Ex~i Flow Measurement Ltd

DESIGNERS OF FLOW MEASUREMENT
EQUIPMENT FOR THE OIL AND GAS INDUSTRY

# SFC3000
## FLOW COMPUTER

# WINDOWS HELP MANUAL

COMPLETE FLOW
COMPUTER FOR ALL
MEASURING APPLICATIONS
MULTISTREAM | LIQUID | GAS

WEB AND NETWORK ENABLED
AUDIT | ALARM | DATA LOGGING

## *IMPORTANT INFORMATION*

*Ex~i Flow Measurement Ltd. Pursues a policy of continuous development and product improvement. The Information contained in this document is, therefore subject to change without notice. Some display descriptions and menus may not be exactly as described in this manual. However, due to the straight forward nature of the display this should not cause any problem in use.*

*To the best of our knowledge, the information contained in this document is accurate. However, Ex~i Flow Measurement Ltd. Cannot be held responsible for any errors, omissions or inaccuracies or any losses incurred as a result of them.*

*In the design and construction of this equipment and instructions contained in this manual, due consideration has been given to safety requirements in respect of statutory industrial regulations*

*Users are reminded that these regulations similarly apply to installation, operation and maintenance, safety being mainly dependent upon the skill of the operator and strict supervisory control*

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# 1. Help Index

Use the tabs on the left to select a topic.

# 2. General Controls and Conventions

## Numeric Data Entry Box

Clear background, black text, used for entering Numeric Data, a value must be entered here.

## Optional Numeric Data entry Box

Coloured background, black text used for entering optional Numeric Data. If no value is entered then right click mouse key and select Invalidate, box will show , and no number will be entered.

An invalid Number will be shown on the display as --------- and if read serially as 1E+38

## Pull Down Menu

Select a function or option from a list functions or options

## Icon

Selects a Function or a Page.

## Tabs

Allows an Individual Page, sub page or function to be selected from a series of pages, sub pages or functions.

## Expanded item

Less items can be shown when - is pressed.

## Non Expanded item

More items can be shown when + is pressed.

# Option Buttons

Red Cross means OFF or No

Green tick means ON or Yes

# Data Tree

Items from the Data Tree can be either selected or can be "Dragged and dropped" from the Tree into a Selection Box, for example when setting up a Logging system or a Modbus list etc.

Yellow Data circle means Read Only.

Red Data circle means Read and Write.

# Hover over

Hold the cursor arrow over any item, button on menu etc. Do not click any mouse button, the item will be lightly highlighted and show a hit or tip relating to the selection.

# Grey Text

Indicates that this item has no function or cannot be entered in this particular mode of the system, the data is shown for information purposes only.

# 3. Config Menu

## Edit Offline

This functions allows the user to create or modify a configuration without actually being connected to a unit. Upon entry into the function the user will be prompted to select the Software Version type that he wishes to use the machine type standard flow computer or prover and the number and type of Streams that will be configured.
Once these items have been setup the Configuration pages are entered.

## Connect

When the connect button is operated, the software, will open a discovering window and it will check, all USB and Ethernet connection to the PC for any connected machines.
The operator will then be prompted with a list of connected machines. The machine to connect too should be highlighted and the OK button pressed.
The software, will then connect to the machine read out the basic configuration, type and serial number, and display this at the top of the Configuration Menu Page.

## Load Set-up

When selected this function will prompt the user to select a .exi file from the memory of the PC, for loading into the configuration software.
Once the appropriate file is selected and the Open button pressed, the operator will be prompted to enter the appropriate software version for this previously saved file. This must be selected and the set up file will then be automatically loaded into the windows software and the edit offline main window will be opened, with the set up file entered into it.

## Read Data from SD Card

Allows the user to read data from an SD card configured for use with a flow computer. The card can be inserted into an appropriate card read slot connected or available on the PC, running configuration software.

## Settings

Change the appearance of the software, configure user access levels.

## Help

This help menu.

## About

Details of versions and dates of the software.

## Exit

Exits the software.

# 4. Setup

When the setup is displayed six main icons will be available at the top of the page:

## Save

Allows the operator to Save the current selected setup file to Computer memory, the User is prompted to enter a file name, browse for a location and a file type.
The normal file type for set-up is .exi using this extension the file can be reloaded into the windows operating software.
Other Possible file types are .pdf, .html, .rtf, .txt, .xls or .csv.

## Print

Allows the operator to Print a copy of either the complete setup file or a selected page of the set up file from any printer currently available on the PC.

## Preview

Gives a print preview of the selected setup file.

## Import

Allows a previously saved flow computer set up file saved in the .exi file format to be imported into the software. Individual items from the configuration can be individually selected to be downloaded. For Example a display page or a modbus set up can be individually selected from the previously saved file and imported into the set up to be downloaded.
Press the import button and select a file to import from the left hand table will show the available items to copy across, select the required item or items to copy and drag and drop to the appropriate tree position on the right hand side. When the operation is complete press OK.

## Download

Downloads the modified or new setup file into the selected connected flow computer.

