE MUST BE MOUNTED IN A REMOTE LOCATION OFF THE METER BODY IF THE PROCESS TEMPERATURE EXCEEDS THE LOWER OR UPPER AMBIENT RATING -40 °C TO 60 °C (-40 °F TO 140 °F). THE ELECTRONICS MUST BE MOUNTED NEXT TO THE METER BODY ON A PIPE STAND OR OTHER RIGID STRUCTURE.
MODEL 3812:
FOR THE MODEL 3812, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER. THE REMOTE MOUNT OPTION IS LIMITED TO THE PROCESS TEMPERATURE RANGE OF THE APPROPRIATE TRANSDUCER TYPE (SEE NOTE 17).
MODEL 3814:
TRANSDUCER CABLES (P/N 1-360-01-801, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY FOR PROCESS FLUID TEMPERATURES UP TO 100 °C (212 °F). FOR PROCESS FLUID TEMPERATURES UP TO 150 °C (302 °F), THE HIGH TEMPERATURE TRANSDUCER CABLES (P/N 1-360-01-802, 15 FT. LONG OR 1-360-01-803, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY. IN ANY CONFIGURATION, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER.
MODEL 3818:
FOR THE MODEL 3818, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER. THE REMOTE MOUNT OPTION IS LIMITED TO THE PROCESS TEMPERATURE RANGE OF THE APPROPRIATE TRANSDUCER TYPE (SEE NOTE 17).
THE INTERNAL GROUNDING TERMINAL SHALL BE USED AS THE PRIMARY EQUIPMENT GROUND. THE EXTERNAL GROUND TERMINAL IS ONLY A SUPPLEMENTAL BONDING CONNECTION WHERE LOCAL AUTHORITIES PERMIT OR REQUIRE SUCH A CONNECTION.
TO METER. (I.E. PC → TX --> METER → RX) COMM SIGNAL NAMING CONVENTION IS WITH RESPECT
RJ45 SOCKET NUMBERING AND T568B WIRING FOR STANDARD PATCH CABLING. ETHERNET PORTS AUTOMATICALLY DETECT DIRECT PC OR HUB CONNECTION. CROSSOVER NOT REQUIRED FOR DIRECT PC CONNECTION
TOP
FRONT
RJ45 (FEMALE)
RJ45 (MALE)
EXPANSION MODULE RJ45 (FEMALE)
RJ45 (MALE)
CPU MODULE
TX+ --> PIN 1 (O/W) --> PIN 1 (O/W)
TX- --> PIN 2 (O) --> PIN 2 (O)
RX+ --> PIN 3 (G/W) --> PIN 3 (G/W)
RX- --> PIN 6 (G) --> PIN 6 (G)
PC SIDE SERIAL CONNECTION MUST BE WIRED FOR COMPLETE NULL MODEM FOR SUCCESSFULL HOOKUP TO METER
NULL MODEM CONNECTIONS FOR PC END OF CABLE (RS232 WITH NO HANDSHAKING ONLY)
CPU MODULE
DB9 (FEMALE)
RX --> PIN 3
TX --> PIN 2
COM --> PIN 5
PIN 1
PIN 4
PIN 6
PIN 7
PIN 8
FEMALE 9 PIN DSUB CONNECTOR (BACK VIEW)
CPU MODULE DIP SWITCH SETTINGS
SWITCH | DESCRIPTION
PORT A | PORT A OVERRIDE
DHCP | DHCP SERVER ENABLE
WRITE PROT. | MEMORY PROTECT
TO ENABLE THE PORT A OVERRIDE, SWITCH MUST BE MOVED FROM THE OFF TO ON POSITION. PORT A WILL BE SET TO 19200,8,N,1 IO 32 FOR TWO MINUTES.
MODEL 3810 SERIES TRANSDUCERS TYPE LT-01, LT-03, LT-04, LT-05, LT-06, LT-07, LT-08, LT-09, LT-10, LT-11, LT-12, LT-13, LT-14, LT-15, LT-16 AND LT-17.
THE TRANSDUCERS ARE NOT INTENDED FOR USE ACROSS A BOUNDARY WALL.
THE TEMPERATURE CLASSIFICATION OF THE TRANSDUCERS IS THE SAME AS THE ASSOCIATED METER BODY WHEN MOUNTED FROM THE METER BODY. IF THE ELECTRONICS ENCLOSURE IS NOT MOUNTED TO THE METER BODY, REFER TO THE CERTIFICATION LABEL DMC-0206537 ON THE METER BODY FOR THE APPROPRIATE CLASSIFICATION OF THE TRANSDUCERS, T4 OR T3.
PROCESS TEMPERATURE MUST NOT EXCEED THE OPERATING TEMPERATURE RANGE OF THE TRANSDUCERS AS INDICATED IN THE TABLE BELOW.
TRANSDUCER TYPE | PROCESS TEMPERATURE RANGE
LT-01 | -50 °C (-58 °F) TO +100 °C (+212 °F)
LT-03 | -50 °C (-58 °F) TO +100 °C (+212 °F)
LT-04 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-05 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-06 | -196 °C (-321 °F) TO +60 °C (+140 °F)
LT-07 | -196 °C (-321 °F) TO +60 °C (+140 °F)
LT-07B | -196 °C (-321 °F) TO +60 °C (+140 °F)
LT-08 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-09 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-10 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-11 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-12 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-13 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-14 | -50 °C (-58 °F) TO +200 °C (+392 °F)
