Daniel™ 3810 Series Liquid Ultrasonic Flow Meters

DANIEL™

EMERSON™
Process Management

Daniel customer service

Location	Telephone number	Fax number
North America/Latin America	+1.713.467.6000	+1.713.827.4805
Daniel Customer Service	+1.713.827.6314	+1.713.827.6312
USA (toll free)	+1.888.356.9001	+1.713.827.3380
Asia Pacific (Republic of Singapore)	+65.6777.8211	+65.6777.0947.0743
Europe (Stirling Scotland, UK)	+44 (0)1786.433400	+44 (0)1786.433401
Middle East Africa (Dubai, UAE)	+971 4 8118100	+971 4 8865465
Daniel Measurement and Control, Inc. (Headquarters) 11100 Brittmoore Park Drive Houston, TX 77041 USA http://www.daniel.com		

Email

- Customer Service: tech.service@emersonprocess.com
- Customer Support: daniel.cst.support@emerson.com
- Asia-Pacific: danielap.support@emerson.com
- Europe: DanielEMA.CST@EmersonProcess.com

Return Material Authorization (RMA)
A Return Material Authorization (RMA) number must be obtained prior to returning any equipment for any reason. Download the RMA form from the Support Services web page by selecting the link below. http://www2.emersonprocess.com/EN-US/BRANDS/DANIEL/SUPPORT-SERVICES/Pages/Support-Services.aspx

Signal words and symbols

Pay special attention to the following signal words, safety alert symbols and statements:

⚠ **Safety alert symbol**

This is a safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER!

Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING!

Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION!

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Notice is used to address safety messages or practices not related to personal injury.

Important
Important is a statement the user needs to know and consider.

Tip
Tip provides information or suggestions for improved efficiency or best results.

Note
Note is "general by-the-way" content not essential to the main flow of information.

Important safety instructions

Daniel Measurement and Control, Inc. (Daniel) designs, manufactures and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel must strictly adhere both to the information printed on the product and to all instructions provided in this manual prior to installation, operation, and maintenance.

Daniel also urges you to integrate this manual into your training and safety program.

BE SURE ALL PERSONNEL READ AND FOLLOW THE INSTRUCTIONS IN THIS MANUAL AND ALL NOTICES AND PRODUCT WARNINGS.

⚠ WARNING!

Failure to follow the installation, operation or maintenance instructions for a Daniel product could lead to serious injury or death from explosion or exposure to dangerous substances.

To reduce the risk:

- **Comply with all information on the product, in this manual, and in any local and national codes that apply to this product.**
- **Do not allow untrained personnel to work with this product.**
- **Use Daniel parts and work procedures specified in this manual.**

Product owners (Purchasers):

- Use the correct product for the environment and pressures present. See technical data or product specifications for limitations. If you are unsure, discuss your needs with your Daniel representative.
- Inform and train all personnel in the proper installation, operation, and maintenance of this product.
- To ensure safe and proper performance, only informed and trained personnel should install, operate, repair and maintain this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from: *http://www.Daniel.com*.
- Save this instruction manual for future reference.
- If you resell or transfer this product, it is your responsibility to forward this instruction manual along with the product to the new owner or transferee.
- ALWAYS READ AND FOLLOW THE INSTALLATION, OPERATIONS, MAINTENANCE AND TROUBLESHOOTING MANUAL(S) AND ALL PRODUCT WARNINGS AND INSTRUCTIONS.
- Do not use this equipment for any purpose other than its intended service. This may result in property damage and/or serious personal injury or death.

Product operation (Personnel):

- To prevent personal injury, personnel must follow all instructions of this manual prior to and during operation of the product.

- Follow all warnings, cautions, and notices marked on, and supplied with, this product.

- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from: *http://www.daniel.com*.

- Read and understand all instructions and operating procedures for this product.

- If you do not understand an instruction, or do not feel comfortable following the instructions, contact your Daniel representative for clarification or assistance.

- Install this product as specified in the INSTALLATION section of this manual per applicable local and national codes.

- Follow all instructions during the installation, operation, and maintenance of this product.

- Connect the product to the appropriate pressure and electrical sources when and where applicable.

- Ensure that all connections to pressure and electrical sources are secure prior to and during equipment operation.

- Use only replacement parts specified by Daniel. Unauthorized parts and procedures can affect this product's performance, safety, and invalidate the warranty. "Look-a-like" substitutions may result in deadly fire, explosion, release of toxic substances or improper operation.

- Save this instruction manual for future reference.

Notice

Warranty and Limitations

1. LIMITED WARRANTY: Subject to the limitations contained in Section 2 herein, Daniel Measurement & Control, Inc. ("Daniel") warrants that the licensed firmware embodied in the Goods will execute the programming instructions provided by Daniel, and that the Goods manufactured by Daniel will be free from defects in materials or workmanship under normal use and care and Services will be performed by trained personnel using proper equipment and instrumentation for the particular Service provided. The foregoing warranties will apply until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Daniel, whichever period expires first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services. Products purchased by Daniel from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Daniel has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Daniel thereof in writing during the applicable warranty period, Daniel shall, at its option, correct any errors that are found by Daniel in the firmware or Services or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Daniel to be defective, or refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources or environmental conditions, accident, misuse, improper installation, modification, repair, use of unauthorized replacement parts, storage or handling, or any other cause not the fault of Daniel are not covered by this limited warranty, and shall be at Buyer's expense. Daniel shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by Daniel. All costs of dismantling, reinstallation and freight and the time and expenses of Daniel's personnel and representatives for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Daniel. Goods repaired and parts replaced by Daniel during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Daniel and can be amended only in a writing signed by Daniel. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES. Buyer acknowledges and agrees that corrosion or erosion of materials is not covered by this warranty.

2. LIMITATION OF REMEDY AND LIABILITY: Daniel shall not be liable for damages caused by delay in performance. The remedies of Buyer set forth in this agreement are exclusive. In no event, regardless of the form of the claim or cause of action (whether based in contract, infringement, negligence, strict liability, other tort or otherwise), shall Daniel's liability to Buyer and/or its customers exceed the price to Buyer of the specific goods manufactured or services provided by Daniel giving rise to the claim or cause of action. Buyer agrees that in no event shall Daniel's liability to Buyer and/or its customers extend to include incidental, consequential or punitive damages. The term "consequential damages" shall include, but not be limited to, loss of anticipated profits, revenue or use and costs incurred including without limitation for capital, fuel and power, and claims of Buyer's customers.

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Appendices and reference

1   Startup checklist

1.1   Equipment and information checklist

Table 1-1: Equipment and information checklist

	Site pipe and ID drawings with elevations
	Site wiring diagrams
	Daniel Liquid Ultrasonic Meter calibration data
	Daniel 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 Daniel MeterLink™
	Establish flow in the meter (at lease 4 feet per second to ensure good thermal mixing)
	Save the meter configuration file - your "As Found" record of the meter. In Daniel MeterLink™ select Tools|Edit/Compare Configuration . Click the Read button and select File Save .
	Open File|Program Settings and customize Daniel 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
	From the Logs/Reports menu, click Maintenance Logs/Reports , collect and save a Maintenance Log to record the initial performance of your meter (this is your "As Found" record)
	From the Meter|Field Setup Wizard menu make any configuration adjustments, such as setting the frequency 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)

2 Initial communication set up

Topics covered in this chapter:

- *Set up meter communications*
- *Import a meter record*
- *Export a meter record*
- *Collect As Found logs and reports*
- *Customize Daniel MeterLink settings*
- *Set up Modbus communications*
- *Set up HART® communications*
- *Set up the meter in a DeltaV System*

2.1 Set up meter communications

After the installation of your Daniel Ultrasonic Meter, install Daniel MeterLink™ on your PC or laptop as described in the Daniel MeterLink Software for Gas and Liquid Ultrasonic Flow Meters Quick Start Manual (P/N 3-9000-763) for your operating system (Windows® 2000, Windows® Vista, Windows® 7 or Windows® 8), then configure the meter.

The installation CD is made available with the Daniel MeterLink Software for Gas and Liquid Ultrasonic Flow Meters Quick Start Manual (P/N 3-9000-763) located inside the back cover.

The Daniel MeterLink installation program is available for download from the Daniel Measurement and Control, Inc. website:

http://www.daniel.com/um2.htm

2.1.1 Daniel MeterLink™ configuration utilities

Daniel 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

- Field Setup Wizard
  - Startup
  - General
  - Frequency/Digital Output Sources
  - Frequency Outputs
  - Meter Digital Outputs
  - Current Outputs
  - HART® Outputs
  - Meter Corrections

- Temperature and pressure
- Local Display
- Tools
    - Edit/Compare Configuration
    - Waveform Viewer
    - SOS Calculator
    - Waveform Viewer
    - Outputs Test
    - Transducer Swap-Out
    - Program Download
    - Communications Analyzer

2.1.2   Set up the meter directory

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

2.1.3   Create a new meter record

1. Select Insert, Insert Duplicate, or Add from the File pull-down menu to create a new record.
2. Setup the record by entering a Short Desc, Meter Type, and select the connection type(s) check boxes Direct, Modem, Ethernet.
3. For each connection type selected, a button will be enabled at the bottom of the dialog with the same name. Click these buttons to edit the connection properties for that connection method.
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

Connect to the meter directly through one of the serial ports on the meter using one of the serial ports on your computer. Click Direct to set the following parameters.

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

Note

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

- Comms Address: Enter the communication address that is configured in the meter hardware. The default address for meters from the factory is 32. For Daniel Ultrasonic meters the valid range is from 1 to 247.

- Port: Select the available driver from the list of those installed on your machine.

Note

If using Windows® XP, multiple drivers could be installed, called Communications cable between two computers, one for each COM port on the machine. For Windows® Vista Windows® 7 and Windows™ 8, you cannot use the Communications cable between two computers at this time and must use the Daniel Direct Connection driver.

- Baud Rate: Select the serial port baud rate from the drop-down list for which the meter hardware is configured. The default Baud Rates is 19200.

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 *Section 2.1.4*.

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

- **Note**

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

- Daniel 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 Daniel MeterLink™ has created for this meter. Most of the information required is setup correctly by Daniel MeterLink.

- Baud Rate: Select the desired Baud Rate from the drop-down 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.

- Daniel 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 Daniel MeterLink has created for this meter. Most of the information required is setup correctly by Daniel 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 Daniel ultrasonic meter hardware for Ethernet connectivity. Use the Direct, Modem, Ethernet and Ethernet 2 check boxes 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 Daniel Liquid Ultrasonic meters or you can use 192.168.135.100 if DHCP is enabled in the meter (see DHCP below for more details).

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

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

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

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

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

2.1.7 Ethernet initial connection steps

1. Power up the meter. Verify the Ethernet connection status by the CPU Module "LINK" LED which should be on solid green. Launch Daniel MeterLink and create a new meter record.

2. Shutdown the PC.

3. Plug the Ethernet adapter cable Phoenix end into the meter Field Connection Board connector J8 and connect the RJ-45 end into the PC Ethernet connector.

4. Enable the Ethernet LAN connector DHCP server on the CPU Module by moving the DHCP (switch-1) to the ON position (see direction arrow on the CPU Module label).

5. Power up (boot) the PC and log in to the initial Windows® logon prompt.

6. Verify the Ethernet connection status by the CPU ModuleLINK LED which should be on solid green.

7. Launch Daniel MeterLink and create a new meter record.

2.2 Import a meter record

1. Select File > Import from the Meter Directory drop- down menu or click Import.

2. Select a meter directory.DAT file to import the file into the currently used meter directory file.

   If an identical meter record already exists and a duplicate is trying to be imported, Daniel MeterLink inserts the duplicate meter record. The Import button performs the same operation.

2.3 Export a meter record

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 Daniel Ultrasonic meters. Daniel 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

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2.4 Collect As Found logs and reports

Use the Daniel MeterLink™ Logs/Reports menu and collect and save the logs and reports for a historical record of the meter a t 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 setup in File | Program Settings.

2.5 Customize Daniel MeterLink settings

Open Daniel 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 Daniel 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

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- 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 Daniel Ultrasonic meters

- Tab from spreadsheet to next control instead of next cell

- TCP/IP meter connection database timeout - amount of time Daniel 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

2.6   Set up Modbus communications

Daniel 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 I/O settings required to allow serial communication with the Daniel 3810 Liquid Ultrasonic Flow Meters.

The Daniel 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 Daniel website and select the Product page for the model of your meter.

http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/Ultrasonic.aspx

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: Enter the alternate TCP port number here after selecting Enable alternate modbus TCP port. 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. Daniel MeterLink™ will prompt you if it was not able to write the specified port number to the meter.

2.7   Set up HART® communications

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

The HART Device Description application provides dynamic variables, device-specific commands, universal commands and common practice commands in accordance with the HART Communication Foundation. The Device Description defines the communication details from the device to the host (e.g. menus for the Field Communicator, graphical displays for

AMS Device Manager and the device parameters - process variables, pressure, temperature, diagnostics and three status alert groups - Failed, Maintenance and Advisory). Refer to the HART Field Device Specification (P/N 3-9000-762) for details.

http://www.hartcomm.org/protocol/about/aboutprotocol.html

http://www2.emersonprocess.com/en-US/brands/amssuite/Pages/AMSSuite.aspx

http://www2.emersonprocess.com/en-US/brands/fieldcommunicator/475FC/Pages/475FieldCommunicator.aspx

2.8   Set up the meter in a DeltaV System

Daniel 3810 Series Ultrasonic Flow Meters are compatible with DeltaV System communications. The following are optional communications configurations of Daniel 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 shown below.
- *http://www2.emersonprocess.com/en-US/brands/DeltaV/Pages/index.aspx*
- Click Books Online under Quick Links.
- Setup your user account and access the manual.

3   Flow measurement

Topics covered in this chapter:

- *Flow measurement principles*
- *Smoothing*
- *Acquisition mode*
- *Chord average flow and sound velocity measurements*
- *Volumetric flow rate values*
- *3810 Series liquid flow meter diagnostics*

3.1   Flow measurement principles

Daniel 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
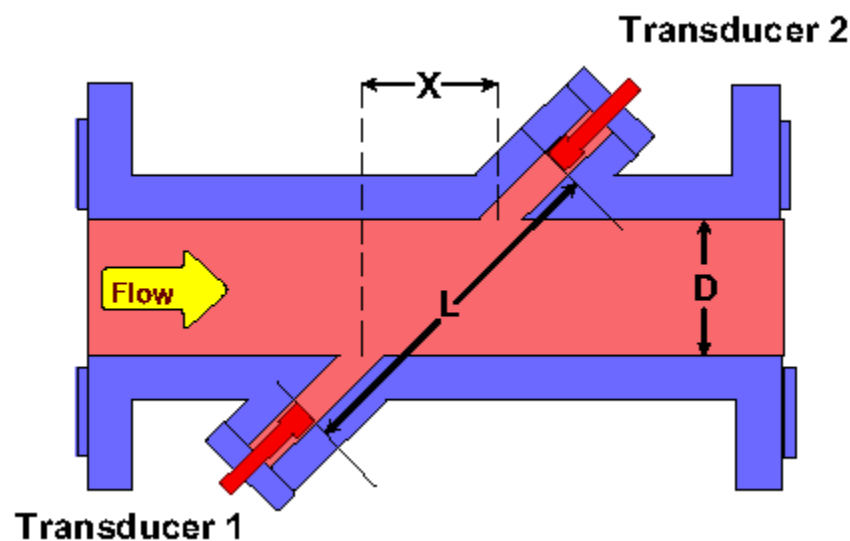
Figure 3-2: Model 3812 measurement principle
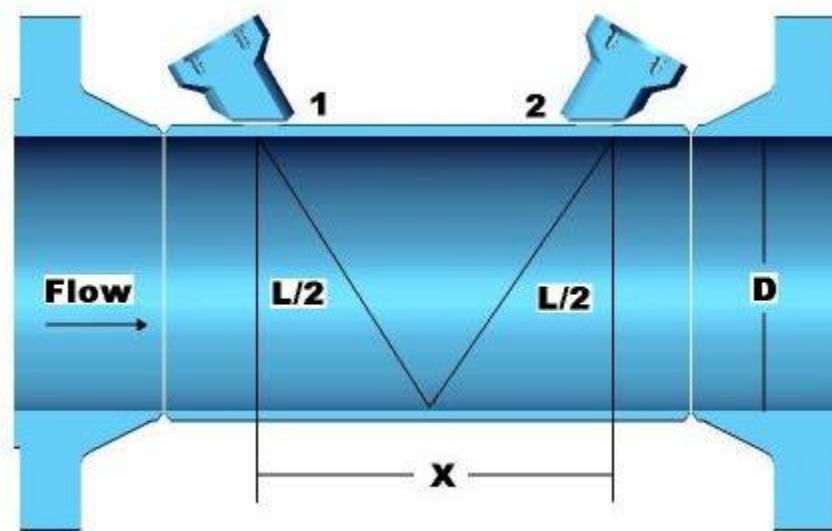
3.1.1 Transducer timing control

Transducer timing control, the performance of batch data collection and calculation updates in Daniel 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
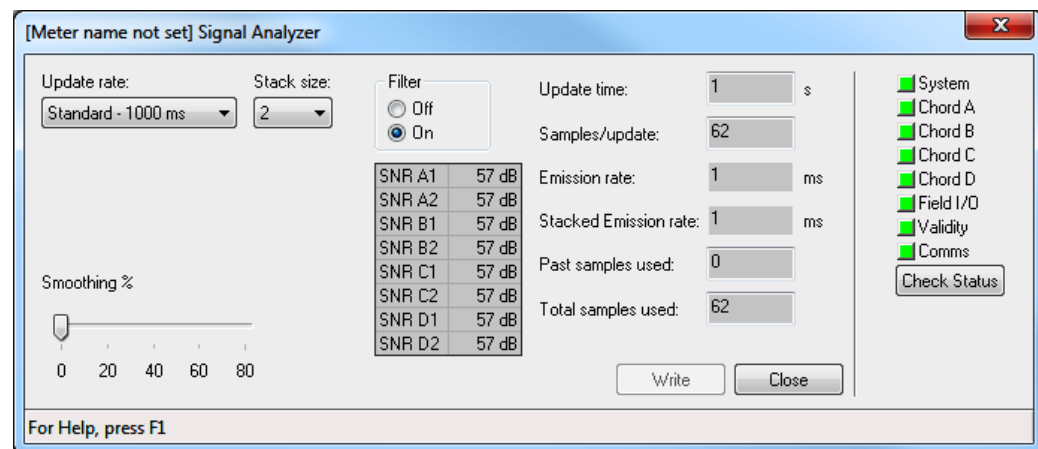
3.1.2 Terminology for flow measurement

Flow measurement terminology

Table 3-1: Terminology for ultrasonic flow meters

Terminology	Definition
Sequence	A complete cycle of firing all enabled transducers in a single round of transducer operation (For example, when all eight transducers of the Model 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). We recommend the default Filter setting, which is the OFF position.
Stack emission rate	The time elapsed before a single transducer is re-fired when stacking is enabled (minimum stack emission rate is 2 milliseconds with the Filter OFF.)
Chords inactive or active	The exclusion or inclusion of a chord-forming pair of transducers in the sequence of transducer operation
Update time	The time elapsed, in seconds, between each processing, or recalculation of data that is collected from sequences of transducer firings
Batch period, or batch cycle	Synonymous with Update time, as defined above.
Sample	Refers to one point on the waveform as in samples per cycle. The data that is collected from one Sequence of transducer operation (This term is displayed in the Daniel MeterLink Signal Analyzer screen, and is nearly synonymous with Sequence, as defined above. That is, Samples/update, as displayed in the Daniel 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 Daniel Customer Service if you are unsure of how stacking a signal can affect the meter's operation. Refer to Technical Support under the Help menu of Daniel 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. The minimum emission rate for the gas meter is 1 milliseconds with the filter ON or OFF. We recommend 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 Daniel Customer Service if you are unsure of how this change can affect the meter's operation. Refer to Technical Support under the Help menu of Daniel 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 4-1. The Standard batch update period is the default. The actual batch update period is readable via the*BatchUpdatePeriod* data point.