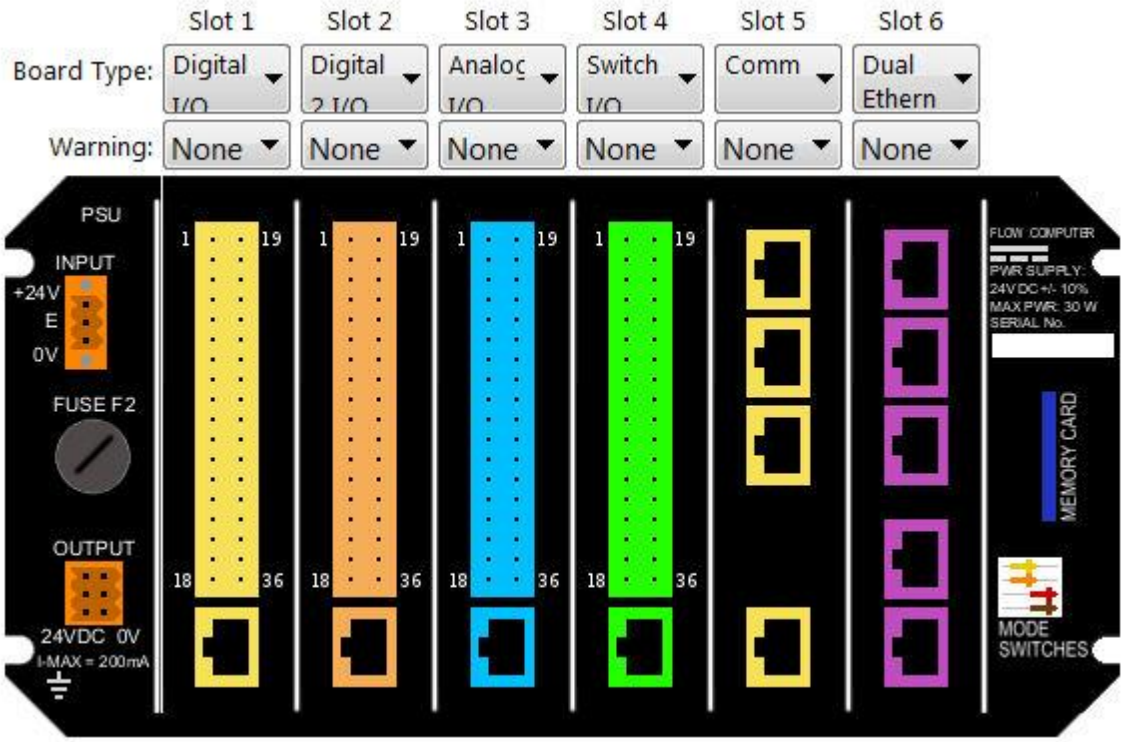
## Help

Displays the help menu.

# 5. Summary

Displays a summary of the basic memory usage of the current setup, this page contains no user controls.

# 6. Hardware

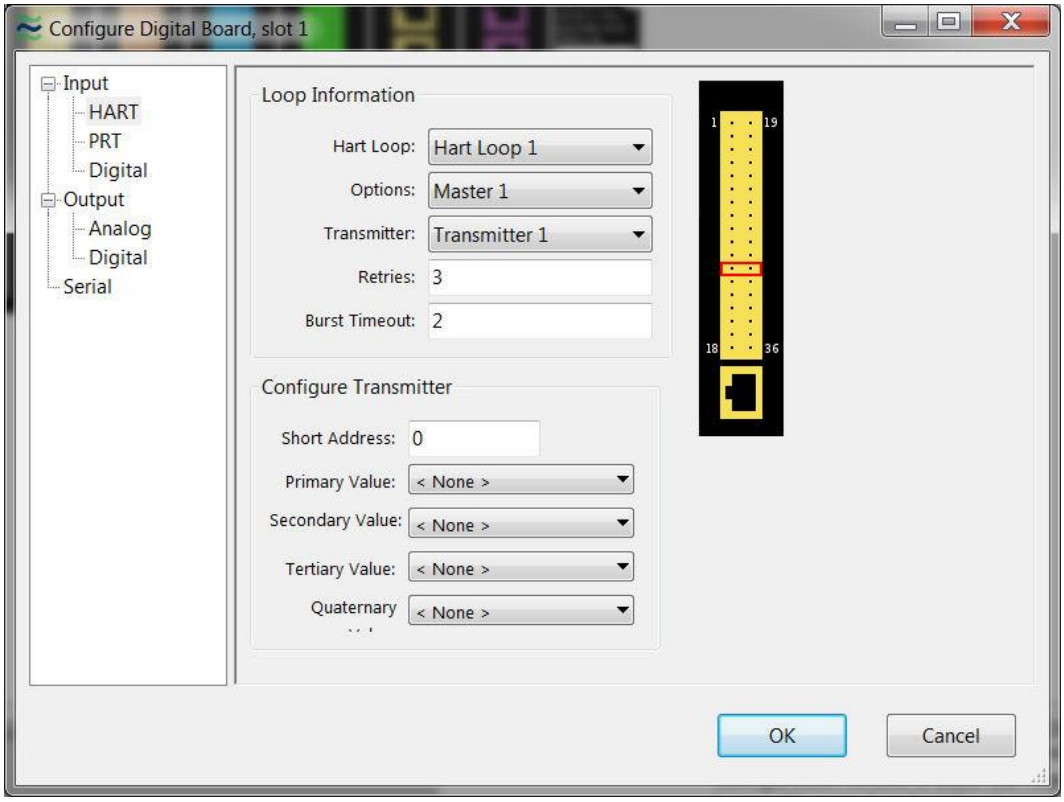



Allows the user to configure the board type in any of the Slot1 to 6 positions.

Allows the user to configure each board type by double clicking on the board to be configured.