LT-15 | -50 °C (-58 °F) TO +200 °C (+392 °F)
LT-16 | -50 °C (-58 °F) TO +200 °C (+392 °F)
LT-17 | -50 °C (-58 °F) TO +200 °C (+392 °F)
THE 3410 SERIES METER STANDARD ENCLOSURE OPTION HAS ONLY AVAILABLE SLOT FOR A SINGLE I/O MODULE. THE RETROFIT ENCLOSURE OPTION HAS TWO AVAILABLE SLOTS FOR TWO I/O MODULES. RETROFIT OPTION SUPPORTS INSTALLATION OF ONLY ONE EXPANSION I/O MODULE WITH ETHERNET SWITCH (P/N 1-360-03-026) IN EITHER SLOT
FACTORY CABLE INCLUDES EXPLOSION PROOF SEAL.
SECONDARY SHIELD ONLY PRESENT ON MODEL 3814 AND 3818 LNG TRANSDUCER CABLING.
DIMENSIONS OF FLAMEPROOF JOINTS ARE OTHER THAN THE RELEVANT MINIMUM OR MAXIMUM SPECIFIED IN TABLE 3 OF EN/IEC 60079-1:2014. PLEASE CONTACT MANUFACTURER FOR DETAILS.
ALL CABLE ENTRY DEVICES SHALL BE CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE 'd', SUITABLE FOR THE CONDITIONS OF USE AND CORRECTLY INSTALLED. CONTINUED –>
IECEx UL 11.0004X CERTIFICATE NOTE: TABULATION OF ADDITIONAL PREVIOUS EDITIONS APPLIED
THE FOLLOWING ADDITIONAL PREVIOUS EDITIONS OF STANDARDS NOTED UNDER THE "STANDARDS" SECTION OF THIS CERTIFICATE WERE APPLIED TO INTERNAL COMPONENTS AS ITEMIZED BELOW WHERE THERE HAS BEEN NO SIGNIFICANT CHANGE BETWEEN THESE PREVIOUS EDITIONS AND THE EDITIONS NOTED UNDER THE "STANDARDS" SECTION.
FLAMING ELEMENTS MODEL NUMBER PA-D-3-D-20 OR PA-D-1-1-30 MANUFACTURED BY REDAPT. | IEC 60079-0:2011
THREAD ADAPTERS MODEL NUMBER RS-1-3-D-30-04 OR RS-1-1-D-30-04 MANUFACTURED BY REDAPT. | IEC 60079-0:2011
FIELD WIRING MUST BE RATED FOR 75 °C OR HIGHER. FOR AMBIENT TEMPERATURES BELOW -10 °C (14 °F), USE FIELD WIRING SUITABLE FOR THE MINIMUM AMBIENT TEMPERATURE.
REFER TO THE APPROPRIATE INSTRUCTION MANUAL FOR INSTRUCTIONS FOR SAFETY INCLUDING PUTTING INTO SERVICE, USE, ASSEMBLING AND DISMANTLING, MAINTENANCE, INSTALLATION, AND ADJUSTMENT.
MODEL 3812:
3-9000-765 3812 INSTALLATION MANUAL
3-9000-767 3812 MAINTENANCE AND TROUBLESHOOTING MANUAL
MODEL 3814:
3-9000-760 3810 SERIES INSTALLATION MANUAL
3-9000-764 3814 MAINTENANCE AND TROUBLESHOOTING MANUAL
MODEL 3818:
3-9000-771 3818 INSTALLATION MANUAL
3-9000-772 3818 MAINTENANCE AND TROUBLESHOOTING
LABEL FOR 3810 SERIES FLOW METER:
SERIAL NUMBER IS SEQUENTIALLY INCREMENTING NUMBER
MANUFACTURING DATE IS MM/YY FORMAT
MM = 2-DIGIT MONTH OF MANUFACTURE (01–12)
YY = YEAR OF MANUFACTURE
FOR THE U.L. U.S. MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE UNITED STATES:
UL 1203, 5TH EDITION
UL 508, 18TH EDITION
UL 913, 8TH EDITION
FOR THE U.L.–C MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN CANADA:
CAN/CSA C22.2 No. 30–M1986, REV. 1988, R2016
CAN/CSA C22.2 No. 14–18
CAN/CSA C22.2 No. 157–92
FOR THE ATEX MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE EUROPEAN UNION:
EN 60079-0:2018
EN 60079-1:2014
EN 60079-11:2012
FOR THE IECEX MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS:
IEC 60079-0: 7TH EDITION
IEC 60079-1: 7TH EDITION
IEC 60079-11: 6TH EDITION
SI METRIC
THIRD ANGLE PROJECTION
EMERSON.
3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM
DMC-004936
KB
PROG. FILE NO. USM-01307
FILENAME: DMC004936W03.DWG, DATE: 03-10-22, TIME: 1:54 P.M.
3 OF 4


NOTES:
3810 SERIES ELECTRONICS
EXTERNAL CONNECTIONS
ANALOG INPUT SINK CONFIG
ANALOG INPUT SOURCE CONFIG
ANALOG OUTPUT SINK CONFIG
ANALOG OUTPUT SOURCE CONFIG
EMERSON.
3810 SERIES ULTRASONIC METER
SYSTEM WIRING DIAGRAM
DMC-0049.36

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2023

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