Table 3-2: Actual meter update period

SpecBatch-UpddtPeriod	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 Daniel 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 8 new samples are collected, then those 8 samples along with the last 2 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 Daniel 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 AcquisitionVelHold 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

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

Equation 3-2: Chord Speed of Sound

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

Where the *PortAngleFactor* is a dimensionless factor that is dependent upon the chord port angle with respect to the meter body:

for 60 degree port angles,

Equation 3-3: 60° Port Angle Factor

$$PortAngleFactor = \left(1 + \left[0.5 \times \left(\frac{v_{chord}^2}{C_{chord,classic}^2} \right) \times \left(\frac{X_{chord}^2}{L_{chord}^2} \right) \times \tan^2(60°) \right] \right)$$

Equation 3-4: 75° Port Angle Factor

$$PortAngleFactor = \left(1 + \left[0.5 \times \left(\frac{v_{chord}^2}{C_{chord,classic}^2} \right) \times \left(\frac{X_{chord}^2}{L_{chord}^2} \right) \times \tan^2(75°) \right] \right)$$

for all other port angles,

Equation 3-5

PortAngleFactor = 1

V_{chord} =	chord average flow velocity (m/s) (*FlowVelA ... FlowVelD*)	
C_{chord} =	chord average speed of sound (m/s) (*SndVelA ... SndVelD*)	
L_{chord} =	chord "L" dimension (m) (*LA ... LD*)	
X_{chord} =	chord "X" dimension (m) (*XA ... XD*)	
t_1 =	chord average transit time in the upstream direction (s) (*MeanTmA1 ... MeanTmD1*)	
t_2 =	chord average transit time in the downstream direction (s) (*MeanTmA2 ... MeanTmD2*)	

Note

A positive chord average velocity indicates flow in the forward direction whereas a negative chord average velocity indicates flow in the reverse direction.

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 3-6: Average Flow Velocity

$$C_{Avg} = \frac{\sum\limits_{ActiveChords} \cdot C_{Chord}}{NumActiveChords}$$

$C_{Avg} =$ 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, and (3) an indicator that the value is still the default (*Is[Fwd/Rev]Prop[A..D]DfltBin[1..10]*). A chord proportion value is the ratio of the chord velocity to the average weighted flow velocity as shown in *Equation 3-7* below. The default indicator is used to determine if a bin's velocity and proportion data values have been updated from their initialized values. The bins are initialized with the average velocity over the bin's range and meter-geometry-dependent proportion values. All default indicators are initialized to TRUE. The bin data is stored in non-volatile memory.

Equation 3-7: 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 gas 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 3-9 and sets the bin's default indicator to FALSE. ThePropUpdtBatches data point, configurable via the Daniel 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 3-8:   Updating chord proportion bin data values

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

$$Avg\mathrm{Pro}pChordBin_{n+1} = \frac{Avg\mathrm{Pro}pChordBin_n(NumVals - 1) + \mathrm{Pro}p_{Chord}}{NumVals}$$

$AvgVel_{ChordBin_{n+1}}$ =	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 Daniel 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.

Refer to the flow measurement tables in the Daniel 3810 Series Liquid Ultrasonic Product Datasheet (P/N DAN-LIQ-USM-DS-0306) on the Daniel website:

http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/Ultrasonic.aspx

3.5.1 Raw volumetric flow rates

Equation 3-9: Raw Volumetric Flow Rate

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

$Q_{Raw}=$	"raw" volumetric flow rate (m3/h) (QMeter)
$V_{CustomerCal}=$	customer-calibrated average flow velocity (m/s) (AvgFlow)
$\pi =$	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 3-10: Flow condition volumetric flow rate

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

$Q_{Flow}=$	flow-condition volumetric flow rate (m3/h) (QFlow)
$Q_{Raw} =$	"raw" volumetric flow rate (m3/h) (QMeter)
$ExpCorr_P =$	expansion correction factor due to pressure (dimensionless) (ExpCorrPressure)
$ExpCorr_T =$	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 3-11: 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)

β =   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 3-12: Pressure-effect strain per unit stress

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

β =   pipe strain per unit stress (MPaa-1) (**StrainPerUnitStress**)

D_{out} =   outside diameter of the meter or pipe (m) (**PipeOutsideDiameter**)

D_{in} =   inside diameter of the meter or pipe (m) (**PipeDiam**)

V =   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 Temperature Expansion Correction Equation.

Equation 3-13: 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 B-16

Equation 3-14: Reynolds Number

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

$Re=$	Reynolds Number (dimensionless) (**ReynoldsNumber**)
$\pi =$	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**)
$\mu =$	dynamic viscosity (Pa • s) (**Viscosity**)

3.5.6 Volume forward and reverse accumulators

Flow rate forward and reverse volume accumulators

The Daniel 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 3-3* below.

Table 3-3: 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

3.6.1 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.

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

3.6.2   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.

3.6.3   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.

3.6.4   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.

3.6.5   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 (see above). A value of 0 degrees indicates no appreciable swirl.

3.6.6   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   Daniel Liquid Ultrasonic Flow Meters calibration and configuration parameters

4.1   Calibration methods

Factory calibration and user-defined calibration

The Daniel 3810 Series Liquid Ultrasonic Flow Meter uses two calibration corrections: "Factory Calibration" and "Customer Calibration". In this methodology, the "Factory Calibration" values are set by Daniel 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). These two calibration methods are explained in further detail below.

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 Daniel personnel.**

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

Daniel 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 should only be modified under direction of Daniel personnel.
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 Daniel personnel.
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 Daniel personnel.
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 Daniel personnel.
Reverse A0	Data points affected: 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 Daniel personnel.

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

Daniel MeterLink Display Name	Data Points, Options and Guidelines
Reverse A1	Data points affected: 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 Daniel personnel.
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 Daniel personnel.
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 Daniel personnel.

High viscosity calibration method

If the high viscosity calibration method selector (HighViscosityMethod) is "Enabled", then the result of applying the zero calibration high viscosity flow offset is applied to the average weighted flow velocity (shown in the following table).

Table 4-2: High viscosity calibration coefficients

Daniel MeterLink Display Name	Data Points, Options and Guidelines
Forward A0 High Viscosity	Data points affected: • FwdA0HighViscosity 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 Daniel personnel.

Table 4-2: High viscosity calibration coefficients *(continued)*

Daniel MeterLink Display Name	Data Points, Options and Guidelines
Forward A1 High Viscosity	Data points affected: • FwdA1High Viscosity Options: • Enter a value (dimensionless) within the range [0.95,1.05]. Guidelines: • This value should only be modified under direction of Daniel personnel.
Forward A2 High Viscosity	Data points affected: • FwdA2High Viscosity 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 Daniel personnel.
Forward A3 High Viscosity	Data points affected: • FwdA3High Viscosity 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 Daniel personnel.
Reverse A0 High Viscosity	Data points affected: 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 Daniel personnel.
Reverse A1 High Viscosity	Data points affected: Data points affected: • RevA1High Viscosity Options: • Enter a value (dimensionless) within the range [0.95,1.05]. Guidelines: • This value should only be modified under direction of Daniel personnel.

Table 4-2: High viscosity calibration coefficients *(continued)*

Daniel MeterLink Display Name	Data Points, Options and Guidelines
Reverse A2 High Viscosity	Data points affected: • RevA2High Viscosity 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 Daniel personnel.
Reverse A3 High Viscosity	Data points affected: • RevA3High Viscosity 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 Daniel personnel.

4.1.2   Customer calibration method

The Daniel 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 4-3: 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 Daniel MeterLink Calibration - Meter Factors page.

Table 4-3: Customer Calibration

Daniel 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 Daniel personnel.

Should your high viscosity meter need to be re-calibrated, contact Daniel Customer Service. Refer to the *Field Calibration of High Viscosity, Low Reynolds Number Ultrasonic Meter Assemblies Procedure* (Daniel P/N P-02871).

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
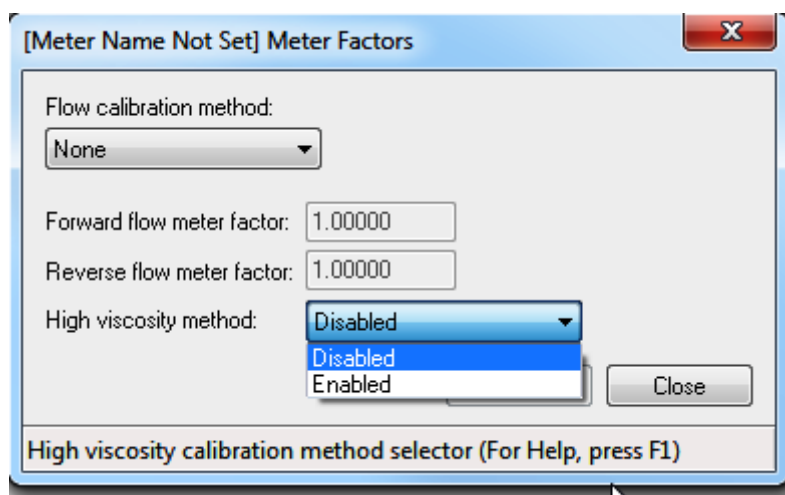
High viscosity meter factors

Table 4-4:   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 4-5:   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
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 4-6:   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

1. Use the Calibration¦Meter Factors menu and select Flow Calibration Method¦Meter Factor from the pull-down menu.

2. Enter the appropriate forward and reverse meter factors and click Write to send the factors to the meter.
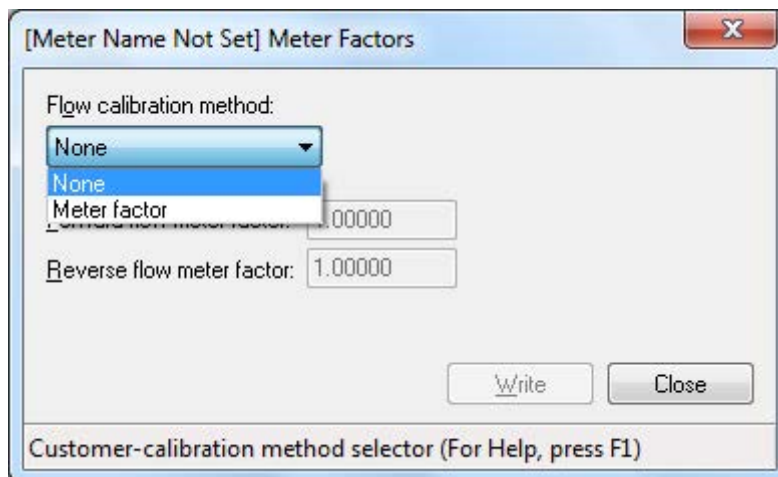
3. For High Viscosity applications, use the Calibration¦Meter Factors menu and select Flow Calibration Method¦Meter Factor from the pull-down menu

    *   Select High Viscosity Method Enabled from the pull-down menu. See *Section 4.1.3* for additional configuration parameters.
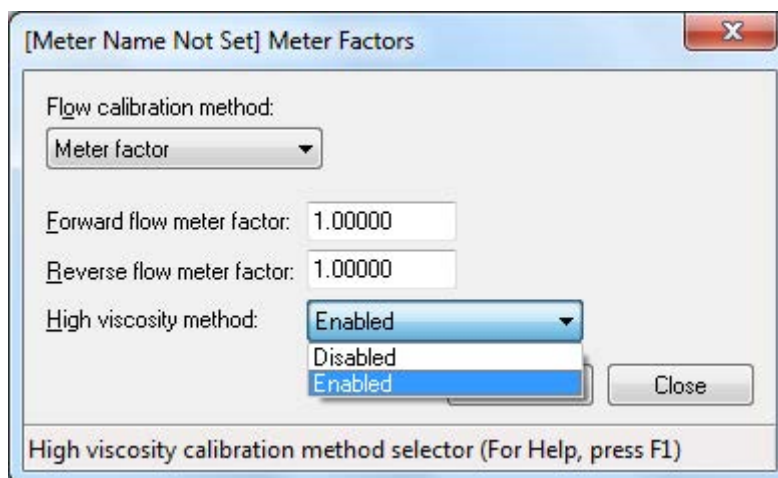
4. Click Close to exit the dialog box. If you made changes, click the Write button to apply the changes.

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

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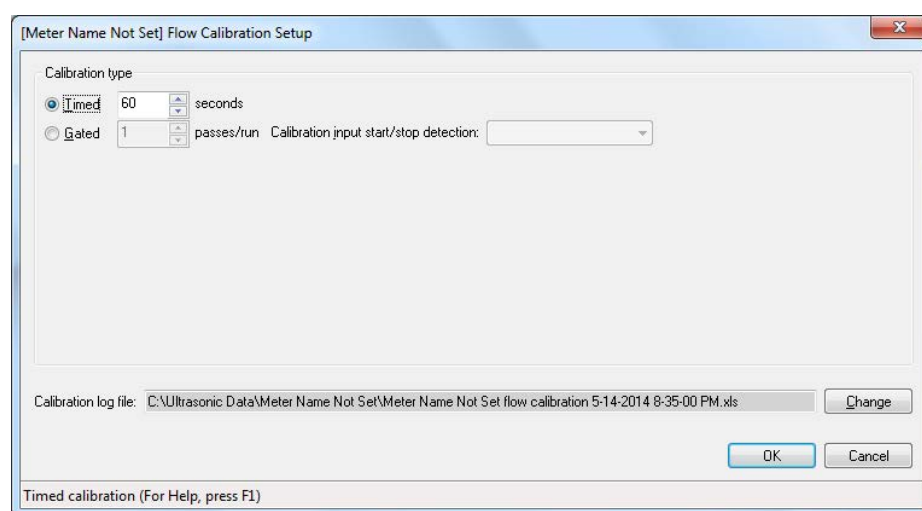
b. Click Change to change the folder location where the Calibration Log file is saved.

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:
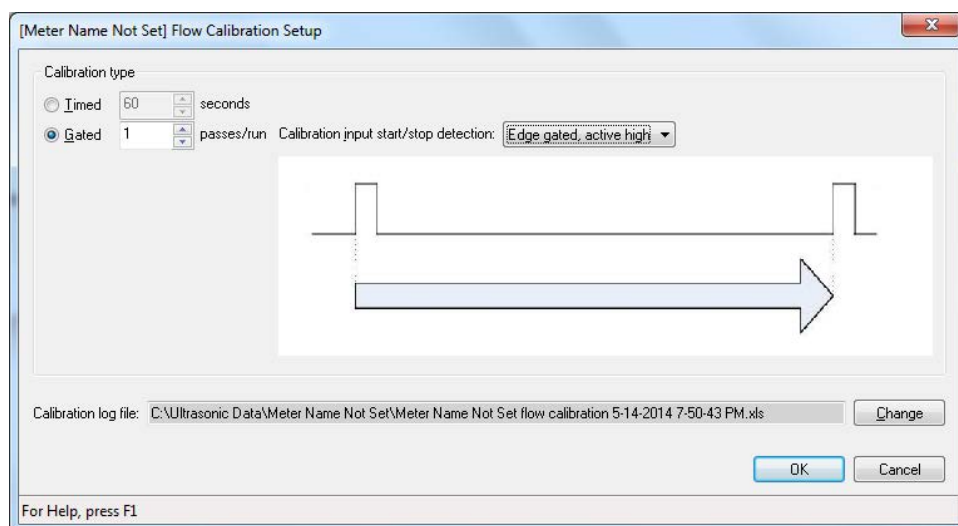
Figure 4-4: Edge gated, active low:
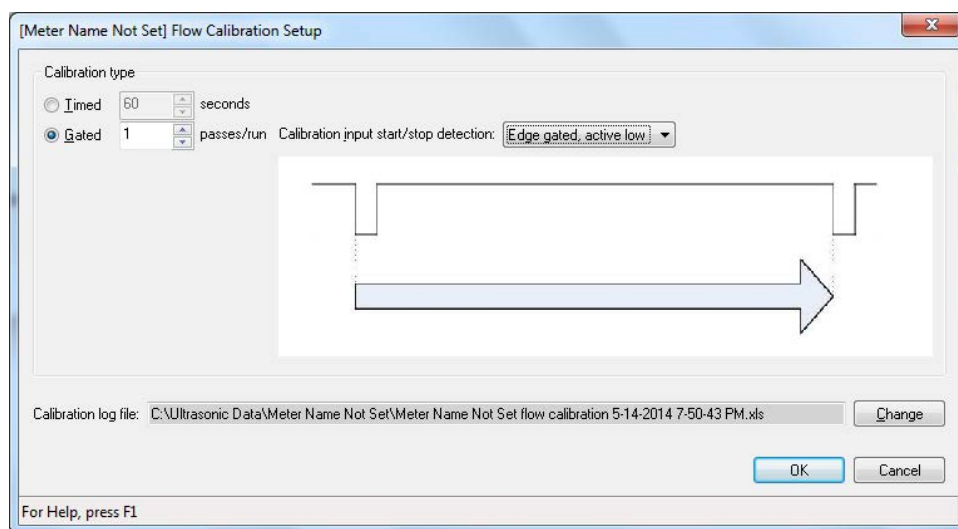
Figure 4-5: State gated, active high:
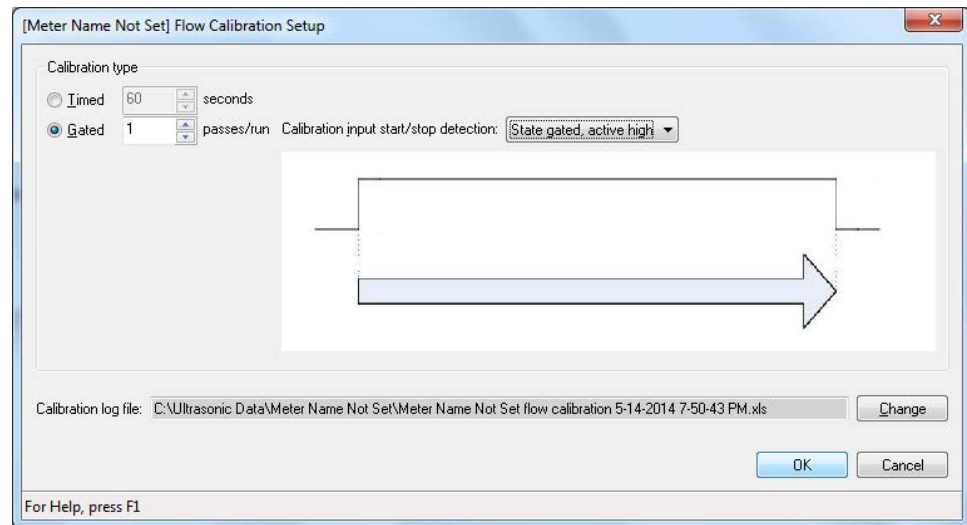
Figure 4-6: State gated, active low:
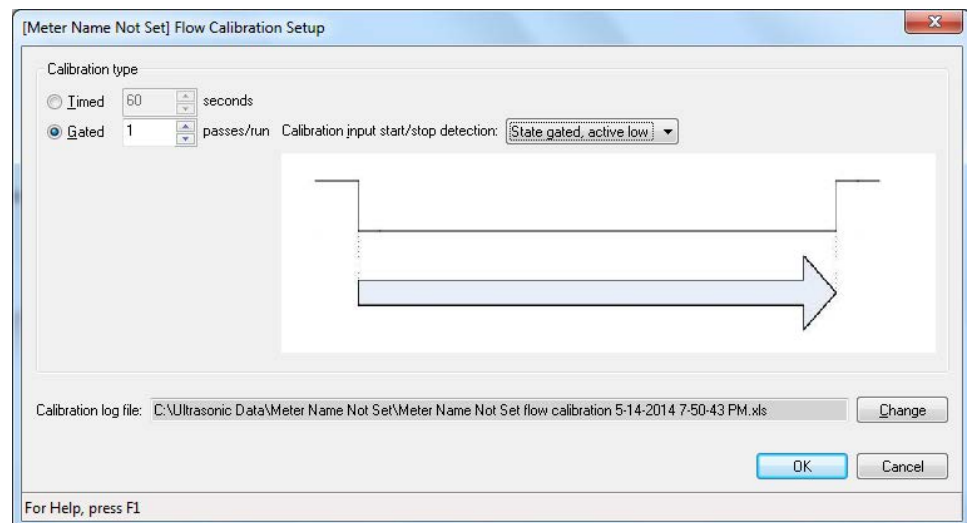
4. Click OK to apply the selected parameters.