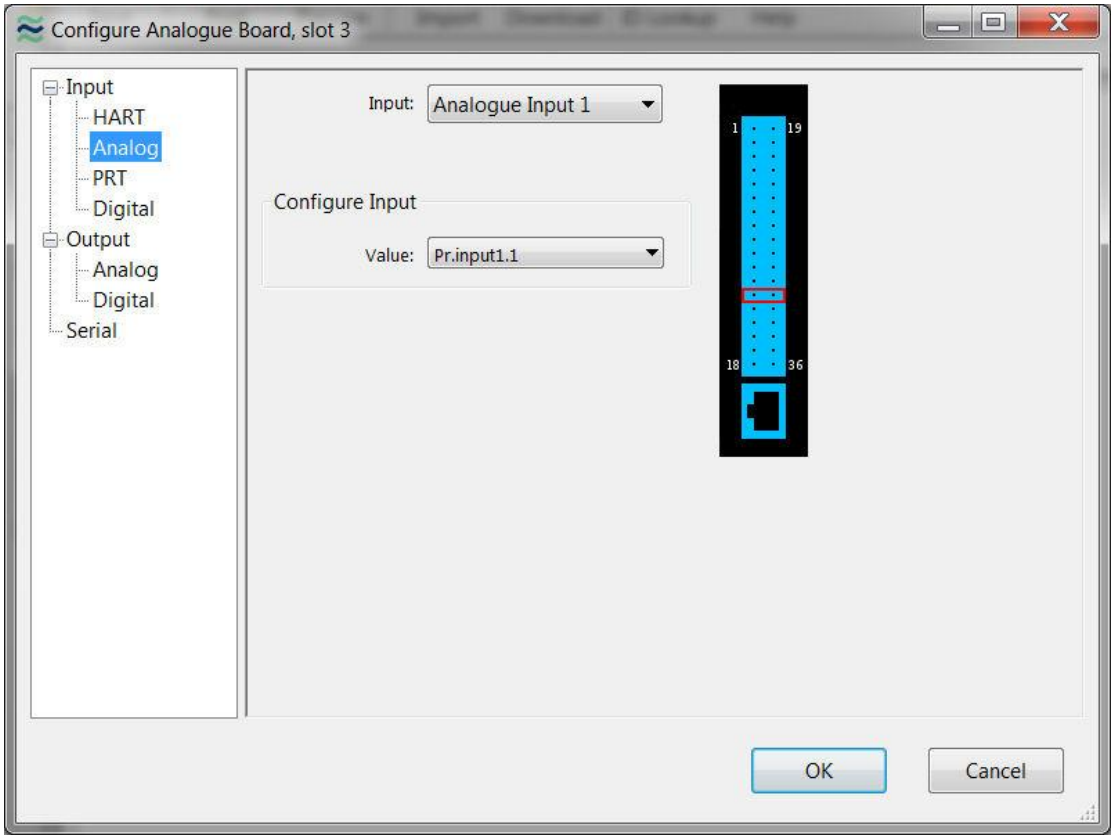
This will in turn bring a Configuration Page for each Board type.

# HART Inputs



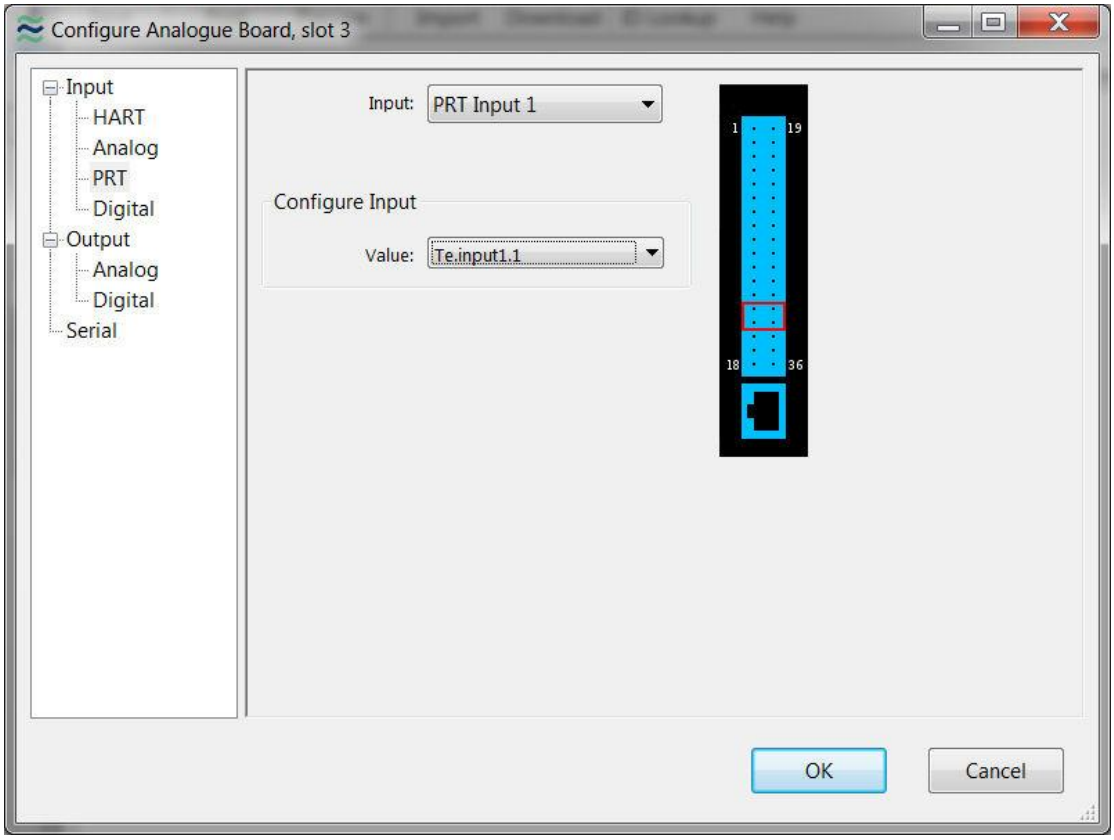

- Select the Hart loop to be configured, there are two on each Digital I/O Board Digital I/O 2 Board and one on each Analogue I/O Board.
- Select the option to be configured, from Master 1 , Master 2 or Burst Mode. For Normal operation where each transmitter is only connected to one HART Input on the flow computer , select Master 1 .If the transmitter is to be configured to be connected to two HART Inputs either on the same or different I/O Cards. Then the one input should be configured as Master 1 and the other as Master 2. If the transmitter is to be used in Burst mode where the Flow computer is used in a configuration where it does not request data but simply listens to what the transmitter sends select Burst mode.
- Retries sets the number of retries in Master mode before an alarm is indicated default is 3 and can be set from 1 to 15.
- Burst mode Timeout sets the time to wait for a valid reply in Burst mode before indicating an alarm default is 2 seconds can be set from 1 to 15 seconds.
- Select the transmitter to be configured, up to 3 are possible on each loop. Assign a short id address, between 1 and 15 for the transmitter to be configured the transmitter should previously have been set up to use the HART mode and have been programmed with the corresponding short address.
- If only one transmitter is to be used on the loop, in the non HART (4-20mA) mode then it should be assigned address 0 in which case the Transmitter 2 and 3 information, will be greyed and is not accessible, indicating that configuration of only one transmitter is possible in this mode.
- Select the Primary Variable to be read from this transmitter from the items listed in the pull down tree. If the transmitter is a multivariable type, when up to 4 variables are available then the Secondary, tertiary and Quaternary values should also be set using the same method as for the Primary value.

# Analogue Inputs



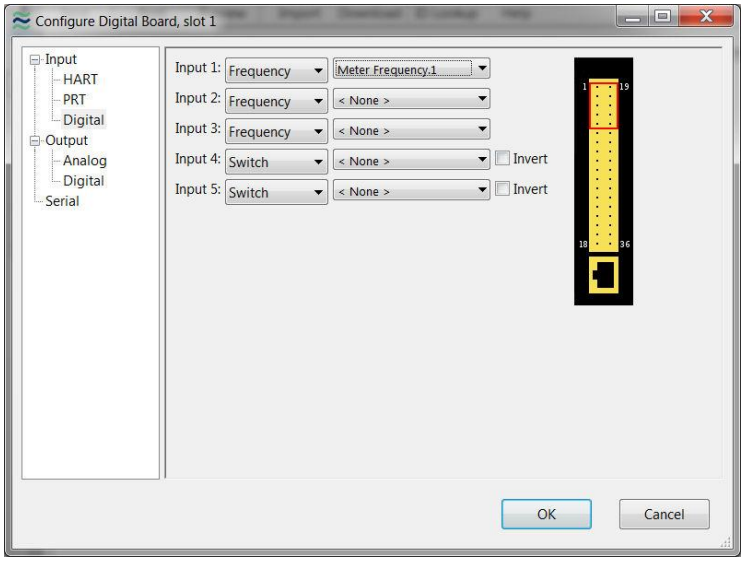

- Select the Analogue Input sensor to be configured there are four inputs on each Analogue I/O Board.
- Select the Variable that will represent this sensor input from the items listed in the pull down tree.

# PRT Inputs




- Select the PRT sensor to be configured there is only one input on each Digital I/O Board and each Analogue I/O Board.
- Select the Variable that will represent this PRT input from the items listed in the pull down tree.

# Digital Inputs




- There are 5 digital inputs on both the Digital I/O Board and the Analogue I/O Board and 4 digital inputs on the Digital I/O 2 Board. If the Unit is configured for standard measurement then
    - Inputs 1 to 3 , can be configured as frequency and pulse counting inputs, Inputs 1 to 5(4 for Digital I/O 2), can be configured as switch contact closure inputs.

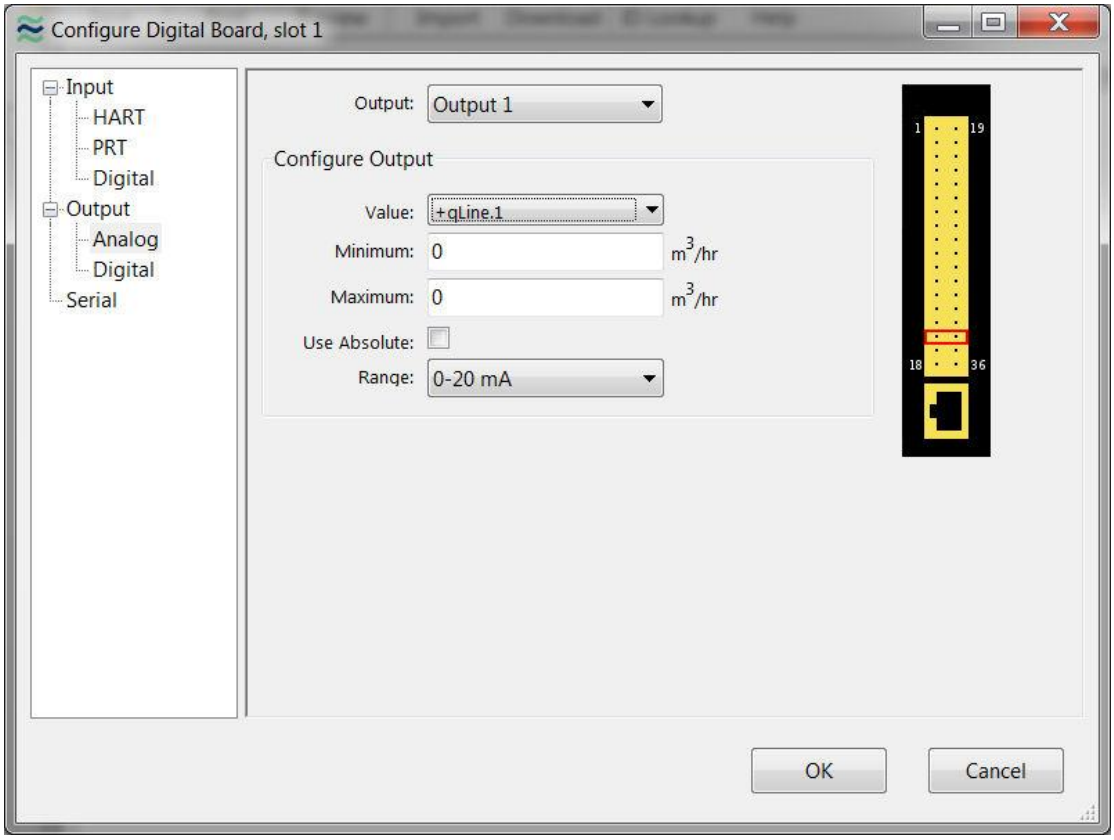
  If the Unit is configured for Liquid or prover operation then more options are possible
    - Inputs 1 to 3 , can be configured as frequency and pulse counting inputs, Inputs 1 to 5(4 for Digital I/O 2) , can be configured as switch contact closure inputs.
      Input 1 and 2 , can be configured for dual pulse operation API 5.5 Level A.
      Input 1 , can be configured for Prover Frequency Input operation.
      Inputs 2 to 4 , can be configured for detector switch operation.
- There are 6 digital inputs on both the Switch I/O Board. If the Unit is configured for standard measurement then
    - Inputs 1 to 3 , can be configured as frequency and pulse counting inputs, Inputs 1 to 6 , can be configured as switch contact closure inputs.