   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 Daniel Liquid Ultrasonic meter that is in a no flow condition.

When the dialog is displayed, Daniel 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

Before Performing a Calibration

1.   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.

2.   Make sure the entire volume of the meter is full of the process fluid.

3.   Allow enough time after blocking in the meter before starting the calibration to make sure there is no flow through the meter.

4.   The meter velocity reported by Daniel 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 Daniel 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 Daniel 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

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, Daniel 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:

4.1.8   Save the configuration

1. Use the Daniel 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, and flow calibration coefficients.

4. Click the Read button to display the meter's configuration parameters.

Figure 4-7: Edit/Compare Configuration
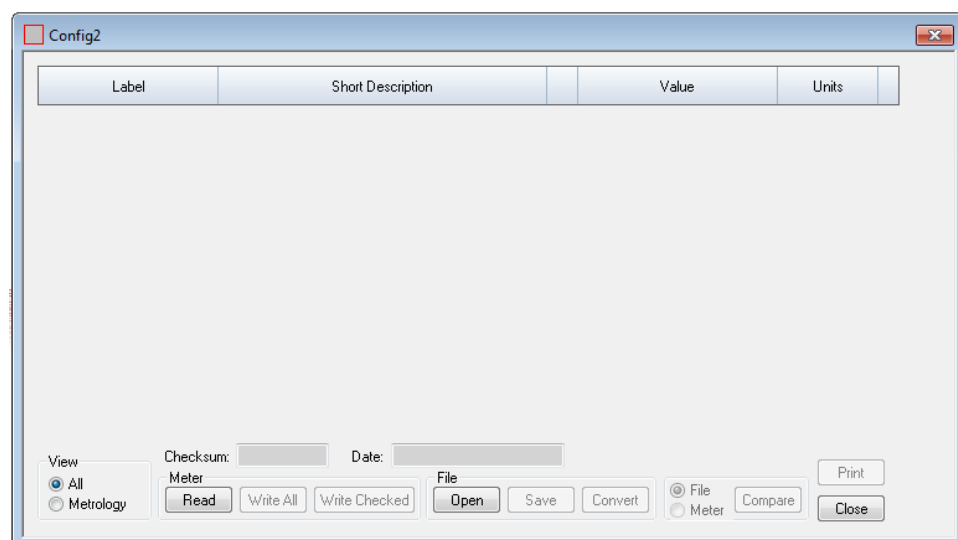
5.   Click Save to open the Save As dialog box.

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.

4.1.9   Calibrate analog inputs and outputs

Using Daniel MeterLink™ Analog Inputs Wizard

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

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

Important

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

Click the Edit Scaling button to modify the input scaling.

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

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 Daniel MeterLink Edit/Compare Configuration screen. It can be set within the range [1, 30 min] and has a default value of 2min.

Analog inputs calibration

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.

   a. The Offset method requires a single calibration point and only affects the input's calibration offset parameter.

   b. 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. Daniel MeterLink 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

5. Click *Finish* to write the values to the meter. If the meter is not configured to use live values from the analog input for calculation, a prompt displays asking if the configuration should be changed to use the live input.

6. Place the WRITE PROT. switch on the CPU Module to **ON** to write-protect the meter's configuration.

Analog output data points

Table 4-7: Analog outputs data points

Daniel Meter-Link 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 **StartAO1** to enter the test mode (TRUE) (**Note:** The Start button will become the Stop button after clicking on it.) • Click **StopAO1** 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.

Table 4-7: Analog outputs data points *(continued)*

Daniel Meter-Link Display Name	Data Points, Options and Guidelines
Current Output Start/StopAO2	Data points affected: **IsAO2EnableTest** Options: Click **StartAO2** to enter the test mode (TRUE) (**Note:** The Start button will become the Stop button after clicking on it.) Click **StopAO2** 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.

Configure Frequency/Digital output sources

The meter has three user-configurable selections for configuring either a Frequency output or Digital output (FODO).

- FODO1 (four possible parameter configurations)
- FODO2 (eight possible parameter configurations)
- FODO3 (eight possible parameter configurations

Frequency or Digital Outputs (FODO 1) source

- FO1A, DO1A, FO1B, DO1B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate or Corrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1 B Phase
- Digital output 1A is based on Digital output1A content (Frequency1A Validity and Flow Direction)

Frequency or Digital Outputs (FODO 2) source

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate or Corrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1B Phase
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 2B is based on frequency content and Frequency 2B Phase
- Digital output 1A is based on Digital output1A content (Frequency 1A Validity and Flow Direction)

- Digital output 1B is based on Digital output 1B content (Frequency 1B Validity and Flow Direction)

- Digital output 2A is based on Digital output 2A content (Frequency 2A Validity and Flow Direction)

- Digital output 2B is based on Digital output 2B content (Frequency 2B Validity and Flow Direction)

Frequency or Digital Outputs (FODO 3) source

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

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

- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate or Corrected Flow Rate)

- Frequency output 1B is based on frequency content and Frequency 1B Phase

- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)

- Frequency output 2B is based on frequency content and Frequency 2B Phase

- Digital output 1A is based on Digital output1A content (Frequency 1A Validity and Flow Direction)

- Digital output 1B is based on Digital output 1B content (Frequency 1B Validity and Flow Direction)

- Digital output 2A is based on Digital output 2A content (Frequency 2A Validity and Flow Direction)

- Digital output 2B is based on Digital output 2B content (Frequency 2B Validity and 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.

The outputs for FODO1 and Digital Output1 (Group 1 on the CPU Module) share a common ground and have 50V isolation. FODO2 and FODO3 (Group 2 on the CPU Module) share a common ground and have 50V isolation. This allows an output to be connected to a different flow computer. The outputs are opto-isolated from the CPU Module and have a withstand voltage of at least 500V rms dielectric.

Figure 4-8: Frequency/Digital Outputs possible configurations

Frequency/Digital output §		Source configuration§
Frequency /Digital Output 1[a]¶ ¶ ¶ ¶ ¶ ¶ ¶	• 〉 Frequency output 1A¶ • 〉 Frequency output 1B¶ • 〉 Digital output 1A¶ • 〉 Digital output 1B¶ ¶ ¶ ¶	§ FODO1 ◀── FO1A FO1B DO1A DO2B
Frequency /Digital Output 2[b]¶ ¶ or ¶ ¶ Frequency /Digital Output 3[b §]	• 〉 Frequency output 1A¶ • 〉 Frequency output 1B¶ • 〉 Digital output 1A¶ • 〉 Digital output 1B¶ • 〉 Frequency output 2A¶ • 〉 Frequency output 2B¶ • 〉 Digital output 2A¶ • 〉 Digital output 2B§	FODO2 ◀── FO2A FO2B DO2A FODO3 ◀── DO2B

A. *Solid blue line denotes valid selection for Frequency/Digital Output 1.*
B. *Black dashed -line denotes valid selections for Frequency/Digital Output 2 and Frequency/Digital Output 3.*

Figure 4-9: CPU Module - Frequency/Digital outputs common ground Group 1
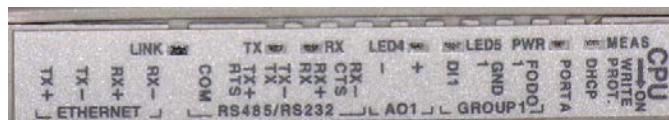
Figure 4-10: CPU Module - Frequency/Digital outputs common ground Group 2

Configure frequency outputs

The Frequency Outputs allows you to configure the available frequency outputs for the meter. If you previously configured one or more Frequency/Digital outputs make selections for the following parameters.

Content

- Valid outputs are based on Uncorrected (Actual) flow rates or on Corrected (Standard) flow rates. If pressure or temperature is set to Not used on the Daniel MeterLink Startup Page, the Corrected (Standard) option will not be available.

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

- Select the maximum frequency for the frequency outputs. Valid options are 1000 Hz and 5000 Hz. This property is disabled if Frequency outputs was cleared on the Startup Page. The frequency outputs will over range up to 7500 Hz.

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

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

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

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

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

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

Frequency Feedback

When frequency feedback is used, the frequency output signal is fed-back into the processor so that error (due to frequency quantization) can be corrected. Frequency quantization is what happens when the desired frequency cannot be exactly represented (since infinite granularity cannot be achieved). The FreqXFeedbackCorrectionPcnt data point specifies the percentage of the error fed back for correction. Typically, this percentage is quite small since in most cases the error is quite small and fluctuates "naturally" about zero. This point is editable via the Tools|Edit/Compare Configuration screen. It is recommended that the FreqXFeedbackCorrectionPcnt not be modified from its default value of 1%. Setting FreqXFeedbackCorrectionPcnt to zero, effectively disables frequency feedback.

Configure digital input/outputs

Daniel 3810 Liquid Ultrasonic Flow Meters provide one digital input (referred to as DI1). Digital Input 1 available indicator is based on the CPU Module's I/O board. 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 Daniel MeterLink Field Setup Wizard. It must be configured via the Daniel MeterLink Tools|Edit/Compare Configuration. The value of the input is accessible via the DI1 data point.

Digital Input calibration

The IsDI1 UsedForCal 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

For detailed digital proving configuration, refer to *Section 4.1.5*

Digital output

Select the function for which the digital output should be configured. Available options are:

- validity
- flow direction

Figure 4-11: Digital outputs
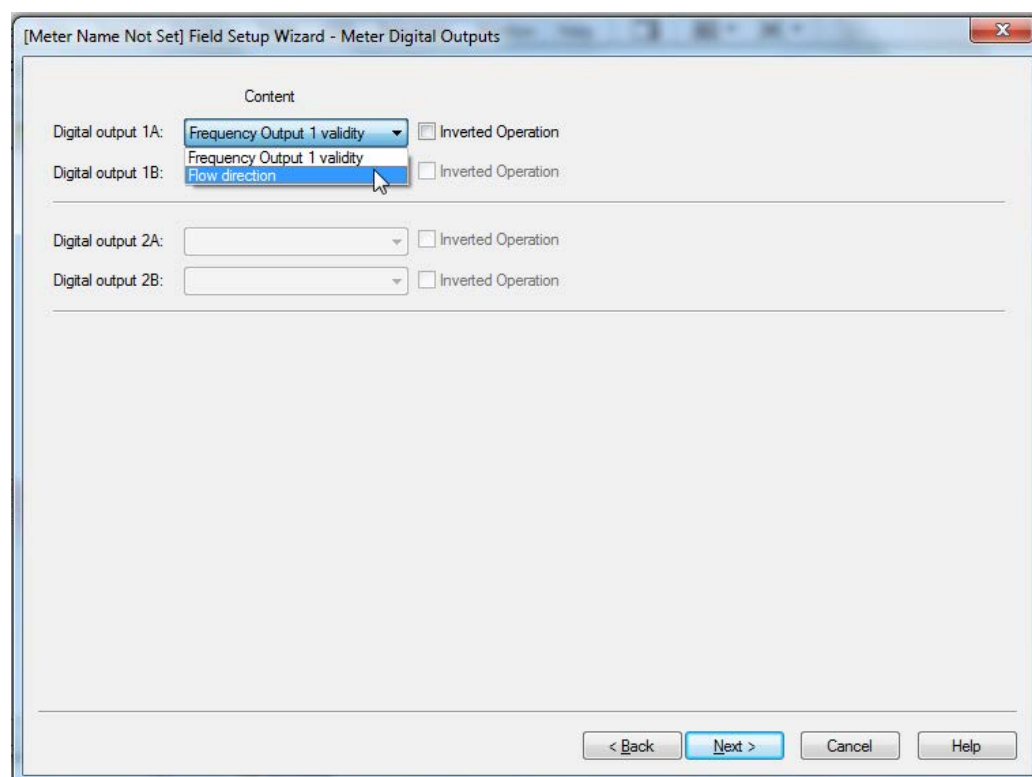
The inverted operation option is useful if the output of the ultrasonic meter is reversed from what a flow computer is expecting. This means that if the output normally outputs a HIGH for a TRUE condition, selecting this checkbox will change the output to output a LOW for a TRUE condition.

Outputs test mode

Frequency outputs test

The Daniel 3810 Series Liquid Ultrasonic Flow Meter provides a mode of operation for individually testing the frequency output signal pairs. Entering, configuring, and exiting this mode is accomplished by setting data points using the Daniel MeterLink Tools - Outputs Test screen.

Figure 4-12: 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.

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

To fix the frequency and current outputs to a user-defined value, enter the desired percentage of full-scale into the Output setting. For Daniel 3810 Series 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.

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

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

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

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

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

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

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

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

Configure HART outputs

Configure the HART outputs of the Daniel Ultrasonic meter. For additional information refer to the HART Field Device Specification (P/N 3-9000-762).

Configure the HART outputs for the device

Use the Daniel MeterLink Field Setup Wizard to configure the HART process variables.

Figure 4-13: HART outputs

1. Click the HART outputs checkbox on the Field Setup Wizard Startup page.

2. Use the pull-down menu to select the Process variables,

   • Primary variable - Uncorrected flow rate
   • Secondary variable - Uncorrected flow rate
   • Third variable - Uncorrected flow rate, pressure or temperature
   • Fourth variable - Uncorrected flow rate, pressure or temperature

3. Input the device identification parameters,

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

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

Configure meter corrections

The Field Setup Wizard Meter Corrections Page allows you to enter properties for:

- Temperature expansion correction
- Pressure expansion correction

Figure 4-14: Field Setup Wizard Startup

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).

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

- last good value (0), or
- fixed value (1).

This data point (FlowPOrTSrcUponAlarm) is configurable via the Daniel MeterLink Tools|Edit/ Compare Configuration screen. The default parameter is to use the "last good value".

Configure meter temperature expansion corrections

1.   Enable Live or Fixed for Temperature for meter corrections and Temperature expansion correction on the Meter|Field Setup Startup page.

2.   Click Next until the Field Setup Wizard - Meter Corrections page displays.

3.   Enter the linear expansion coefficient of the meter body material.

Figure 4-15: Field Setup Wizard - Meter Corrections

4.   Enter the reference temperature for the Linear expansion coefficient.

5.   Enter the Pressure expansion correction if desired.

Configure meter pressure expansion corrections

1.   Enable Live or Fixed for Pressure for meter corrections and Pressure expansion correction on the Field Setup Wizard Startup page.

2.   Enter the outside diameter of the meter body.

3.   Enter the Young's Modulus value (ratio of tensile stress to tensile strain).

4.   Enter the Poisson's Ratio value (the absolute ratio of the pipe material lateral strain over axial strain).

5.   Click Next until the Finish button displays in the Field Setup Wizard to write the corrections to the meter.

Pressure and temperature data updates

The Daniel 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, or fixed).

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.

Table 4-8: Flow-condition pressure and temperature data source

Input Type (Enable-PressureInput 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*	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)**

Note

*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 4-4: Flow-condition absolute flow pressure

$$\rho_{abs,f} = \rho_f + \rho_{Atmosphere} \quad Input\,\mathrm{P}ressureUnit = False\,(Gage)$$

$$\rho_{abs,f} = \rho_f \quad Input\,\mathrm{P}ressureUnit = True\,(Absolute)$$

$P_{abs,\,f}$ flow-condition absolute pressure (MPaa) (**AbsFlowPressur**e)

P_f flow-condition pressure (MPa if **InputPressureUnit**=FALSE, MPaa if **InputPressureUnit**=TRUE) (**FlowPressure**)

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

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).

Enable the checkbox on the Field Setup Wizard - General page to generate this alarm.

Note

You must have a valid **ContinuousFlowAnalysisKey** for this feature.

Figure 4-16: Reverse flow alarm

Configure local display parameters

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

Figure 4-17: 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
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

Local Display label description	Valid units
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
AO1 - 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 drop-down arrow 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.

5 Archive logs and reports

Topics covered in this chapter:

- *Archive logs and reports*
- *Event log: alarm/audit*
- *Collecting and viewing log records*
- *Collecting maintenance logs*
- *Collecting trend maintenance logs*
- *Collecting meter archive logs*

5.1 Archive logs and reports

5.1.1 Archive logs types

Daniel 3810 Series Liquid Ultrasonic Flow Meters provides five types of archive data logs which you can read and optionally save.

- daily logs
- hourly logs
- audit logs
- alarm logs
- system logs

5.1.2 Daily and hourly log data point actions

Five different log data point actions are supported by the daily and hourly logs.

- 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: causes the data point's flow-gated average value over the log interval (day or hour) to be recorded. A point's flow-gated average is the average of its values when the flow is above the low-flow cut-off. If the flow does not exceed the cut-off during the interval, then the data point's flow-gated average is the same as its regular (non-flow gated) average.

- 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.

5.1.3   Daily log report

Use the Daniel MeterLink Logs/Reports menu to access this tool.

Figure 5-1: Archive logs options

The Daniel 3810 Series Liquid Ultrasonic Flow Meter stores a daily log record once per day at the specified contract hour. Specify the Contract hour for daily log from the Field Setup Wizard - General page.