  If the Unit is configured for Liquid or prover operation then more options are possible
    - Inputs 1 to 3 , can be configured as frequency and pulse counting inputs, Inputs 1 to 6 , can be configured as switch contact closure inputs.
      Input 1 and 2 , can be configured for dual pulse operation API 5.5 Level A.
      Input 1 , can be configured for Prover Frequency Input operation.
      Inputs 2 to 5 , can be configured for detector switch operation.

      NOTE In addition the option connections Inputs 7-12 can be configured as switch contact closure inputs , however care should be taken when using the option connections it is important to make sure the link settings are correct. Consult the Operating Instruction manual for guidance.
- Select the input to be set up and select the variable from the pull down tree, that will represent that input.
- For the Switch inputs it is possible to reverse the logic of each input by enabling the

Invert tick box.

# Analogue Outputs




- There are 2 Analogue outputs on the Digital I/O Board, 3 on the Analogue I/O board and 4 on the Digital I/O 2 board. Select the output to be configured.
- Select the Variable that will be represented by the Analogue Output from the pull down tree.
- Set the Output Range 4-20mA or 0-20mA.
- Set the Minimum value this is the value represented by 0 or 4mA of the output.
- Set the Maximum value this is the value represented by 20mA of the output.
- If the selected variable can be signed positive and negative, the Use absolute tick box should be enabled if it is required to use the Absolute value of the variable rather than the signed value.

# Digital Outputs

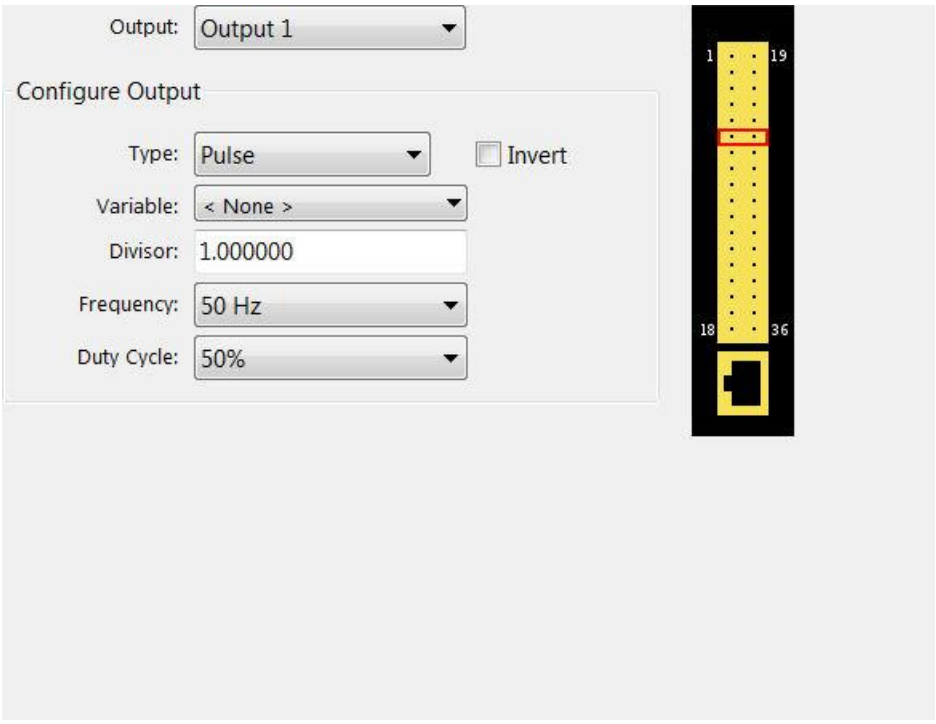
There are 5 Digital outputs on the Digital I/O Board 5 on the Analogue I/O Board and 6 on the Digital I/O 2 board. Select the output to be configured from the list.

On the Switch I/O Board there are 6 Digital Outputs and a further 6 option outputs which can be configured as Digital Outputs.
Care should be taken when using option outputs and consideration should be taken of the correct board link settings. See Operating Instruction manual for guidance.

Outputs can be configured as different types:-

| | |
|---|---|
| Off | Not Used |
| Pulse | Set to Pulse output telemetry |
| Alarm | Alarm indication |
| State | Output set to on or off state e.g. Valve operation |
| Corrected Pulse | Prover Pulse bus output |

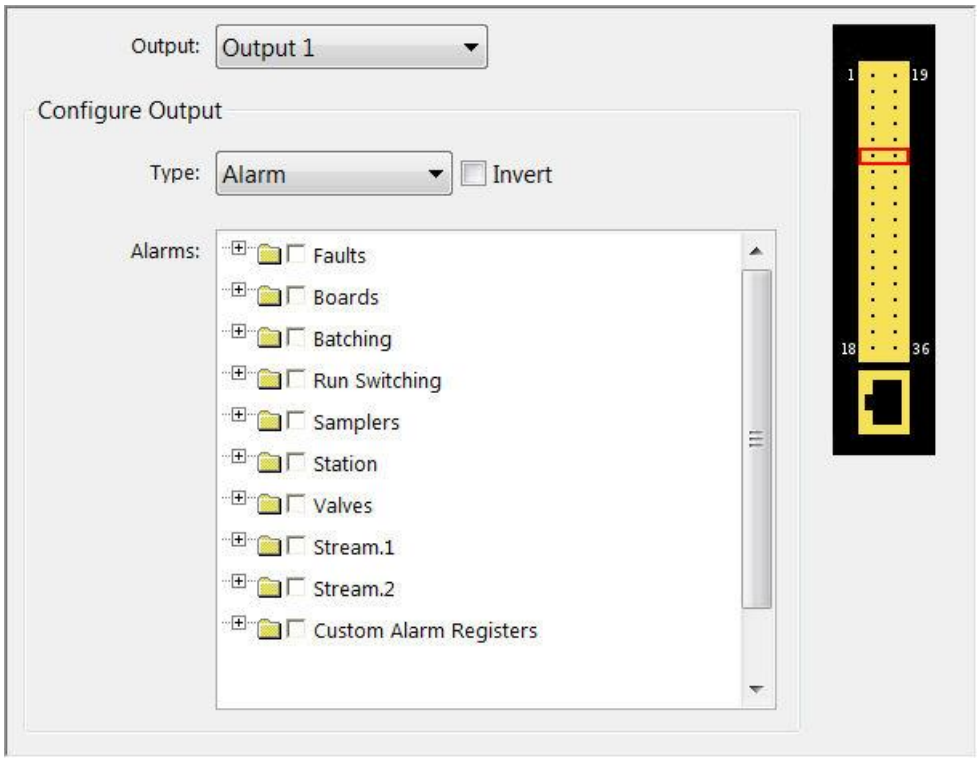
## Pulse Outputs




- Select the Variable that will be represented by the Digital Pulse Output from the pull down tree. NOTE this would normally be a Counter Increment value.
- Enter the Divisor or output scaling factor.
- Select the Frequency of the output in Hz, from 50 to 2
- Select the Output Duty cycle from 25%, 50% or 75%

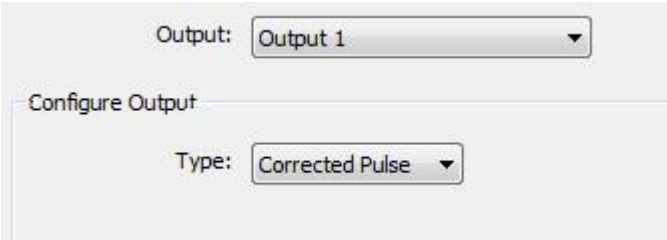
NOTE: it is possible to reverse the logic of each output by enabling the Invert tick box.

## Alarm Outputs



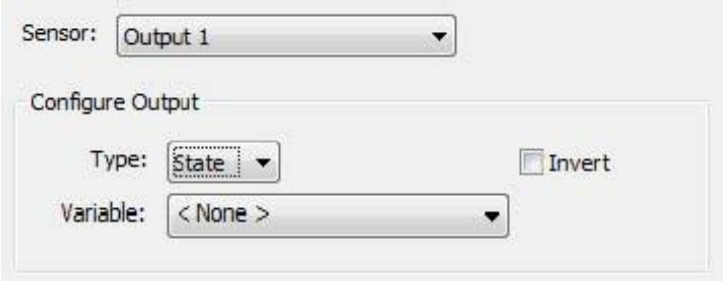

- An alarm output can be set to represent , individual Alarms or groups of alarms.
- From the Tree menu select the required alarm or alarms that the output will represent, the alarm is selected by enabling the tick box adjacent to each alarm or group of alarms.
- NOTE it is possible to reverse the logic of each output by enabling the Invert tick box.

## Corrected Pulse Output



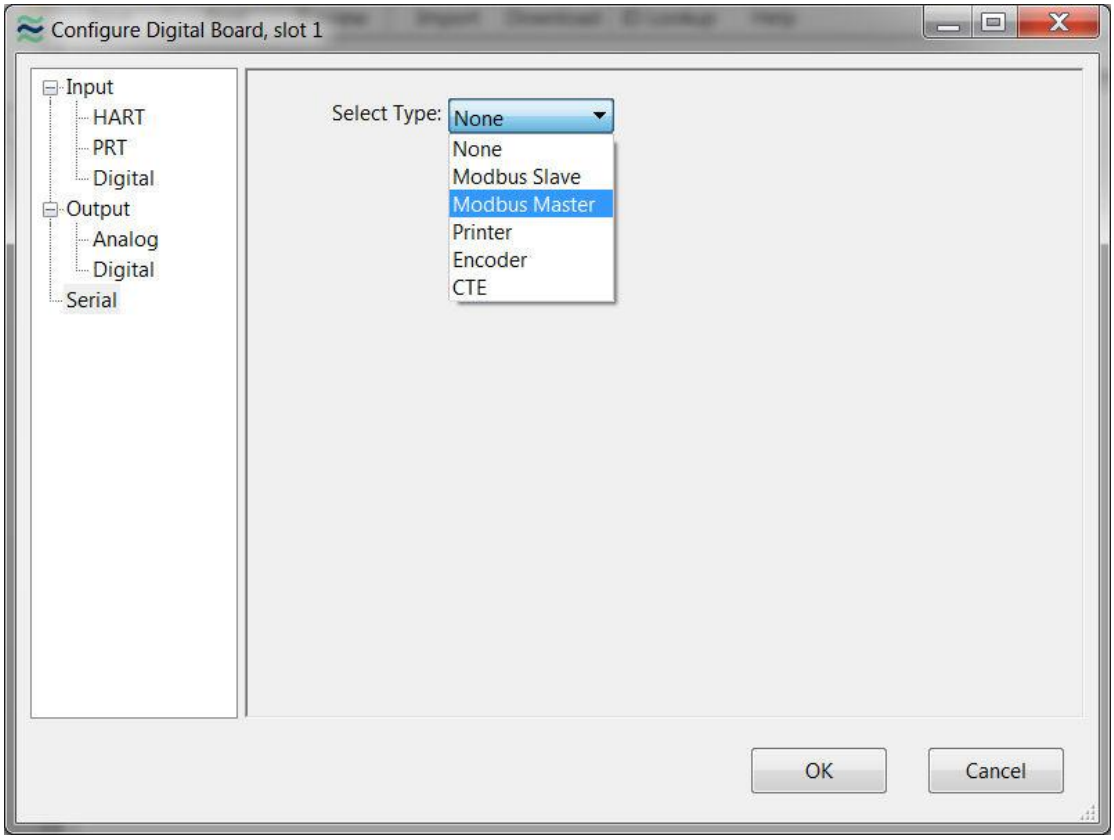

- The Corrected Pulse bus Output should only be selected when the Unit is going to be used with a gas or liquid Prover. This output is connected to the other Pulse bus outputs in the system and to the Prover pulse input.
- NOTE Only Pulse Output No 1 can be selected for this function as this output has a higher operating frequency range than the other outputs.
- The only configuration required for this output is to select Corrected pulse from the pull down menu.