Figure 5-2: Field Setup Wizard - General page Contract Hour

The meter can store up to 365 daily 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 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 Daniel MeterLink Tools|Edit/Compare Configuration screen. The default is to overwrite old, unread records.

The data points included in the daily log and the corresponding log action are as shown in the *Daily log content data* tables. Data points required by the API Chapter 21 standard are marked with an asterisk (*). For information on a particular data point, consult Daniel MeterLink online help (see the help topic for any data point in Daniel 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 clickDisplay .)

Daily log content data

Table 5-1: Daily log action type

Data point	Log action
PosVolFlow *	Totalize and Snapshot
NegVolFlow *	Totalize and Snapshot

Table 5-1: Daily log action type *(continued)*

Data point	Log action
PosVolBase	Totalize and Snapshot
NegVolBase	Totalize and Snapshot
FlowTemperature *	Flow-Gated
FlowPressure *	Flow-Gated
AbsFlowPressure *	Flow-Gated
AccumFlowTime *	Totalize
AvgSndVel *	Flow-Gated

PrevDayMacro1 * :		**Macro**
bit 31-30	(unused)	
bit 29	DI1	
bits 28-25	(unused)	
bit 24	IsAcqModuleError	
bit 23	DidPowerFail	
bit 22	DidCnfgChksumChg	
bit 21	IsElecTempOutOfRange	
bit 20	IsElecVoltOutOfRange	
bit 19	(unused)	
bit 18	(unused)	
bits 17-0	(unused)	

PrevDayMacro2 * : bit num-bered	Data point	Macro
bit 31	(unused)	Chords A and B - dual-path me-ters
bit 30	IsMeasSndSpdRange	
bit 29	IsAvgSoundVelRangeErr	Chords A - D - four path meters
bit 28	IsMeterVelAboveMaxLmt	
bit 27	IsHardFailedA	
bit 26	IsHardFailedB	
bit 25	IsHardFailedC	
bit 24	IsHardFailedD	
bit 23	(unused)	
bit 22	IsSNRTooLow	
bits 21-19	(unused)	
bit 18	IsPressureInvalid	
bit 17	IsTemperatureInvalid	
bit 16	IsAnyLogFull	
bit 15-10	(unused)	
bit 9	(unused)	
bit 8	(unused)	
bit7	(unused)	
bit 6	(unused)	
bit 5	IsReverseFlowDetected	
bit 4	IsSndVelCompErr	
bit 3	(unused)	
bits 4-0	(unused)	

Data point	Log action
SndVelA SndVelB SndVelC SndVelD	Flow-Gated
FlowVelA FlowVelB FlowVelC FlowVelD	Flow-Gated
AvgFlow	Flow-Gated
(Percent of good batch signals) PctGoodA1, PctGoodA2 PctGoodB1, PctGoodB2, PctGoodC1, PctGoodC2, PctGoodD1, PctGoodD2	Paths A1-B1, A2-B2 Dual-path meters Paths C1-D1, C2-D2 4-path meters
QFlow	Flow-Gated
PosVolFlow	Snapshot

Data point	Log action
NegVolFlow	Snapshot
PosVolBase	Snapshot
NegVolBase	Snapshot

Data point	Log action
Symmetry	Flow-Gated
CrossFlow	Flow-Gated
TurbulenceA	Flow-Analysis-Gated
TurbulenceB	Flow-Analysis-Gated
TurbulenceC	Flow-Analysis-Gated
TurbulenceD	Flow-Analysis-Gated
CrossFlow	Flow-Analysis-Gated
Symmetry	Flow-Analysis-Gated
ProfileFactor	Flow-Analysis-Gated
SwirlAngle	Flow-Analysis-Gated
CnfgChksumValue	Snapshot
CnfgChksumDate	Snapshot

Data point	Log action
(Transducer Gain) GainA1, GainA2, GainB1, GainB2, GainC1, GainC2, GainD1, GainD2	Average
(Signal Energy) SEA1, SEA2, SEB1, SEB2, SEC1, SEC2, SED1, SED2	Average
(Noise Energy) NEA1, NEA2, NEB1, NEB2, NEC1, NEC2, NED1, NED2	Average
(Transit time standard deviation) SDevTmA1 SDevTmA2 SDevTmB1 SDevTmB2 SDevTmC1 SDevTmC2 SDevTmD1 SDevTmD2	Flow-Gated

5.1.4   Hourly log report

The Liquid Ultrasonic Meter stores an hourly log record once per hour on the hour. The meter can store up to 2400 hourly records (100 days' worth). 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 Daniel MeterLink Tools|Edit/Compare Configuration screen. The default is to overwrite old, unread records. 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 *Hourly log data content* . Data points required by the API Chapter 21 standard are marked with an asterisk (*). For information on a particular data point, consult Daniel MeterLink online help, Liquid 3810 Series Registers Reference.

Hourly log data content

Date point	Log action
PosVolFlow*	Totalize and Snapshot
NegVolFlow*	Totalize and Snapshot
FlowTemperature*	Flow-Gated
FlowPressure*	Flow-Gated
AbsFlowPressure*	Flow-Gated
AccumFlowTime*	Totalize
AvgSndVel*	Flow-Gated

PrevDayMacro1*	Date point
bit 31	(unused)
bit 30	(unused)
bit 29	DI1
bits 28-26	(unused)
bit 25	IsDetectionErr
bit 24	IsAcqModuleErr
bit 23	DidPowerFail
bit 22	DidCnfgChksumChg
bit 21	IsElecTempOutOfRange
bit 20	IsElecVoltOutOfRange
bits 19-0	(unused)

PrevDayMacro2*	Data point
bit 31	(unused)
bit 30	IsMeasSndSpdRange
bit 29	IsAvgSoundVelRangeErr
bit 28	IsMeterVelAboveMaxLmt
bit 27	IsHardFailedA
bit 26	IsHardFailedB
bit 25	IsHardFailedC
bit 24	IsHardFailedD
bit 23	IsPkSwDetect
bit 22	IsSNRTooLow
bit 21	IsAnyXdcrMaintReqd
bit s 20-19	(unused)
bit 18	IsPressureInvalid
bit 17	Is TemperatureInvalid
bit 16	IsAnyLogFull
bit 15-6	(unused)
bit 5	IsReverseFlowDetected
bits 4-0	(unused)

Date point	Log action
SndVelA SndVelB SndVelC SndVelD	Flow-Gated
FlowVelA FlowVelB FlowVelC FlowVelD	Flow-Gated
AvgFlow	Flow-Gated
(Percent of good batch signals) PctGoodA1, PctGoodA2 PctGoodB1, PctGoodB2, PctGoodC1, PctGoodC2, PctGoodD1, PctGoodD2	Average
QFlow	Flow-Gated
QBase	Flow-Gated
Viscosity	Flow-Gated

5.1.5   Audit log report

The Daniel 3810 Series Liquid Ultrasonic Flow Meter stores an audit log record whenever any parameter affecting the liquid flow measurement is modified. The audit log record indicates which data point changed, the date and time of the change, and both the "As-found" and "As-left" values.

The meter can store up to 3000 audit records. The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point DoOverwriteUnreadAuditLog. This point can be modified using the Daniel MeterLink Tools - Edit/Compare Configuration screen. The default is to overwrite old, unread records. Refer to *Section 5.2.5* 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 for the audit log are as shown in (*Table 5-2*). 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 and Temperature
- Reynolds Number Calculation
- Signal Processing
- Tracking

Audit log data

Group monitored data points

Table 5-2:   Audit log calibration group monitored data points

Calibration data group data points
AvgDlyA
AvgDlyB

Table 5-2: Audit log calibration group monitored data points *(continued)*

Calibration data group data points
AvgDlyC
AvgDlyD
CalFlag
CalMethod
DltDlyA
DltDlyB
DltDlyC
DltDlyD
FwdA0
FwdA1
FwdA2
FwdA3
FwdFlwRt1
FwdFlwRt10
FwdFlwRt11
FwdFlwRt12
FwdFlwRt2
FwdFlwRt3
FwdFlwRt4
FwdFlwRt5
FwdFlwRt6
FwdFlwRt7
FwdFlwRt8
FwdFlwRt9
FwdMtrFctr1
FwdMtrFctr10
FwdMtrFctr11
FwdMtrFctr12
FwdMtrFctr2
FwdMtrFctr3
FwdMtrFctr4
FwdMtrFctr5
FwdMtrFctr6
FwdMtrFctr7
FwdMtrFctr8
FwdMtrFctr9

Table 5-2:   Audit log calibration group monitored data points *(continued)*

Calibration data group data points
LA
LB
LC
LD
PipeDiam
RevA0
RevA1
RevA2
RevA3
RevFlwRt1
RevFlwRt10
RevFlwRt11
RevFlwRt12
RevFlwRt2
RevFlwRt3
RevFlwRt4
RevFlwRt5
RevFlwRt6
RevFlwRt7
RevFlwRt8
RevFlwRt9
RevMtrFctr1
RevMtrFctr10
RevMtrFctr11
RevMtrFctr12
RevMtrFctr2
RevMtrFctr3
RevMtrFctr4
RevMtrFctr5
RevMtrFctr6
RevMtrFctr7
RevMtrFctr8
RevMtrFctr9
SystemDelay
WtA ... WtD

Table 5-2:   Audit log calibration group monitored data points *(continued)*

Calibration data group data points
XA ... XD

Table 5-3:   Audit log Chord proportions group monitored data points

Chord proportions data group data points
LowFlowLmt
NumVals
PropUpdtBatches
ResetProp

Table 5-4:   Audit log communication group monitored data points

Communications data group data points
CommTCPTimeoutPortA
CommTCPTimeoutPortB

Table 5-5:   Audit log co-located meter group monitored data point

Co-located meter data group data point
ColocMeterMode

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

Data logging group data points
AlarmTurnOffHysterisisCount
AlarmTurnOffHysterisisTimeSpan
ContractHour
DailyLogInterval
HourlyLogInterval

Table 5-7:   Audit log expansion correction group monitored data points

Expansion correction data group data points
EnableExpCorrPress
EnableExpCorrTemp
LinearExpansionCoef
PipeOutsideDiameter

Table 5-7: Audit log expansion correction group monitored data points *(continued)*

Expansion correction data group data points
PoissonsRatio
RefTempLinearExpCoef
YoungsModulus
Viscosity

Table 5-8: Audit log flow analysis group monitored data points

Expansion correction data group data points
EnableExpCorrPress
EnableExpCorrTemp
LinearExpansionCoef
PipeOutsideDiameter
PoissonsRatio
RefPressExpCoef
RefTempLinearExpCoef
YoungsModulus

Table 5-9: Audit log frequency, digital and analog group monitored data points

Frequency, digital, and analog signals data group data points
AO1ActionUponInvalidContent
AO1Content
AO1CurrentTrimGain
AO1CurrentTrimZero
AO1Dir
AO1FullScaleEnergyRate
AO1FullScaleMassRate
AO1FullScaleVolFlowRate
AO1MaxVel
AO1MinVel
AO1TestModeOutputPercent
AO1TrimCurrent
AO1TrimGainExtMeasCurrent
AO1TrimZeroExtMeasCurrent
AO1ZeroScaleEnergyRate
AO1ZeroScaleMassRate

Table 5-9: Audit log frequency, digital and analog group monitored data points
  (continued)

Frequency, digital, and analog signals data group data points
AO1ZeroScaleVolFlowRate
AO2ActionUponInvalidContent
AO2Content
AO2CurrentTrimGain
AO2CurrentTrimZero
AO2Dir
AO2FullScaleEnergyRate
AO2FullScaleMassRate
AO2FullScaleVolFlowRate
AO2MaxVel
AO2MinVel
AO2TestModeOutputPercent
AO2TrimCurrent
AO2TrimGainExtMeasCurrent
AO2TrimZeroExtMeasCurrent
AO2ZeroScaleEnergyRate
AO2ZeroScaleMassRate
AO2ZeroScaleVolFlowRate
DI1IsInvPolarity
DO1AContent ... DO1BContent
DO1AIsInvPolarity ... DO1BIsInvPolarity
DO1PairTestEnable
DO2AContent ... DO2BContent
DO2AIsInvPolarity... DO2BIsInvPolarity
DO2PairTestEnable
FODO1Mode
FODO1Source
FODO2Mode
FODO2Source
FODO3Mode
FODO3Source
Freq1BPhase
Freq1Content
Freq1Dir
Freq1FeedbackCorrectionPcnt

Table 5-9: Audit log frequency, digital and analog group monitored data points *(continued)*

Frequency, digital, and analog signals data group data points
Freq1FullScaleEnergyRate
Freq1FullScaleMassRate
Freq1FullScaleVolFlowRate
Freq1MaxFrequency
Freq1MaxVel
Freq1MinVel
Freq1TestModeOutputPercent
Freq1ZeroScaleEnergyRate
Freq1ZeroScaleMassRate
Freq1ZeroScaleVolFlowRate
Freq2BPhase
Freq2Content
Freq2Dir
Freq2FeedbackCorrectionPcnt
Freq2FullScaleEnergyRate
Freq2FullScaleMassRate
Freq2FullScaleVolFlowRate
Freq2MaxFrequency
Freq2MaxVel
Freq2MinVel
Freq2TestModeOutputPercent
Freq2ZeroScaleEnergyRate
Freq2ZeroScaleMassRate
Freq2ZeroScaleVolFlowRate
IsAO1EnableTest
IsAO2EnableTest
IsDI1ForCalActiveLow
IsDI1ForCalStateGated
IsFreq1BZeroedOnErr
IsFreq1EnableTest
IsFreq2BZeroedOnErr
IsFreq2EnableTest

Table 5-10: Audit log HART data group monitored data points

HART data group data points
HARTDate
HARTDescriptor
HARTDeviceFinalAssyNum
HARTLongTag
HARTMessage
HARTMinNumPreambles
HARTNumPreambleBytesFromSlave
HARTPollingAddress
HARTPressureUnit
HARTQVContent
HARTRateTimeUnit
HARTSlot0Content
HARTSlot1Content
HARTSlot2Content
HARTSlot3Content
HARTTag
HARTTemperatureUnit
HARTTVContent
HARTVelUnit
HARTVolUnit

Table 5-11: Audit log general group monitored data points

General data group data points
AlarmDef
AsyncEnable
AvgSoundVelHiLmt
AvgSoundVelLoLmt
ChordalConfig
ChordInactvA
ChordInactvB
ChordInactvC
ChordInactvD
DampEnable
DeviceNumber
DitherEnable

Table 5-11: Audit log general group monitored data points *(continued)*

General data group data points
FlowDir
MaxNoDataBatches
MeterMaxVel
MinChord
MinPctGood
NonNormalModeTimeout
RTCSecondsSinceEpochSet
SSMax
SSMin
UnitsSystem
VelHold
VolFlowRateTimeUnit
VolUnitMetric
VolUnitUS
XdcrFiringSync
ZeroCut

Table 5-12: Audit log indicators group monitored data points

Audit log indicators group data points
CnfgChksumDate
CnfgChksumValue
DidCnfgChksumChg
DidColdStart
DidPowerFail
DoWarmStart
IsConfigProtected
IsCorePresent
PowerFailTime
WatchDogReset

Table 5-13: Audit log local display group monitored data points

Local display data group data points
LocalDisplayFlowRateTimeUnit
LocalDisplayItem1

Table 5-13: Audit log local display group monitored data points *(continued)*

Local display data group data points
LocalDisplayItem10
LocalDisplayItem2
LocalDisplayItem3
LocalDisplayItem4
LocalDisplayItem5
LocalDisplayItem6
LocalDisplayItem7
LocalDisplayItem8
LocalDisplayItem9
LocalDisplayScrollDelay
LocalDisplayVolUnitMetric
LocalDisplayVolUnitUS

Table 5-14: Audit log meter information group monitored data points

Meter information data group data points
CPUBdBootLoaderSwVer
CPUBdSwVer
Eth1DfltGatewayAddr
Eth1IPAddr
Eth1SubnetMask
FileSysVer
MeterSerialNumber
OSVer
UserScratch1
UserScratch2

Table 5-15: Audit log pressure and temperature group monitored data points

Pressure and temperature data group data points
AtmosphericPress
EnablePressureInput
EnableTemperatureInput
FlowPOrTSrcUponAlarm
FlowPressureWhileCal
FlowTemperatureWhileCal

Table 5-15: Audit log pressure and temperature group monitored data points
(continued)

Pressure and temperature data group data points
HighPressureAlarm
HighTemperatureAlarm
InputPressureUnit
LiveFlowPressureCalCtrl
LiveFlowPressureGain
LiveFlowPressureOffset
LiveFlowTemperatureCalCtrl
LiveFlowTemperatureGain
LiveFlowTemperatureOffset
LowPressureAlarm
LowTemperatureAlarm
MaxInputPressure
MaxInputTemperature
MinInputPressure
MinInputTemperature

Table 5-16: Audit log Reynolds number calculation group monitored data point

Reynolds number calculation group data point
Viscosity

Table 5-17: Audit log signal processing group monitored data points

Signal processing data group data points
BatchPercentSmoothing
BatchSize
CRange
DltChk
EmRateActual
EmRateDesired
Filter
FireSeq
GainHighLmt
GainLowLmt
MaxHoldTm

Table 5-17: Audit log signal processing group monitored data points *(continued)*

Signal processing data group data points
MaxNoise
MinHoldTime
MinSigQlty
NegSpan
Pk1Pct
Pk1Thrsh
Pk1Wdth
PosSpan
SampInterval
SampPerCycle
SetXdcrType
SndSpdChkMaxVel
SndSpdChkMinVel
SNRatio
SpecBatchUpdtPeriod
StackEmRateActual
StackEmRateDesired
StackSize
TmDevFctr1
TmDevLow1
XdcrFreq
XdcrNumDriveCycles

Table 5-18: Audit log tracking group monitored data points

Tracking data group data points
ResetTrkParam
Tamp
TampHi
TampLo
TampSen
TampWt
Tspe
TspeHi
TspeLmt
TspeLo

Table 5-18: Audit log tracking group monitored data points *(continued)*

Tracking data group data points
TspeSen
TspeWt
Tspf
TspfHi
TspfLo
TspfMatch
TspfSen
TspfWt

5.1.6   Determining power-up and power-down times

Audit log function

The audit log can be used to determine the meter start (or re-start) time and the meter power-down time by examining the PowerFailTime record(s). The PowerFailTime 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.

Table 5-19: Audit log time stamps

Sequence Number	Date	Time
112	5/22/2014	12:12:35 PM
113	5/22/2014	12:12:35 PM
114	5/22/2014	12:12:35 PM
115	5/22/2014	12:12:35 PM
116	5/22/2014	12:12:35 PM
117	5/22/2014	12:12:35 PM
118	5/22/2014	12:13:31 PM
119	5/22/2014	12:14:16 PM
120	5/22/2014	12:14:16 PM
121	5/22/2014	12:14:16 PM
122	5/22/2014	12:14:16 PM
123	5/22/2014	12:14:16 PM
124	5/22/2014	12:14:16 PM
125	5/22/2014	12:14:16 PM
126	5/22/2014	12:14:16 PM
127	5/22/2014	12:15:12 PM

Table 5-19: Audit log time stamps *(continued)*

Sequence Number	Date	Time
128	5/22/2014	12:24:20 PM
129	5/22/2014	12:45:06 PM
130	5/22/2014	1:00:55 PM
131	5/22/2014	1:00:55 PM
132	5/22/2014	1:00:55 PM
133	5/22/2014	1:00:55 PM
134	5/22/2014	1:00:55 PM
135	5/22/2014	1:02:17 PM
136	5/22/2014	1:03:20 PM
137	5/22/2014	1:03:25 PM

5.2　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 Daniel 3810 Series Liquid 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 Daniel MeterLink Tools| Edit/Compare Configuration screen. The default is to overwrite old, unread records. Refer to *Section 5.2.5* 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.

5.2.1 Alarm log data content

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.

Alarm log data records

Table 5-20: Alarm log monitored data points

Data point	Low alarm limit	High alarm limit
GainAUp, GainADn, GainBUp, GainBDn, GainCUp[1], GainCDn, GainDUp, GainDDn.	GainLowLmt	GainHighLmt
AvgSndVel	AvgSoundVelLoLmt	AvgSoundVelHiLmt
SpecFlowPressure	LowPressureAlarm	HighPressureAlarm
SpecFlowTemperature	LowTemperatureAlarm	HighTemperatureAlarm
LiveFlowPressure	LowPressureAlarm	HighPressureAlarm
LiveFlowTemperature	LowTemperatureAlarm	HighTemperatureAlarm
AvgFlow	MeterMaxNegVel	MeterMaxVel
SysTemp	-40°C	100°C
SysVoltage1V	0.90V	1.10V
SysVoltage1V2	1.08V	1.32V
SysVoltage2V5	2.225 V	2.775 V
SysVoltage3V3	2.937 V	3.663 V

(1) Chords C and D are 4-path ultrasonic meters

Table 5-21: Boolean alarm limits

Data point	Boolean alarm limit
IsHardFailedA … IsHardFailedD	TRUE
IsMeasSndSpdRangeA … IsMeasSndSpdRangeD	TRUE
Freq1DataValidity … Freq2DataValidity	FALSE
QMeterValidity	FALSE
QFlowValidity	FALSE
IsAcqModuleError	TRUE
IsHourlyLogFull, IsDailyLogFull, IsAuditLogFull, IsSystemLogFull	TRUE
IsBatchDataRcvFailed	TRUE
IsClkInvalid	TRUE

5.2.2   System log records

The Daniel 3810 Series Liquid Ultrasonic Flow Meter logs all system messages in the system log. The meter can store up to 3000 system records. The user can select whether old, unread records can be overwritten by new records when the log becomes full via the data point DoOverwriteUnreadSystemLog. This point can be modified using the Daniel MeterLink Tools|Edit/Compare Configuration screen. The default is to overwrite old, unread records. Refer to *Section 5.2.5* for information on reading records and marking records as read. The data point IsSystemLogFull indicates whether or not the system log is full and cannot overwrite old, unread records.

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

5.2.3   Reading log records

Daniel 3810 Series Liquid Ultrasonic Flow Meter log records are read using the Daniel MeterLink Logs/Reports|Meter Archive Logs screen. The are three log groups:

- daily
- hourly
- event (audit, alarm, and system 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.

Figure 5-3:   Meter archive logs selections

5.2.4   Options for reading daily and/or hourly log records

The options for reading daily and hourly log records are the same. The Daniel MeterLink Logs/Reports|Meter Archive Logs screen indicates the number of daily records that are available to read. Select the log type(s) to be collected via the Collect daily log and/or Collect hourly log check boxes. Select whether to collect all log records or the last specified number of daily records. Also, select whether to collect all log data or just the data points required by the API Chapter 21 standard. *Table 6-1* lists the daily log data points and *Table 6-2* lists the hourly log data points.

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

The options for reading audit, alarm, and system log records are the same. The Daniel 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.

5.3   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 2003 - 2013 is installed on the PC. The Excel file generated by this utility has up to six worksheets depending upon the logs collected: Daily Log, Hourly Log, Alarm Log, Audit Log, System Log, and Meter Config. The collected log data is also displayed on the screen.

- Comma-separated values - This format creates a file with data separated by commas. Each log record collected is put on a separate line in the file. Each log type is separated by a blank line. The meter configuration follows the log data separated by a blank line. The collected log data is also displayed on the screen.

- Don't log to file - This option will not save any of the collected log data to a file but will display it on the screen.

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

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

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

5.4   Collecting maintenance logs

The Trend Maintenance Logs dialog box contain two list boxes. The tree list Microsoft Excel workbooks will show all the directories on your PC, but will only show files in them that are Maintenance Logs in Windows Excel® format or Trend files and only if they are not currently open in Windows Excel® . To display all files in the Microsoft Excel workbooks directory tree, clear the Show only maintenance log and trend workbooks option.

1. Establish communication with the meter via Daniel MeterLink.

2. From Daniel MeterLink main menu, select Logs/Reports|Trend Maintenance Logs. The Microsoft Excel™ tree list displays.

7. 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 5-6: Microsoft® ® Excel toolbar workbook report view

8. Charts is the default view when you open the Maintenance Log.

Figure 5-7: Microsoft® ®Excel Charts view
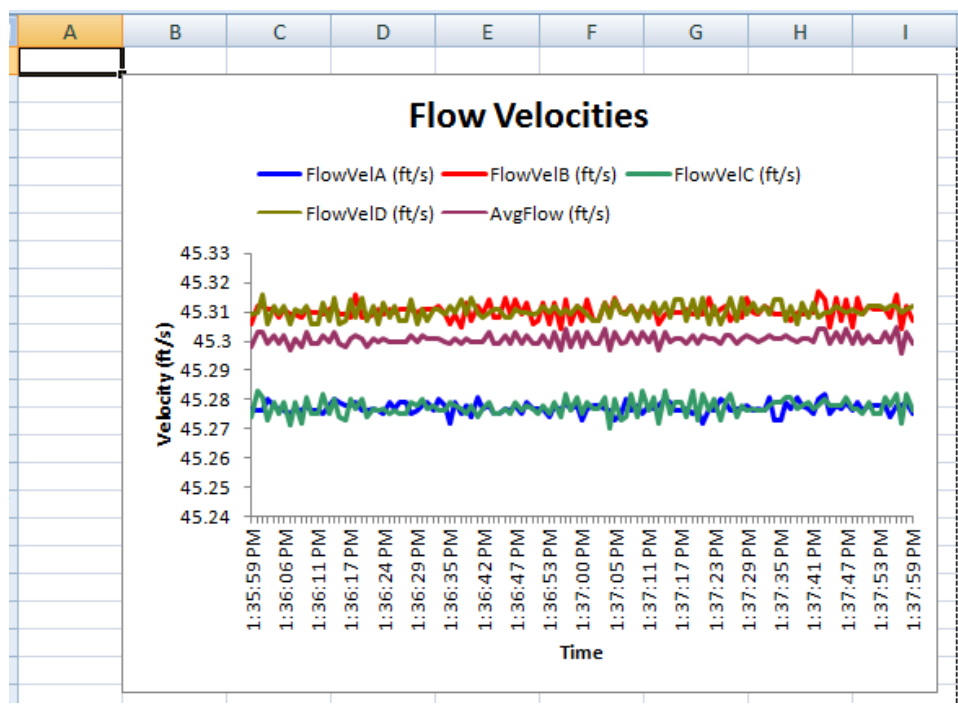
9. Click the Inspection Report tab to view the inspection report.

Figure 5-8: Microsoft Excel ®Inspection report view

10.   Click the Meter Config tab to view the meter's configuration report.

Figure 5-9:   Microsoft Excel ®Meter Configuration report

11.   Click the Raw Data tab to view the meter's raw data report.

Figure 5-10: Microsoft Excel ®Raw data report

Meter Name: Meter name not set **Log started:** 5/29/2014 1:35:59 PM **Duration:** 2 minutes **# samples:** 121
Company Name: Daniel Measurement and Control, Inc.
Comment:

Date	Time	QMeter (gal/min)	QFlow (gal/min)	FlowTemperature (F)	FlowPressure (psia)	SystemStatus	FlowVelA (ft/s)	FlowVelB (ft/s)	FlowVelC (ft/s)
5/29/2014	1:35:59 PM	4836.2	4831.8	32	14.7	0x00000000	45.277	45.306	45.274
5/29/2014	1:36:00 PM	4836.7	4832.3	32	14.7	0x00000000	45.276	45.312	45.283
5/29/2014	1:36:01 PM	4836.7	4832.3	32	14.7	0x00000000	45.276	45.312	45.281
5/29/2014	1:36:02 PM	4836.3	4831.9	32	14.7	0x00000000	45.28	45.311	45.273
5/29/2014	1:36:03 PM	4836.6	4832.2	32	14.7	0x00000000	45.278	45.311	45.279
5/29/2014	1:36:04 PM	4836.3	4831.9	32	14.7	0x00000000	45.277	45.308	45.275
5/29/2014	1:36:06 PM	4836.6	4832.2	32	14.7	0x00000000	45.276	45.311	45.279
5/29/2014	1:36:07 PM	4836.1	4831.7	32	14.7	0x00000000	45.275	45.309	45.271
5/29/2014	1:36:08 PM	4836.5	4832.1	32	14.7	0x00000000	45.277	45.309	45.279
5/29/2014	1:36:09 PM	4836.2	4831.8	32	14.7	0x00000000	45.276	45.308	45.272
5/29/2014	1:36:10 PM	4836.7	4832.3	32	14.7	0x00000000	45.278	45.311	45.281
5/29/2014	1:36:11 PM	4836.3	4831.9	32	14.7	0x00000000	45.276	45.31	45.275
5/29/2014	1:36:11 PM	4836.3	4831.9	32	14.7	0x00000000	45.276	45.31	45.275
5/29/2014	1:36:12 PM	4836.6	4832.2	32	14.7	0x00000000	45.275	45.309	45.282
5/29/2014	1:36:13 PM	4836.4	4832	32	14.7	0x00000000	45.278	45.311	45.275
5/29/2014	1:36:14 PM	4836.7	4832.4	32	14.7	0x00000000	45.28	45.312	45.28
5/29/2014	1:36:15 PM	4836.3	4831.9	32	14.7	0x00000000	45.279	45.309	45.274
5/29/2014	1:36:16 PM	4836.2	4831.9	32	14.7	0x00000000	45.278	45.309	45.273
5/29/2014	1:36:17 PM	4836.5	4832.1	32	14.7	0x00000000	45.278	45.308	45.28
5/29/2014	1:36:18 PM	4836.6	4832.3	32	14.7	0x00000000	45.279	45.316	45.277
5/29/2014	1:36:19 PM	4836.6	4832.2	32	14.7	0x00000000	45.276	45.308	45.28
5/29/2014	1:36:20 PM	4836.2	4831.8	32	14.7	0x00000000	45.276	45.308	45.274
5/29/2014	1:36:22 PM	4836.5	4832.1	32	14.7	0x00000000	45.277	45.309	45.277
5/29/2014	1:36:23 PM	4836.4	4832	32	14.7	0x00000000	45.276	45.311	45.276
5/29/2014	1:36:24 PM	4836.5	4832.1	32	14.7	0x00000000	45.275	45.309	45.277
5/29/2014	1:36:25 PM	4836.4	4832	32	14.7	0x00000000	45.279	45.311	45.275
5/29/2014	1:36:26 PM	4836.4	4832.1	32	14.7	0x00000000	45.277	45.31	45.276
5/29/2014	1:36:27 PM	4836.4	4832	32	14.7	0x00000000	45.279	45.311	45.275
5/29/2014	1:36:27 PM	4836.4	4832	32	14.7	0x00000000	45.279	45.311	45.275
5/29/2014	1:36:28 PM	4836.6	4832.2	32	14.7	0x00000000	45.275	45.311	45.279
5/29/2014	1:36:29 PM	4836.4	4832	32	14.7	0x00000000	45.276	45.31	45.278
5/29/2014	1:36:30 PM	4836.6	4832.2	32	14.7	0x00000000	45.278	45.311	45.28
5/29/2014	1:36:31 PM	4836.5	4832.1	32	14.7	0x00000000	45.279	45.311	45.277
5/29/2014	1:36:32 PM	4836.5	4832.2	32	14.7	0x00000000	45.276	45.311	45.278
5/29/2014	1:36:33 PM	4836.5	4832.1	32	14.7	0x00000000	45.28	45.312	45.276
5/29/2014	1:36:34 PM	4836.4	4832	32	14.7	0x00000000	45.278	45.309	45.276
5/29/2014	1:36:35 PM	4836.3	4831.9	32	14.7	0x00000000	45.272	45.306	45.279
5/29/2014	1:36:36 PM	4836.5	4832.1	32	14.7	0x00000000	45.279	45.309	45.278
5/29/2014	1:36:37 PM	4836.3	4831.9	32	14.7	0x00000000	45.275	45.305	45.277
5/29/2014	1:36:39 PM	4836.5	4832.1	32	14.7	0x00000000	45.278	45.313	45.275
5/29/2014	1:36:40 PM	4836.4	4832	32	14.7	0x00000000	45.274	45.307	45.278
5/29/2014	1:36:41 PM	4836.5	4832.1	32	14.7	0x00000000	45.281	45.312	45.274
5/29/2014	1:36:42 PM	4836.4	4832	32	14.7	0x00000000	45.277	45.309	45.277

5.5   Collecting trend maintenance logs

The Trend Maintenance Logs dialog box allows you to merge two or more Maintenance logs together into a single Trend file in order to build a historical database of the performance of ultrasonic meters.

Maintenance logs can also be merged with existing Trend files to form a new Trend file of the combined data. The Trend feature can be useful to see how the meter performance changes with changing flow conditions over time. It can also be useful to detect performance issues when the meter performance is deteriorating slowly over time but the flow conditions have not changed in a manner to account for it.

Note

Maintenance logs or Trend files to be trended must all have matching column headings. This means the logs must be in the same units (i.e. U.S. Customary or Metric), must have the same pressure type (i.e. gage or absolute), and must have the same time base (1/sec, 1/min, 1/hr, 1/day). If not, an error message will be displayed stating the column headings do not match and the file will not be added to the Workbook to trend list.

Note

The Trend function can only merge maintenance log files created with Daniel CUI v2.XX and later and all versions of Daniel MeterLink™. Daniel MeterLink™ does support merging Daniel 3804 Liquid Ultrasonic meter maintenance logs and trend files with Daniel 3810 Series Ultrasonic meter maintenance logs and trend files. This can be useful in the event the electronics on a meter have been upgraded to the new Daniel 3810 Series electronics. Some parameters like gain, signal level, and noise level may show a shift between electronics which is normal.

⚠ **WARNING!**

Make sure any Maintenance Log file or Trend file that you would like to add to the Workbooks to trend list is not opened in Windows®Excel®. If it is open, Daniel MeterLink will not be able to add it to the list of files to trend.

⚠ **WARNING!**

The Show only maintenance log and trend workbook **checkbox may not work properly on Windows™ XP machines with Security Update for Windows™ XP (823980).**
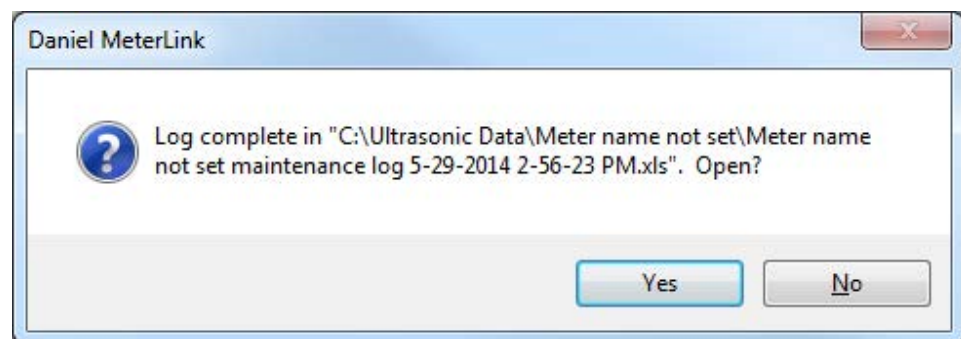
5.5.1   Collect a trend maintenance log

The Trend Maintenance Logs dialog box contain two list boxes. The tree list Microsoft Excel workbooks will show all the directories on your PC, but will only show files in them that are Maintenance Logs in Windows®Excel® format or Trend files and only if they are not currently open in Windows®Excel® . To display all files in the Microsoft Excel workbooks directory tree, clear the Show only maintenance log and trend workbooks option.

1. Establish communication with the meter via Daniel MeterLink.

2. From Daniel MeterLink main menu, select Logs/Reports|Trend Maintenance Logs. The Microsoft Excel® tree list displays.
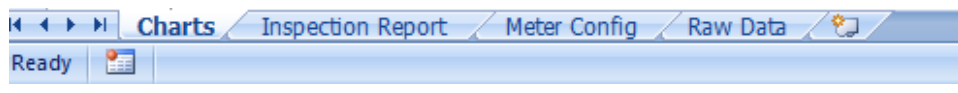
Figure 5-11:   Trend logs tree list
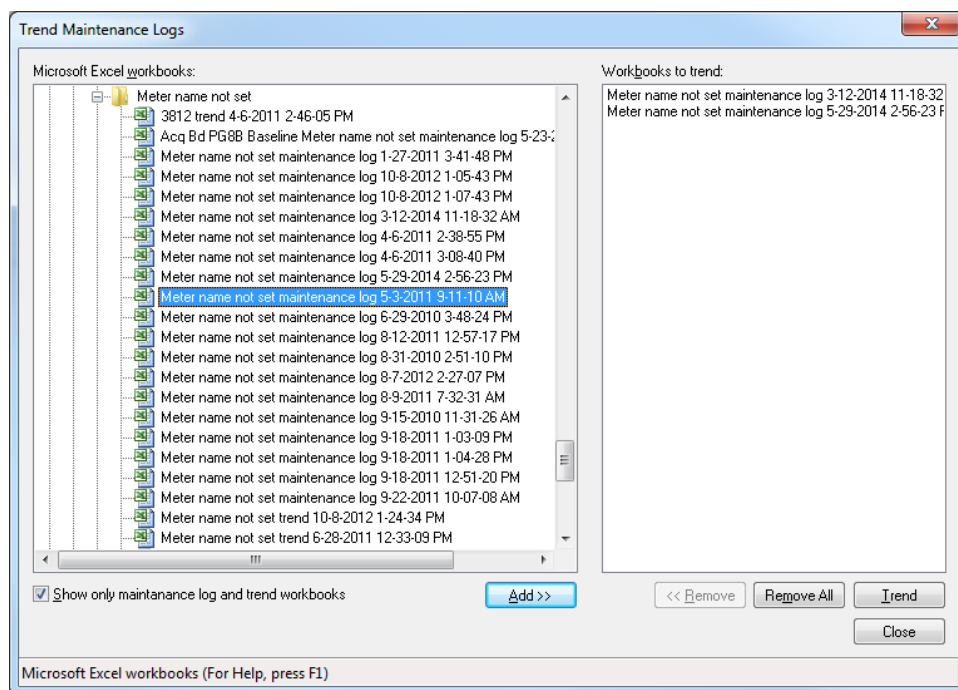
3.   Add files to the Workbooks to trend list by either double-clicking on the file or by selecting the file and clicking Add. You can add an entire folder by selecting the folder and clicking Add All >> or by double-clicking the folder in the tree list. This will include only the files in this folder and not any files contained in subfolders. You can remove files from the Workbooks to trend list by selecting the file and clicking << Remove. Click Remove All to clear the Workbooks to trend list of all files.