# State Outputs




- A state output is set to follow the state of a particular id, this can be used for testing purposes or for Valve output control.
- For testing to set the output to OFF Set the selected Variable to and the Output will be set to OFF.
- For testing to set the output to ON Set the selected Variable to and enable the invert tick box the output will be set to ON.
- For valve operation set the selected Variable to be a Manual Valve control value. The Output will then follow the logic State of the Manual Valve Control. See the General , Valve set up page for more details.

# Serial Output




There is a single non isolated serial output on the Switch I/O Board, Digital I/O board, Digital I/O 2 board and Analogue I/O board.

There are 3 isolated serial outputs on both the Communications board and Dual Ethernet board.

A serial output can be configured to the following functions:-

| | |
|---|---|
| None | No function |
| Modbus Slave | Modbus slave for reading of Data |
| Modbus Master | For Connection to Slave devices, US meter, GC etc. |
| Printer | For Connection to a Serial Printer. |
| Encoder | For Connection to an Meter Encoder using the NAMUR protocol. |
| CTE | For Connection to any device operating the Italian CTE serial protocol. |

# Modbus Slave

Note: Familiarity with Serial Communication and the Modbus Protocol is assumed on the part of the operator. See Section 8 Modbus Slave Details.

# Modbus Master

Note: Familiarity with Serial Communication and the Modbus Protocol is assumed on the part of the operator. See Section 9 Modbus Master Details

## Master Type

The Master Type page configures the Modbus Master device that will be connected to this serial Port.

- For an Ultrasonic Meter Select Ultrasonic Single for a single Stream or Multiple for more than one stream.
- For a Gas Chromatograph Select the type that will be used.

The interpacket delay defines that delay between data packets, default is 100mS, but it can be re-configured to accommodate different devices.

The ID refers to the Modbus id of the connected device.

For Gas Chromatographs Data associated with the specific configuration of the interface to the GC and the data that it will send, will need to be configured.

# Printer

For details of the Serial Printer refer to Section 7

# Encoder

The Encoder selection is the communication port for Meters fitted with an Encoder or SMART Index.

When the Model 3000 is used with an encoder meter using the NAMUR Serial Communication protocol the serial communication port used on this corrector is set-up and given functions on this set-up page.

The Selection pull down will define the available functions in this case **Encoder** should be selected.

Once a port has been assigned a function of **Encoder** other menu boxes appropriate to that function will appear as follows:

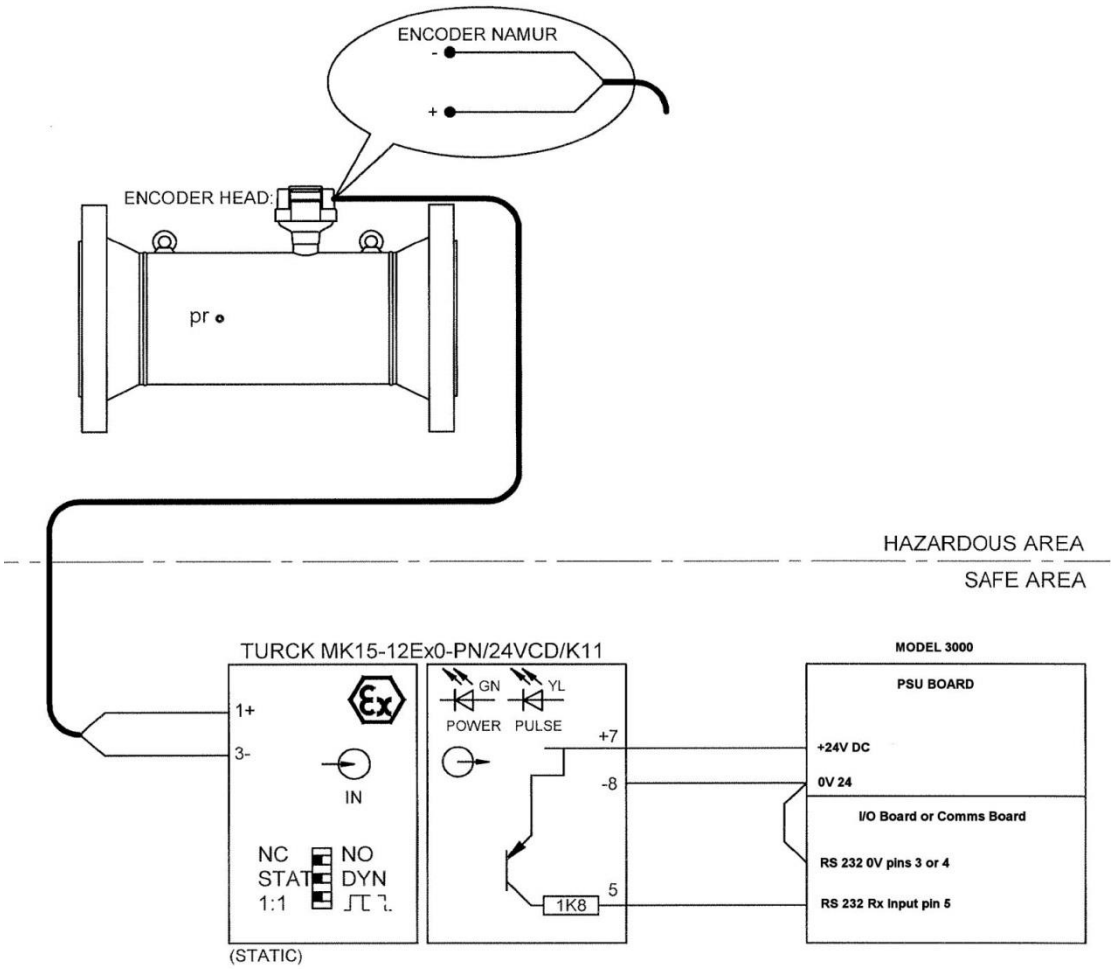
| | |
|---|---|
| **Baud Rate** | fixed default of 2400 |
| **Parity** | fixed default of Even |
| **Stop bits** | fixed default of 1 |
| **No bits** | fixed default of 7 |
| **RS232** or **RS485** | fixed default of RS232 |
| **Timeout** | Communication re-try timeout |