Important

DO NOT select Comma Separated Values (CSV), as this format is not compatible with the generation of graphics, trending and analysis offered by 3810 Series Liquid Ultrasonic Flow Meters and Microsoft Excel®. CSV should only be used if the computer does not have Microsoft Excel®. Once the file is collected in the CSV format, it can not be converted to a Microsoft Excel® format.

4.   Click Trend. Daniel MeterLink displays a dialog to name and save the Trend File.

Figure 5-12:   Save trend file
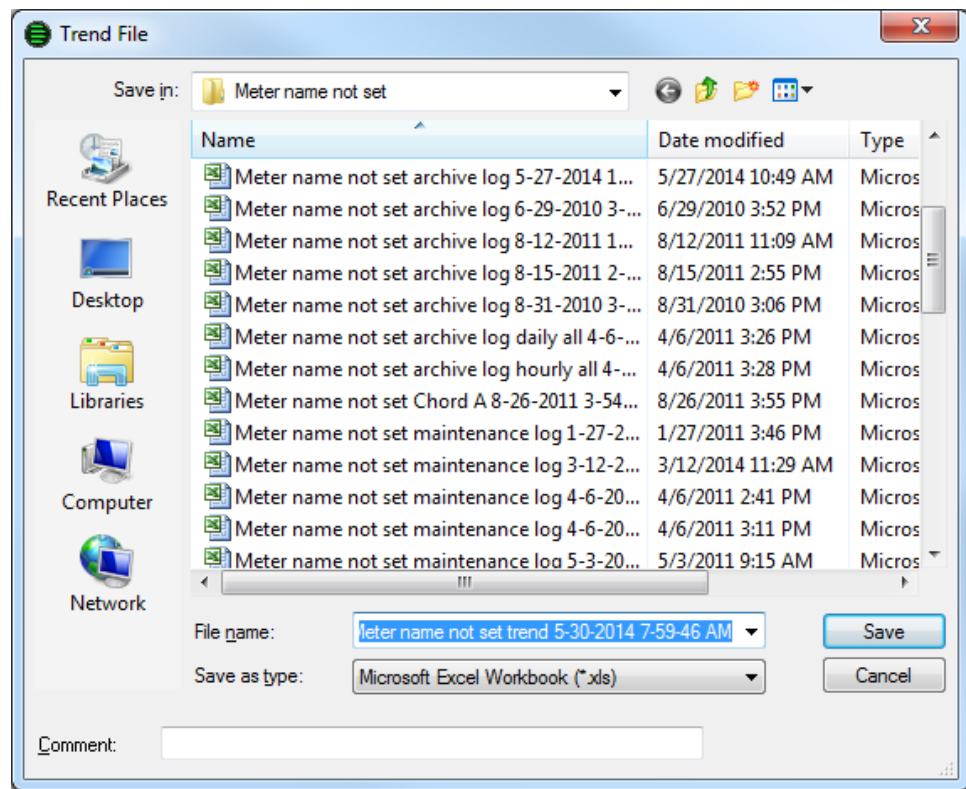
5.   Daniel MeterLink displays the Log Complete message box after the logs are collected.

6.   To view the Microsoft Excel® file, select YES to open the Workbook.

Figure 5-13:   Maintenance log collection complete dialog
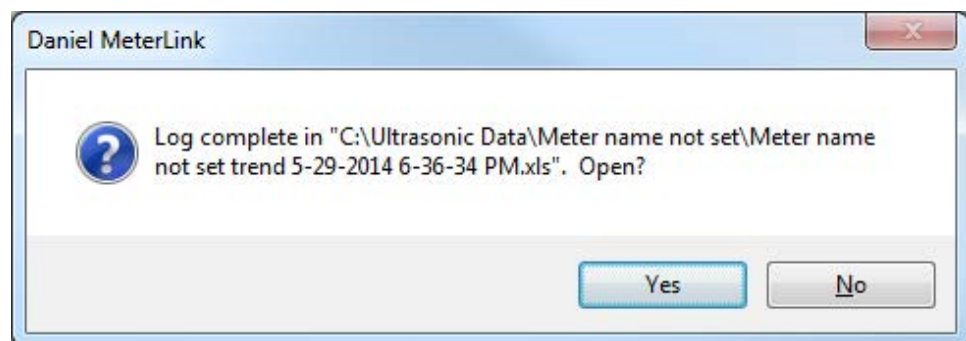
7.   Select the Workbook report view from the Microsoft Excel® toolbar at the bottom of the page. Tab selections include:

• Charts

• Raw Data

Figure 5-14: Microsoft Excel®toolbar workbook report view

8. Charts is the default view when you open the Maintenance Log.

Figure 5-15: Microsoft Excel®Charts view

9. Click the Raw Data tab to view the meter's raw data report.

Figure 5-16: Microsoft Excel®Inspection report view

5.6   Collecting 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 an ultrasonic meter.

5.6.1   Collect meter archive logs

1.   Select the checkboxes for the types of logs you will collect.

Figure 5-17:   Archive log collection parameters
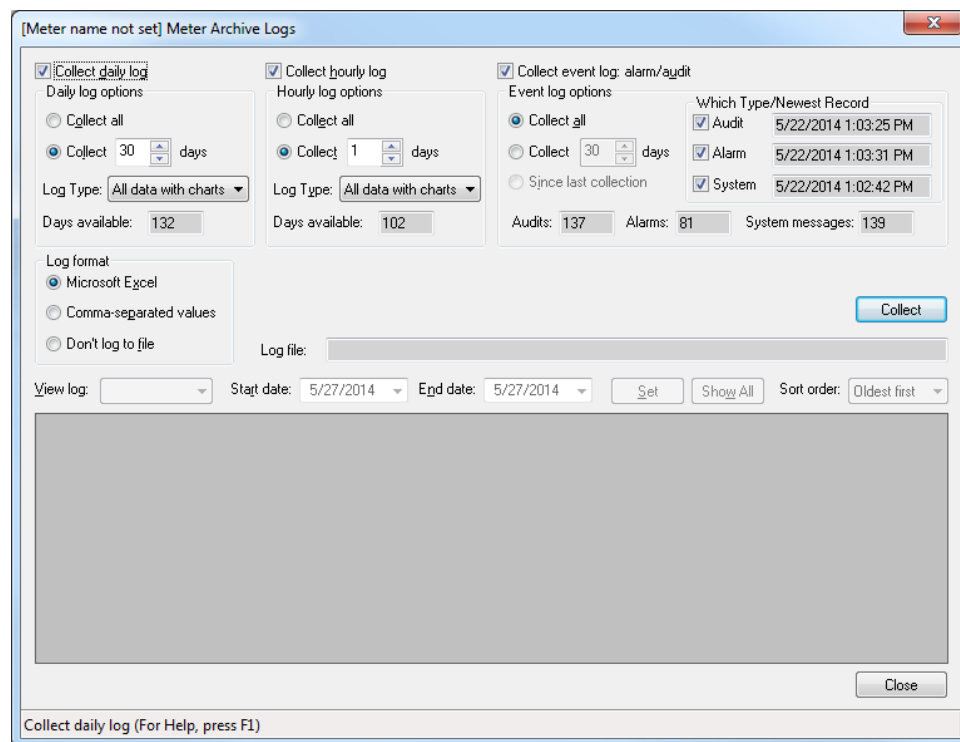
2.   All of the logs are collected into a single Archive log file.

      See *Section 5.2.1* for additional Archive Log information.

3.   Select the Log format as either Microsoft® Excel, Comma-separated values, or Don't
      log to file.

      The Don't log to file option will not save any of the log data to file but will only
      display it on the screen.

4.   The meter configuration is always collected and included into the archive log file.

5.   Select the desired log options and click Collect. Daniel MeterLink opens a Save As
      dialog box to allow you to choose a name for the Archive log.

      A default name based on the Meter Name, type of logs collected, and PC date and
      time is suggested. Change the name or default location if desired.

6 Tools commands utility

The Daniel 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 Daniel MeterLink and the meter.

6.1 Tools commands utility

The Daniel 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 Daniel MeterLink and the meter.

6.1.1 Tools menu

Daniel MeterLink Tools commands menu

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.
Gas SOS Calculator	Calculate speed of sound for a known gas composition.
Outputs Test	Test frequency, current, and digital outputs by fixing them to a set value.
Transducer Swap-Out	Adjust path length parameters when changing out transducers, stalks, holders, or mounts.
Set Baseline Wizard	Establishes the baseline for the meter's flow characteristics that can be used to monitor the heath of the meter run using Continuous Flow Analysis features.
Program Download	Upgrade the program components in Daniel Ultrasonic meters.
Communications Analyzer	Monitor communications between Daniel MeterLink and a meter

6.1.2 Edit/Compare Configuration parameters

Tools menu command

This Daniel MeterLink command utility i used to:

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

Figure 6-1: Edit/Compare configuration parameters
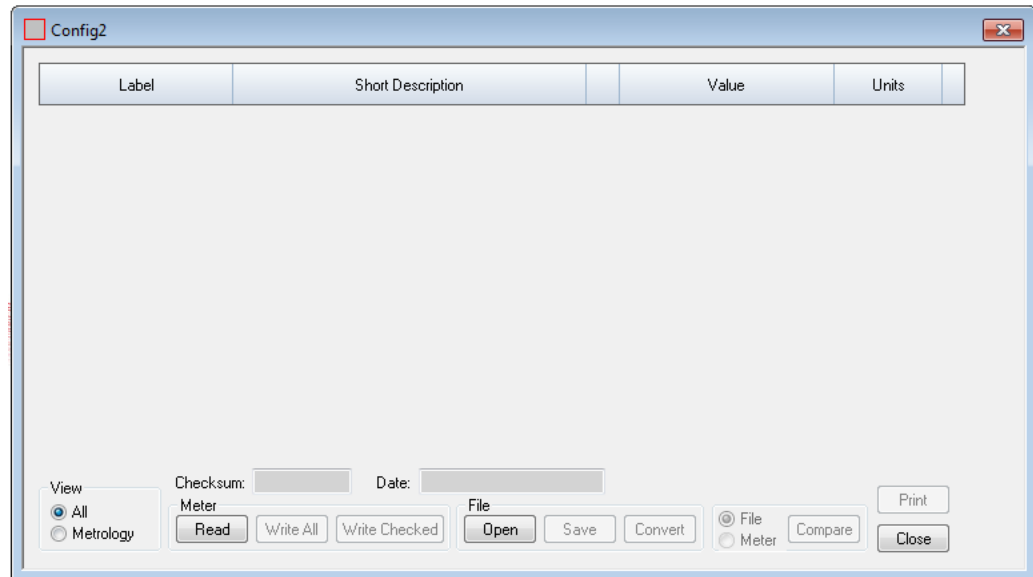
Edit the meter's configuration parameters

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

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

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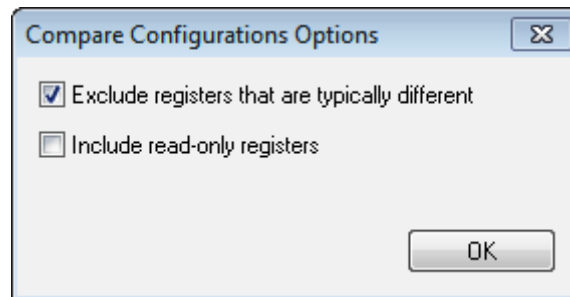
Once the configurations are selected, a dialog displays, providing options to further customize the compare operation.

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 Daniel 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. Daniel MeterLink displays this modified configuration in the dialog. At this point, Daniel 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

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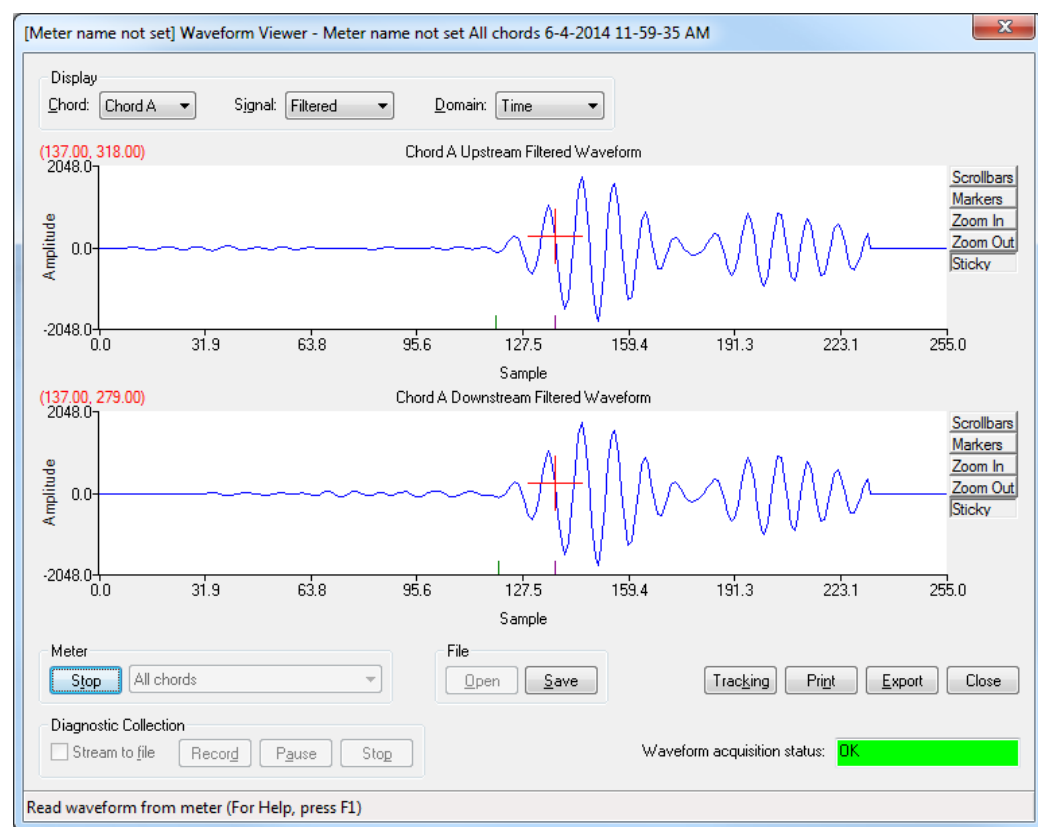
The waveforms may also be displayed in the frequency domain. In this mode a Fast Fourier Transform is taken of the waveform so that the frequency content of the waveform can be displayed. This can be useful in noisy environments to see the frequency of the noise and if it is in the range of the transducer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

Figure 6-5: Waveform viewer - frequency domain
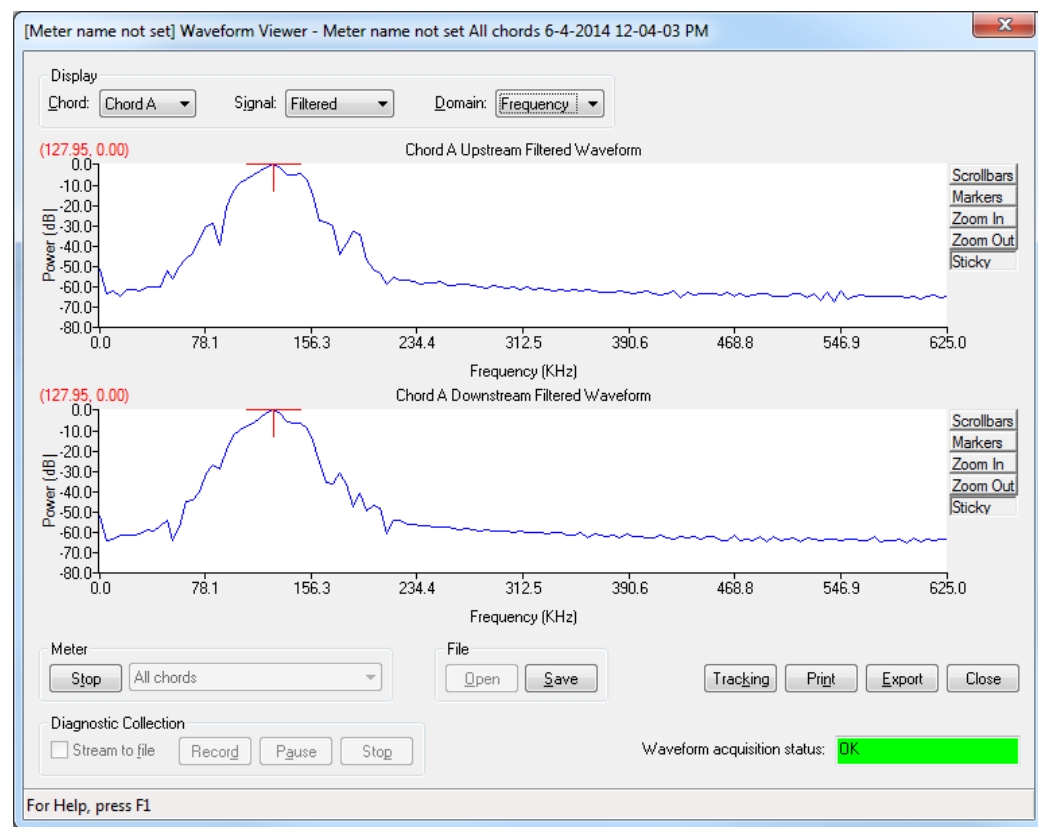
Zero crossing and first motion markers

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

1. Select the waveforms to collect from the Meter pull-down menu and click Read. Selections include:

- All Chords
- Chord A
- Chord B
- Chord C
- Chord D

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

3.   Click Save while streaming waveforms or click Stop

Daniel 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 Daniel 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 Daniel MeterLink to playback these files. The files are only for use internally by Daniel 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 Daniel MeterLink to playback these files. The files are only for use internally by Daniel 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.

Table 6-2: Waveform chart keyboard commands *(continued)*

Function	Keystroke	Description
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.

6.1.3 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 about the Outputs Test Mode.

6.1.4 Transducer swap-out

The transducer swap-out utility allows you to update parameters such as path lengths, delay times, and delta times for chord. This is necessary anytime transducers, mounts, holders, or stalks have to be replaced for a chord. Refer to the Liquid Ultrasonic Flow Meter maintenance manuals (P/N 3-9000-764 and P/N 3-9000-767) to replace the transducers in the field.

Component Selection

The Transducer Swap-out Wizard Current Chord Parameters page displays the first chord selected. Under *Select which components have changed for chord* (A, B, C, or D) and select which components were changed for the chord.

Transducer chord parameters update

The Transducer Update page displays the Current Chord Parameters for the chord being updated.

Figure 6-6: Transducer chord component changes

There are two groups of tables labeled Components Removed and Components Added. Only the components previously selected will be editable. Enter in the lengths of all the components removed and all the components added. Under New Chord Parameters, the new calculated path length will be displayed.

If changing out Transducers, make sure to enter in the new Delay time and Delta time from the report sheet provided with the transducer pair. Double check the values entered and then click Write to Meter to write the New Chord Parameters to the meter. If this was the only chord selected to change, the Transducer Swap-Out Wizard will close. If other chords where selected to be changed, the Component Selection page will be displayed for the next chord. The wizard will continue until all selected chords have changed.

Set transducer type

Use the pull-down menu to select the appropriate Transducer type and click Write to reconfigure the meter for this type of transducer.
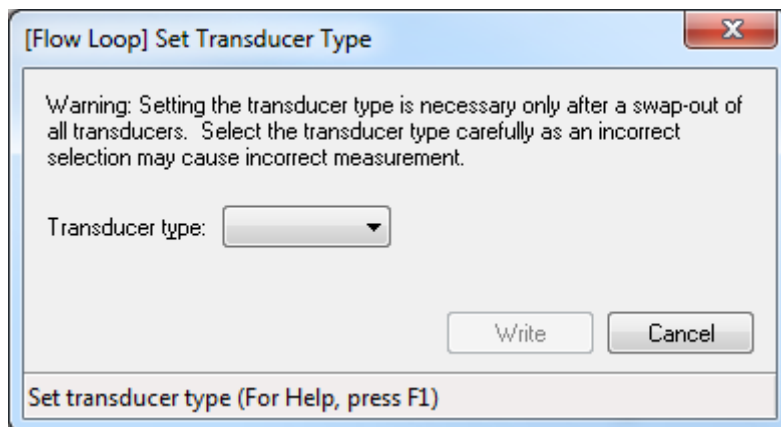
If any of the changes require a warm start, a message is displayed indicating you should warm start the meter. Click Yes to warm start the meter to apply the changes.

Important

It is highly recommended not to use this dialog unless a Daniel service representative has instructed you to do so and has given you specific instructions on what actions to perform.

Click Cancel to close this dialog without making any changes to the meter configuration.

Reset tracking parameters

The Reset tracking menu selection displays the current tracking parameter values for Tspf, Tspe, and Tamp and allows you to change them if needed.
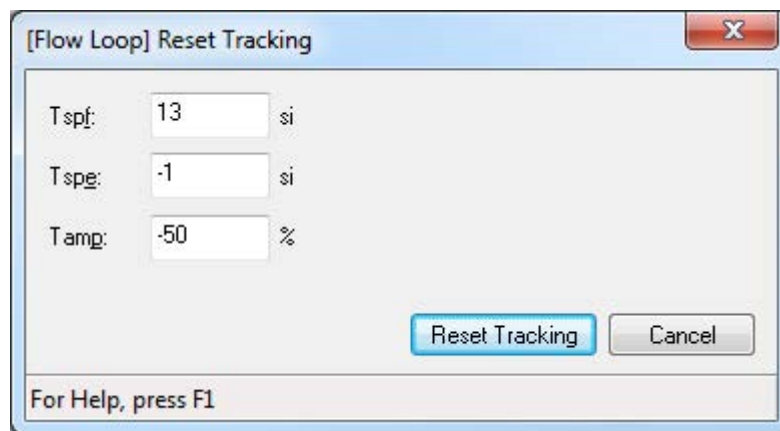
Click Reset Tracking to write any tracking parameter changes to the meter and reset the tracking operation in the meter.

Important

It is highly recommended not to use this dialog unless a Daniel service representative has instructed you to do so and has given you specific instructions on what actions to perform.

6.1.5   Upgrade program components

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

Error recovery for program download failure

If the Program Download failed during firmware upgrade, Daniel MeterLink can no longer connect to the meter or a message Attempt FTP-only connection.... displays when trying to connect perform a Backup Upgrade. It is possible for the meter to lose its programming if the meter power fails during a firmware upgrade process. If this occurs, use the following special procedure, Backup Upgrade, to connect to the meter and download the program again.

1. Use the Daniel MeterLink pull-down menu and select Program Settings. Enable the Allow FTP-only connection checkbox and click OK to close Program Settings dialog.

   a. For **Serial Port Connections**: Make sure you are connected to Port A. You may need to adjust your File|Meter Directory settings for the connection so that they match the port default settings. Port A will default to 19200 baud with a modbus address of 32.

   b. For **Ethernet Connections**: If you are connecting to the meter over an Ethernet port, you should be able to connect with the same IP address as normal. If this is unsuccessful, the meter may have defaulted to 192.168.135.100 with a subnet of 255.255.255.0. Make sure your PC has a compatible address and attempt a connection using this IP address.

2. Once your cabling and Meter Directory record are setup, attempt the connection to the meter. You will receive a message Error 10001 opening database connection to, click OK.

3. At the prompt to Attempt FTP-only connection, click Yes. If successful, the Daniel MeterLink caption reads ...Connected to <meter name>.

4. Go to Tools|Program Download to attempt the firmware upgrade again. If the firmware upgrade is successful, the meter should start working as normally as the meter's configuration is not normally lost.

5. If the configuration is lost, a configuration file was saved by the Program Download utility on the initial firmware upgrade attempt. Use Edit/Compare Configuration to write this saved configuration back to the meter. The saved configuration files are typically stored in C:\Ultrasonic Data\<MeterName>.

6. If the firmware upgrade fails again, contact Daniel Technical Support for assistance. Contact information can be found in Daniel MeterLink under the Help pull down menu by selecting Technical Support. Or, in the Customer service section in the preface of this manual.

6.1.6 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.

6.1.7 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 6-7: Tools menu communications analyzer
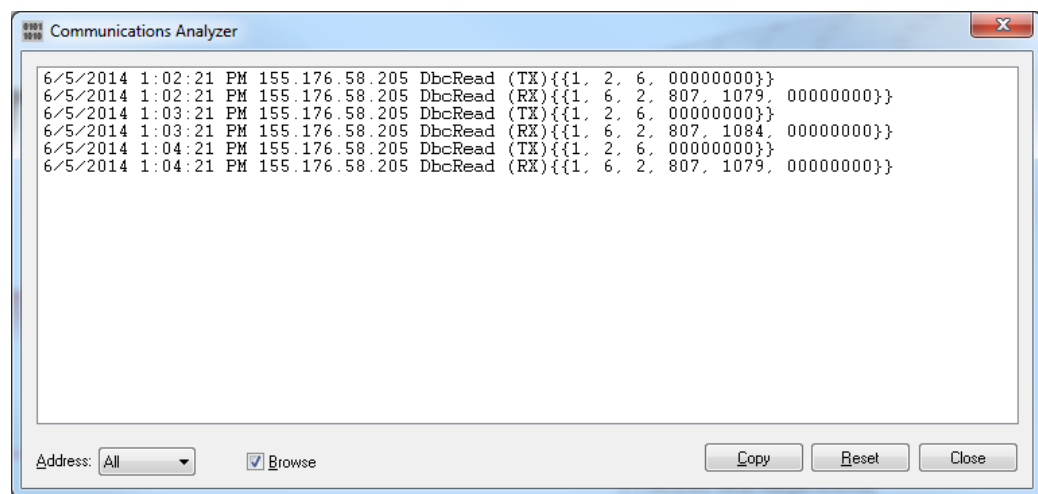
1. Check Browse to disable automatic scrolling. This is useful if you want to look at a certain message while new message are being added to the list.

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 Daniel MeterLink main page.

Appendix 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)

Appendix B
Miscellaneous equations

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.

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

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

Figure 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 ft3/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/day = 86400 s/d

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

VolUnitUS

- Gallons
- Barrels

VolUnitMetric

- Cubic meters

Appendix C
Troubleshooting communications mechanical and electrical issues

C   Troubleshooting communications mechanical and electrical issues

C.1   Troubleshooting communications

Table C-1:   Troubleshooting communications and connectivity errors

Communications and connectivity errors and recommended actions	
Q1.	Why won't the CPU Module LINK LED come on when connecting to the meter via the Ethernet?
A1.	• The LINK light indicates good electric connectivity between two LAN ports. It also indicates proper polarity in the Ethernet connection. • When connecting directly: Check to ensure that the Ultrasonic cable (P/N 2-3-3400-079) 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?

Table C-1: Troubleshooting communications and connectivity errors *(continued)*

Communications and connectivity errors and recommended actions	
A2.	If you are connecting for the first time, review the instructions for initial communication (via Ethernet) setup. Ensure that the Daniel Liquid Ultrasonic Flow 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 the Command prompt window (Start->Run->(type)cmd) • in the Command prompt window, type ipconfig. You should then see something like: • Windows 2000 IP Configuration • Ethernet adapter Local Area Connection 1: • Connection-specific DNS Suffix : • IP Address : 192.168.135.35 (note: the last .35 can be up to .44) • Subnet Mask : 255.255.255.0 • Default Gateway: If you get the following: • Ethernet adapter Local Area Connection 1: • IP Address: 0.0.0.0 Then, the PC has not yet received an IP address from the DHCP server and you should wait (up to 30 seconds) to receive an IP address before attempting to connect to the Daniel Liquid Ultrasonic Flow Meter. If after 30 seconds the PC has not received an IP address from the Daniel Liquid Ultrasonic Flow 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 Daniel Liquid Ultrasonic Flow Meter from the PC, at the DOS prompt type: • ping 192.168.135.100 <enter> If the Daniel Liquid Ultrasonic Flow 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 Daniel Liquid Ultrasonic Flow 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 Daniel Liquid Ultrasonic Flow 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). 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. 3810 Series meters connected to an intranet LAN should not have their DHCP servers enabled.
Q4.	How do I connect to multiple meters via Ethernet when they are on the same hub but not connected to an intranet LAN?

Table C-1: Troubleshooting communications and connectivity errors *(continued)*

Communications and connectivity errors and recommended actions
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. 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 may be 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.

Mechanical and electrical troubleshooting

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

Table C-2: Troubleshooting issues and recommended actions

Issue	Recommended actions
No power to the unit	Check for correct voltage (AC or DC) to the input of the Field Connection Board. 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 Daniel 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 Daniel MeterLink program are set according to jumpers on the meter CPU board.
One or more of the chords is not indicating a reading (reporting zeros)	Check for loose connections at the cable connectors. Check the resistance of the transducers (should be approximately 1-2 W). Problem also may be caused by a bad Acquisition board or interconnect cable. Check system status in Daniel 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 Daniel Customer Service if you are unsure of how stacking a signal can effect the meter's operation. Refer to Technical Support under the Help menu of Daniel MeterLink for contact information.

Table C-2: Troubleshooting issues and recommended actions *(continued)*

Issue	Recommended actions
Connected communication line to the flow computer but no signal is received	Check for loose connections at the flow meter and the flow computer. Check the CPU Module, Field Connection board and the Power Supply wiring. Make sure 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 that the outside chord cables cannot be exchanged with inner chord cables.

Appendix D
Modbus communications

D.1 Modbus communications

Introduction to Modbus Communication

This appendix describes the standard Gould Modbus communication protocol (ASCII mode and RTU mode) implemented by the Daniel 3810 Series Liquid Ultrasonic Flow Meters for communicating with an external flow computer and/or diagnostic computer. Refer to the Daniel web site *http://www.daniel.com/um2.htm* to download the 3810 Series Modbus Tables.

Daniel Liquid Ultrasonic Flow Meter data points are accessed via registers. The available data formats are 16-bit integer, 32-bit long integer, and 32-bit IEEE-format floating point. Each Modbus register is 16 bits in length; thus, two Modbus registers are required for each long integer and each floating point value.

The meter supports only Modbus functions 3 (read multiple registers), 6 (write to a single register), and 16 (write to multiple registers). When accessing multiple registers, all the registers must be within the same data type. Attempts to write to a read-only register generate an error.

The supported exception codes are as follows:

- 01 illegal function
- 02 illegal data address
- 03 illegal data value
- 06 busy (not used at this time)

Message Formats

The abbreviations used to describe the Modbus message formats are:

Table D-1: Modbus Message Format Abbreviations

ADDR	Modbus ADDRESS (Device Identification)
BYTE_CNT	number of bytes in the frame
CR	ASCII carriage return character (ASCII Modbus only)
CRC_LOW	low byte of the 16-bit Cyclic Redundancy Check (RTU Modbus only)
CRC_HI	high byte of the 16-bit Cyclic Redundancy Check (RTU Modbus only)
DATA	the data to be transmitted
FC	Modbus function code (3, 6, or 16)

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Table D-1: Modbus Message Format Abbreviations *(continued)*

LF	ASCII line feed character (ASCII Modbus only)
LRC	8-bit Longitudinal Redundancy Check (ASCII Modbus only)
LSB	least-significant byte
MSB	most-significant byte
REG_CNT	register count
START_REG	starting register number
TFRAME	three and one-half character time delay (RTU Modbus only)

Table D-2: Modbus Register Data per Format Type

Integer	(1 Modbus register) MSB, LSB
(IEEE) Floating Point	(2 Modbus registers) (one exponent byte, three mantissa bytes)
	EXP,MAN, First Register
	MAN,MAN, Second Register
Long Integer	(2 Modbus registers)
	MSB, MIDH, First Register
	MIDL, LSB, Second Register

D.1.1   ASCII Modbus Format

Framing in ASCII transmission mode is accomplished by the use of the colon (:) character to indicate the beginning of a frame and the carriage return/linefeed pair (CR/LF) to indicate the end of a frame. The communication parameters for ASCII Modbus are 7 data bits, even parity, and one stop bit.

The ASCII Modbus 8-bit Longitudinal Redundancy Check (LRC) is produced by converting the hex characters to binary, adding the binary characters without wrap-around carry, and two's complementing the result. The colon, carriage return and line feed characters are not included in the LRC calculation.

The ASCII Modbus formats for the supported Modbus functions are described below.

Function Code 3 – Read Multiple Registers

Send Format:

- :, ADDR, FC, START_REG MSB, START_REG LSB, REG_CNT MSB,
- REG_CNT LSB, LRC, CR, LF

Response Format:

- :, ADDR, FC, BYTE_CNT, ...DATA... , LRC, CR, LF

Function Code 6 – Write Single Register

Send Format:

- :, ADDR, FC, START_REG MSB, START_REG LSB, DATA MSB, DATA LSB, LRC, CR, LF

Response Format:

- :,ADDR, FC, START_REG MSB, START_REG LSB, DATA MSB, DATA LSB, LRC, CR, LF

Function Code 16 – Write Multiple Registers

Send Format:

- :, ADDR, FC, START_REG MSB, START_REG LSB, REG_CNT MSB, REG_CNT LSB, BYTE_CNT, ...DATA..., LRC, CR, LF

Response Format:

- :, ADDR, FC, START_REG MSB, START_REG LSB, REG_CNT MSB, REG_CNT LSB, LRC, CR, LF

D.1.2 RTU Modbus Format

RTU Modbus uses the timing between character transmission to frame a message. The receiving device monitors the elapsed time between receipt of characters. If three and one-half character times elapse without receipt of a new character, then the received message is completed. Thus, the time between transmitting characters within a message must not be longer than three and one-half character times otherwise the receiving device will prematurely declare the message complete. The communication parameters for RTU Modbus are 8 data bits, no parity, and one stop bit.

The RTU Modbus formats for the supported Modbus functions are described below.

Function Code 3 – Read Multiple Registers

Send Format:

- TFRAME, ADDR, FC, START_REG MSB, START_REG LSB, REG_CNT MSB, REG_CNT LSB, CRC_LOW, CRC_HI, TFRAME

Response Format:

- TFRAME, ADDR, FC, BYTE_CNT, ...DATA..., CRC_LOW, CRC_HI, TFRAME

Function Code 6 – Write Single Register

Send Format:

- TFRAME, ADDR, FC, START_REG MSB, START_REG LSB, DATA MSB, DATA LSB, CRC_LOW, CRC_HI, TFRAME

Response Format:

- TFRAME, ADDR, FC, START_REG MSB, START_REG LSB, DATA MSB, DATA LSB, CRC_LOW, CRC_HI, TFRAME

Function Code 16 – Write Multiple Registers

Send Format:

- TFRAME, ADDR, FC, START_REG MSB, START_REG LSB, REG_CNT MSB, REG_CNT LSB, BYTE_CNT, ...DATA..., CRC_LOW, CRC_HI, TFRAME

Response Format:

- TFRAME, ADDR, FC, START_REG MSB, START_REG LSB, REG_CNT MSB, REG_CNT LSB, CRC_LOW, CRC_HI, TFRAME

Appendix E
Write-protected parameters

E.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 E-1* are applicable for firmware v1.06 and later.

Table E-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

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

AO2TrimZeroExtMeasCurrent
AO2ZeroScaleEnergyRate
AO2ZeroScaleMassRate
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

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

DO1AIsInvPolarity
DO1BContent
DO1BIsInvPolarity
DO1PairTestEnable
DO2AContent
DO2AIsInvPolarity
DO2BContent
DO2BIsInvPolarity
DO2PairTestEnable
EmRateDesired
EnableExpCorrPress
EnableExpCorrTemp
EnablePressureInput
EnableTemperatureInput
FireSeq
FlowAnalysisHighFlowLmt
FlowAnalysisLowFlowLmt
FlowDir
FlowPOrTSrcUponAlarm
FODO1Mode
FODO1Source
FODO2Mode
FODO2Source
FODO3Mode
FODO3Source
Freq1BPhase
Freq1Content
Freq1Dir
Freq1FeedbackCorrectionPcnt
Freq1FullScaleEnergyRate
Freq1FullScaleMassRate
Freq1FullScaleVolFlowRate
Freq1MaxFrequency
Freq1MaxVel
Freq1MinVel
Freq1ZeroScaleEnergyRate
Freq1ZeroScaleMassRate

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

Freq1ZeroScaleVolFlowRate
Freq2BPhase
Freq2Content
Freq2Dir
Freq2FeedbackCorrectionPcnt
Freq2FullScaleEnergyRate
Freq2FullScaleMassRate
Freq2FullScaleVolFlowRate
Freq2MaxFrequency
Freq2MaxVel
Freq2MinVel
Freq2ZeroScaleEnergyRate
Freq2ZeroScaleMassRate
Freq2ZeroScaleVolFlowRate
FwdA0
FwdA1
FwdA2
FwdA3
FwdFlwRt1
FwdFlwRt10
FwdFlwRt11
FwdFlwRt12
FwdFlwRt2
FwdFlwRt3
FwdFlwRt4
FwdFlwRt5
FwdFlwRt6
FwdFlwRt7
FwdFlwRt8
FwdFlwRt9
FwdMtrFctr1
FwdMtrFctr10
FwdMtrFctr11
FwdMtrFctr12
FwdMtrFctr2
FwdMtrFctr3
FwdMtrFctr4

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

FwdMtrFctr5
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
InputPressureUnit
IsAO1EnableTest
IsAO2EnableTest
IsFreq1BZeroedOnErr
IsFreq1EnableTest
IsFreq2BZeroedOnErr
IsFreq2EnableTest
LA

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

LB
LC
LD
LinearExpansionCoef
LiveFlowPressureCalCtrl
LiveFlowPressureGain
LiveFlowPressureOffset
LiveFlowTemperatureCalCtrl
LiveFlowTemperatureGain
LiveFlowTemperatureOffset
LowFlowLmt
LowPressureAlarm
LowTemperatureAlarm
MaxHoldTm
MaxInputPressure
MaxInputTemperature
MaxNoDataBatches
MaxNoise
MeterMaxVel
MeterName
MeterSerialNumber
MinChord
MinHoldTime
MinInputPressure
MinInputTemperature
MinPctGood
MinSigQlty
NegSpanSl
NonNormalModeTimeout
NumVals
PipeDiam
PipeOutsideDiameter
Pk1Pct
Pk1Thrsh
Pk1Wdth
PoissonsRatio
PosSpanSl

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

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
SampInterval
SampPerCycle

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

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

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

XC
XD
XdcrFiringSync
XdcrFreq
XdcrNumDriveCycles
YoungsModulus
ZeroCut

Appendix F
Engineering drawings

F.1   3810 Series engineering drawings

HAZARDOUS LOCATION CLASS I, GROUP C OR D
HAZARDOUS LOCATION Ex d ia IIB T4

NON−HAZARDOUS LOCATION

3810 SERIES ELECTRONICS

EXPLOSION−PROOF SEAL (FIELD PROVIDED) △4 △22
EXPLOSION−PROOF WIRING (PER LOCAL CODE) △23

RJ45 CONNECTIONS

△6 10/100BASE T ETHERNET PORT

ETHERNET
TX+
TX−
RX+
RX−

PC	HUB
PIN 3	PIN 1
PIN 6	PIN 2
PIN 1	PIN 3
PIN 2	PIN 6

△14
TO ETHERNET CONNECTION △6

PORT A
RS232 / RS485/RS422
△5 △13

RS232   RS422/485
COM   COM   COM
RTS   TX+   TX+
TX   TX−   TX−
RX   RX+
CTS   RX−
(FULL) (HALF)

50 FT. MAX.(RS232 ONLY)

RS232, RS485, OR RS422 DEVICE △1 △2

EXPLOSION PROOF TRANSMITTER ENCLOSURE ASSEMBLY

GROUP 1
FODO1
GND1
DI1
△10

TO FLOW COMPUTER DEVICE △8

GROUP 2
FODO2
GND2
GND2
FODO3
△10

TO FLOW COMPUTER DEVICE

4−20MA CURRENT OUTPUT 1
AO1
AO1+
AO1−

CONNECTIONS FOR 4−20MA CURRENT OUTPUT / HART SLAVE △29 △30

4−20MA CURRENT OUTPUT 2
AO2
AO2+
AO2−

CONNECTIONS FOR 4−20MA CURRENT OUTPUT △29 △30

ANALOG INPUT 1 (TEMPERATURE)
ANALOG INPUT 2 (PRESSURE)

ANALOG IN
TT+
TT−
PT+
PT−

TO TEMPERATURE TRANSMITTER (4−20MA INPUT) △27 △28 △31
TO PRESSURE TRANSMITTER (4−20MA INPUT)

24V LOOP POWER
+
−
△33

LOOP POWER FOR 4−20MA INPUTS AND OUTPUTS △28 △31

△12

CHGND INTERNAL
CHGND EXTERNAL (2 PLACES)

POWER INPUT (10.4VDC − 36 VDC)
+
−
△3

POWER IN △3

I.S. INTERFACE
FACTORY CABLE (2 FT. MAX.) △19
J3 ACQUISITION MODULE

FACTORY CABLE, TYPICAL △7 △5 △11 △20

INTRINSICALLY SAFE WIRING △9

INTRINSICALLY SAFE BASE ENCLOSURE LIQUID ACQUISITION MODULE ASSEMBLY

△17

A1+	1	WHITE OR RED
A1−	2	BLACK
	3		TRANSDUCER
C1+	4	WHITE OR RED
C1−	5	BLACK
	6		TRANSDUCER
D2+	7	WHITE OR RED
D2−	8	BLACK
	9		TRANSDUCER
B2+	10	WHITE OR RED
B2−	11	BLACK
	12		TRANSDUCER

B1+	1	WHITE OR RED
B1−	2	BLACK
	3		TRANSDUCER
D1+	4	WHITE OR RED
D1−	5	BLACK
	6		TRANSDUCER
C2+	7	WHITE OR RED
C2−	8	BLACK
	9		TRANSDUCER
A2+	10	WHITE OR RED
A2−	11	BLACK
	12		TRANSDUCER

WARNING

TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, READ, UNDERSTAND, AND ADHERE TO THE MANUFACTURER'S LIVE MAINTENANCE PROCEDURES.

READ AND UNDERSTAND USER'S MANUAL BEFORE OPERATING.

WARNING

AN EXTERNAL POWER SOURCE SHALL NOT APPLY A POTENTIAL WITH RESPECT TO EARTH (Um) IN EXCESS OF 250 Vrms OR 250Vdc TO ANY TERMINAL CONNECTION IN THIS UNIT.

SI METRIC
THIRD ANGLE PROJECTION
MATERIAL   BLOCK NOT APPLICABLE
FINISH   BLOCK NOT APPLICABLE

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
F	05/21/13	KDG	ECO SP2023	KVG	KDG
E	02−19−13	KDG	ECO SP1919	CV	KDG
D	10−11−12	MOD	ECO SP1781	MO	MM
C	11/30/11	KDG	ECO SP1412	KVG	KDG
B	04/08/11	KDG	ECO SP1098	KVG	KDG
A	09/29/10	KDG	RELEASED	KVG	KDG

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION
UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
BREAK ALL SHARP CORNERS TO .005−.015 RADIUS AND REMOVE ALL BURRS

DANIEL
Daniel Measurement and Control

TITLE
3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM

DRN	KDG	DATE 09/29/10	DWG NO.		
CHKD	KVG	DATE 09/29/10	DMC−004936		REV F
APPD	KDG	DATE 09/29/10	SCALE NA	P/N	SHT 1 OF 3

PROJ. FILE NO. USM−01307   FILENAME: DMC004936F1.DWG, DATE: 05−21−13, TIME: 3:15 P.M.

HAZARDOUS LOCATION CLASS I, GROUP C OR D
HAZARDOUS LOCATION Ex d ia IIB T4

NON-HAZARDOUS LOCATION

3810 SERIES ELECTRONICS
(OPTIONAL EXPANSION MODULES) /18\

EXPLOSION-PROOF SEAL
/4\ /22\ (FIELD PROVIDED)

EXPLOSION-PROOF WIRING
/23\ (PER LOCAL CODE)

EXPLOSION PROOF
TRANSMITTER
ENCLOSURE
ASSEMBLY

P/N W3O3B1X0022
100 SERIES
COMMUNICATIONS
MODULE
RS-485   /13\

PORT B

RS485
A
B
GND

RS485 DEVICE   /1.\

OR

P/N W3O3B1X0012
100 SERIES
COMMUNICATIONS
MODULE
RS-232   /13\

PORT B

RS232
TX
RX
RTS
GND

RS232 DEVICE   /2.\
               /15.\

50 FT. MAX.(RS232 ONLY)

INTRINSICALLY
SAFE WIRING

CO-LOCATED 3810 SERIES
ELECTRONICS FOR MODEL 3818
METERS

INTRINSICALLY SAFE
BASE ENCLOSURE
LIQUID ACQUISITION
MODULE ASSEMBLY

J6
(SEE NOTES BELOW)

1
2
3
4

3
4
1
2

3810 SERIES
ACQUISITION
MODULE ASSEMBLY
- CONNECTOR J6

1. Terminal J6 is intended to provide power to the device it is connected to and may
   also receive power. The entity parameters assigned for terminal J6 are as follows:
   Output parameters: Input parameters:
   Vt (or Uo) = 6.51 VDC   Vmax (or Ui) = 6.51 VDC
   It (or Io) = 65.8 mA   Imax (or Ii) = 65.8 mA
   Po = 107 mW   Pmax (or Pi) = 107 mW
   Ca (or Co) = 500 uF   Ci = 0 uF
   La (or La) = 32.8 mH   Li = 0 mH

2. Selected intrinsically safe equipment must be third party listed as intrinsically safe for
   the application, and have intrinsically safe entity parameters conforming to Table 1.
   Table 1:

I.S. Equipment		Terminal J6
Vmax (or Ui)	≥	Voc or Vt (or Uo)
Imax (or Ii)	≥	Isc or It (or Io)
Pmax, Pi	≥	Po
Ci + Ccable	≤	Ca (or Co)
Li + Lcable	≤	La (or Lo)

3. Intrinsically safe apparatus connected to terminal J6 that may provide power, must
   have intrinsically safe entity parameters conforming to Table 2.
   Table 2:

Terminal J6		Intrinsically safe apparatus with output parameters
Vmax (or Ui)	≥	Voc or Vt (or Uo)
Imax (or Ii)	≥	Isc or It (or Io)
Pmax, Pi	≥	Po
Ci + Ccable	≤	Ca (or Co)
Li + Lcable	≤	La (or Lo)

4. Capacitance and inductance of the field wiring from the intrinsically safe equipment to
   the terminal J6 shall be calculated and must be included in the system calculations
   as shown in Table 1 and Table 2. Cable capacitance, Ccable, plus intrinsically safe
   equipment capacitance, Ci must be less than the marked capacitance, Ca (or Co),
   shown on any associated apparatus used. The same applies for inductance (Lcable,
   Li and La or Lo, respectively). Where the cable capacitance and inductance per foot
   are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2
   μH/ft.

5. For installations in which both the Ci and Li of the intrinsically safe apparatus
   connected to terminal J6 exceeds 1% of the stated Co and Lo parameters (excluding
   the cable), then 50% of Co and Lo parameters are applicable and shall not be
   exceeded.

0.15 MAX

/34\

J6

P/N 1-360-03-009
3810 SERIES
LIQUID ULTRASONIC FLOW METER
ACQUISITION MODULE - 4 CHORD

J1   J2

/34\   /34\

0.15 MAX   0.15 MAX

SI METRIC

THIRD ANGLE PROJECTION

MATERIAL
BLOCK
NOT APPLICABLE

FINISH
BLOCK
NOT APPLICABLE

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
F	05-21-13	KDG	ECO SP2023	KVG	KDG
E	02-19-13	KDG	ECO SP1919	CV	KDG
D	10-11-12	MOD	ECO SP1781	MO	MM
C	11/30/11	KDG	ECO SP1412	KVG	KDG
B	04/08/11	KDG	ECO SP1098	KVG	KDG
A	09/29/10	KDG	RELEASED	KVG	KDG

GEOMETRIC TOLERANCES &
DIMENSIONS PER
ANSI Y14.5
LATEST REVISION

UNLESS OTHERWISE NOTED
ALL DIMENSIONS IN INCHES
   X.XX   ±.03
   X.XXX   ±.005
   ANGULAR ±0°30'
   FINISH 500 RA MAX

BREAK ALL SHARP CORNERS TO
.003-.015 RADIUS AND REMOVE
ALL BURRS

THIS DRAWING IN DESIGN AND DETAIL IS OUR PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH OUR
WORK. IT SHALL NOT BE REPRODUCED AND SHALL BE RETURNED TO US ON DEMAND. ALL RIGHTS ARE RESERVED.

DANIEL
Daniel Measurement and Control

TITLE
3810 SERIES ULTRASONIC METER
SYSTEM WIRING DIAGRAM

DRN	KDG	DATE	09/29/10	DWG NO.
CHKD	KVG	DATE	09/29/10	DMC-004936
APPD	KDG	DATE	09/29/10	SCALE NA

REV F

PROJ. FILE NO. USM-01307

FILENAME: DMC004936F2.DWG, DATE: 05-21-13, TIME: 3:15 P.M.

SHT 2 OF 3

NOTES:

1. MAX LENGTH OF RS-485 WIRING IS 2,000 FT.

2. ETHERNET OR RS-422 IS THE PREFERRED COMMUNICATIONS INTERFACE. OPTIONALLY, RS-232 MAY BE USED FOR SHORT DISTANCES. (50 FT.)

3. POWER INPUT IS NOMINAL 24 VDC. INPUT RANGE 10.4-36V DC. POLARITY INSENSITIVE.

4. AN EXPLOSION-PROOF SEAL IS REQUIRED WITHIN 457 MM (18 INCHES) OF THE ENCLOSURE.

5. 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 28 AWG. SHIELDED PAIR, 15 FT. MAX.

6. FOR OPTIMUM DIAGNOSTIC INTERFACE, WIRING ETHERNET PORT IS RECOMMENDED. USE CAT6 ETHERNET CABLE.

7. 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.

8. DIGITAL INPUT 1 IS CONTACT CLOSURE ONLY.

9. 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

10. FODO OUTPUTS 1 THROUGH 3 CAN BE INDEPENDENTLY CONFIGURED TO FUNCTION AS FREQUENCY OUTPUTS OR DIGITAL STATUS OUTPUTS. THEY CAN EACH BE INDEPENDENTLY CONFIGURED TO DRIVE AS TTL OR OPEN COLLECTOR.

11. 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 1-360-01-601, 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 1-360-01-800, 15 FT. LONG OR 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. 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).

12. 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.

13. COMM SIGNAL NAMING CONVENTION IS WITH RESPECT TO METER. (I.E. PC - TX -> METER - RX)

14. RJ45 SOCKET NUMBERING

TOP:
FRONT:

15. 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)

16. 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 ID 32 FOR TWO MINUTES.

17. MODEL 3810 SERIES TRANSDUCERS TYPE LT-01, LT-03, LT-04, LT-05, 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 T4 UNLESS THE ELECTRONICS ENCLOSURE IS REMOTELY MOUNTED FROM THE METER BODY. IF THE ELECTRONICS ENCLOSURE IS NOT MOUNTED TO THE METER BODY, REFER TO THE CERTIFICATION LABEL DMC-006037 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-07	-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 +175 °C (+347 °F)
LT-15	-50 °C (-58 °F) TO +175 °C (+347 °F)
LT-16	-50 °C (-58 °F) TO +175 °C (+347 °F)
LT-17	-50 °C (-58 °F) TO +175 °C (+347 °F)

18. THE 3810 SERIES METER HAS ONE AVAILABLE SLOT FOR AN EXPANSION MODULE.

19. FACTORY CABLE INCLUDES EXPLOSION PROOF SEAL.

20. SECONDARY SHIELD ONLY PRESENT ON MODEL 3814 AND 3818 LNG TRANSDUCER CABLING.

21. DIMENSIONS OF FLAMEPROOF JOINTS ARE OTHER THAN THE RELEVANT MINIMUM OR MAXIMUM SPECIFIED IN TABLE 3 OF EN/IEC 60079-1:2007. PLEASE CONTACT MANUFACTURER FOR DETAILS.

22. ALL CABLE ENTRY DEVICES SHALL BE CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE 'd', SUITABLE FOR THE CONDITIONS OF USE AND CORRECTLY INSTALLED.

23. 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.

24. 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

25. LABEL FOR 3810 SERIES FLOW METER:
DATE CODE IS INCLUDED IN THE SERIAL NUMBER. SERIAL NUMBER FORMAT SHALL BE "YY-WWXXXX" WHERE:
YY = 2-DIGIT YEAR OF MANUFACTURE
WW = WEEK OF MANUFACTURE (01-52)
XXXX = SEQUENTIALLY INCREMENTING NUMBER

26. FOR THE U.L. U.S. MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE UNITED STATES:

UL 1203, 4TH EDITION
UL 508, 17TH EDITION
UL 913, 7TH 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. 1988-11
CAN/CSA C22.2 No. 14-10
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 60079-0:2009
EN 60079-1:2007
EN 60079-11:2007

FOR THE IECEx MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS:

IEC 60079-0:2004
IEC 60079-1:2007
IEC 60079-11:2006

27. ANALOG INPUT SINK CONFIG

IN SINK CONFIG, ANALOG INPUTS MUST BE CONNECTED AT THE BOTTOM OF THE LOOP.

28. ANALOG INPUT SOURCE CONFIG

IN SOURCE CONFIG, ANALOG INPUTS MUST BE CONNECTED AT THE BOTTOM OF THE LOOP.

29. ANALOG OUTPUT SINK CONFIG

IN SINK CONFIG, ANALOG OUTPUT CAN BE CONNECTED AT ANY POINT IN THE LOOP.

30. ANALOG OUTPUT SOURCE CONFIG

IN SOURCE CONFIG, ANALOG OUTPUT CAN BE CONNECTED AT ANY POINT IN THE LOOP.

REPRESENTS ADDITIONAL I/O DEVICES LOCATED IN THE LOOP. ADDITIONAL DEVICES ONLY SHOWN TO ILLUSTRATE ANALOG CONNECTIONS. NOT REQUIRED FOR OPERATION

31. ANALOG INPUT 1 AND ANALOG INPUT 2 ARE FUNCTIONALLY IDENTICAL AND ARE NOT ELECTRICALLY ISOLATED FROM EACH OTHER.

32. ANALOG INPUT 1 AND ANALOG INPUT 2 HAVE ADDITIONAL 150 OHMS LOOP IMPEDANCE FOR COMPLIANCE WITH HART COMMUNICATION REQUIREMENTS.

33. 24 VOLTS DC OUTPUT CAN BE USED TO SOURCE POWER TO ONE OR MORE OF THE ANALOG INPUTS OR OUTPUTS.

34. MODEL 3818: CABLING TO CONNECTORS J1, J2 AND J6 ON ACQUISITION MODULE SHALL HAVE DISCRETE WIRES RESTRAINED USING SHRINK TUBING AS SHOWN ON SHEET 2.

SI METRIC
THIRD ANGLE PROJECTION

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
F	05-21-13	KDG	ECO SP2023	KVG	KDG
E	02-11-13	KDG	ECO SP1919	CV	KDG
D	11/30/11	KDG	ECO SP1412	KVG	KDG
C	04/08/11	KDG	ECO SP1088	KVG	KDG
B	09/29/10	KDG	RELEASED	KVG	KDG
A	09/29/10	KDG			

MATERIAL: BLOCK NOT APPLICABLE
FINISH: BLOCK NOT APPLICABLE

DANIEL
Daniel Measurement and Control

TITLE: 3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM

DRN KDG DATE 09/29/10
CHKD KVG DATE 09/29/10
APPD KDG DATE 09/29/10

DMC-004936 REV F

PROJ. FILE NO. USM-01307
FILENAME DMC004936F3.DWG, DATE: 05-21-13, TIME: 3:15 P.M.
SHT 3 OF 3

Daniel Measurement and Control, Inc.
11100 Brittmoore Park Drive
Houston, TX 77041 USA
T +1 713-467-6000
F +1 713-827-4805
USA Toll Free 1 888-356-9001
Daniel Measurement Services, Inc.
T +1 713-827-6314
www.Daniel.com

Europe: Stirling, Scotland, UK
T +44-1786-433400
Middle East Africa: Dubai, UAE
T +971-4-811-8100
Asia Pacific: Singapore
T +65-677-8211

This product is a core component of the PlantWeb digital plant architecture.

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