The Model 3000 will read and display the following Parameters from the Encoder

| | Meaning |
|---|---|
| a<US> | start character **a**, data frame identifier **"meter-readout"** |
| zzzzzzzzzzzzzz<US> | meter readout max. 14 digits in ASCII Decimal, no suppression of leading zeros |
| ww<US> | indication of the dec. pt. of meter-readout max. 2 digits optional + or – and power of 10 in ASCII-Decimal Note 0, +0, -0 are equivalent and are all valid. |
| eee<US> | physical unit of meter readout, max. 3 characters as text e.g. m3 |
| s<FS> | Device Status 1 byte 0x30 to 0x3F where 0x30 means no fault |
| | |
| | |
| b<US> | start character **b**, data frame identifier **"identification"** |
| HHH<US> | manufacturer code must be 3 capital letters e.g. INS |
| TTTTTT<US> | device type or meter class max. 6 characters as text e.g. G1600 |
| SSSSSSSSS<US> | serial number of the meter max. 9 characters as text e.g. 123456789 |
| JJJJ<US> | year of manufacture of meter must be 4 digits in ASCII Decimal e.g. 2003 |
| VVVV<FS> | software version number of Smart Index , max 4 characters as text |
| | |
| | |
| <US> | Unit separator |
| <FS> | File separator |

For more detailed information relating to the setting up and configuration of the Encoder see the operating instruction manuals for that device.

A typical connection drawing is shown below



# CTE Setup

Configuring and using the CTE protocol enables the viewing of instantaneous logging and program data.

Note: Familiarity with Serial Communication and the CTE Protocol is assumed on the part of the operator.

## Settings

The Settings Page enables or configures all communication settings associated with this output.

- Stream - Calculation Stream. CTE must also be enabled for that stream.
- Log Data - Offset of Stream data in log. If one stream is used for CTE data, this will be set to "Data Block 1". The Logs should be configured with data from Stream N. If two streams are used, for example Streams A and B, then the Logs should be configured with data from Stream A and B. Log Data would be set according to which data is required from the port. "Data Block 1" for stream A, "Data Block 2" for stream B. Only one stream is accessible from the port.
- Baud Rate - Set between 300 and 38400.
- Parity - None, odd, even, mark or space.
- Stop Bits - 1 or 2 stop bits.
- Mode - RS232 or RS485.
- Word size - 7 bits or 8 bits.
- Master - When Master if enabled, if a password request is received the password request is echoed. When Master is disabled, password request is ignored.
- Level code1 - Must match Level code1 of request, packet ignored otherwise.
- Level code2 - Must match Level code2 of request, packet ignored otherwise.
- Level code3 - Must match Level code3 of request, packet ignored otherwise.
- Session Timeout - Currently unused.

# Stream Setup/CTE Logdata

The CTE protocol is dependent on the logs being set correctly, and the stream setup. There are 5 logs which need to be configured (order is not important).

Daily (Daily interval)

Monthly (Monthly interval)

Volume Trace (15 Minute interval)

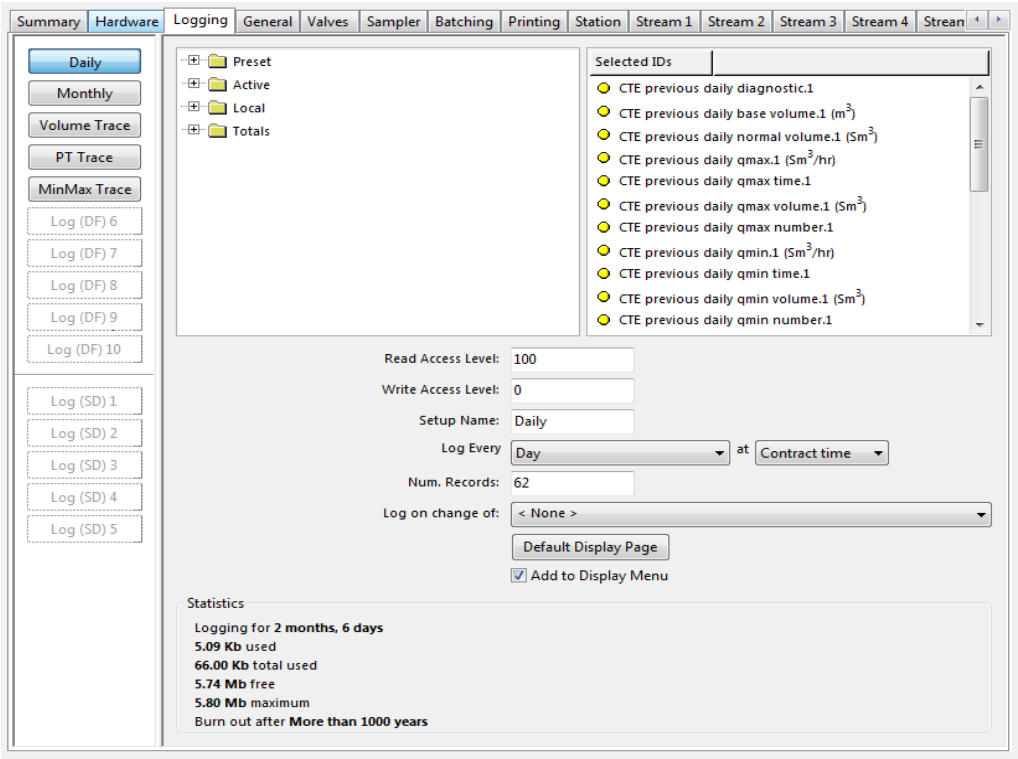
Pressure and Temperature Trace (15 Minute interval)

Min/Max of Pressure/Temperature Pressure (Daily interval)

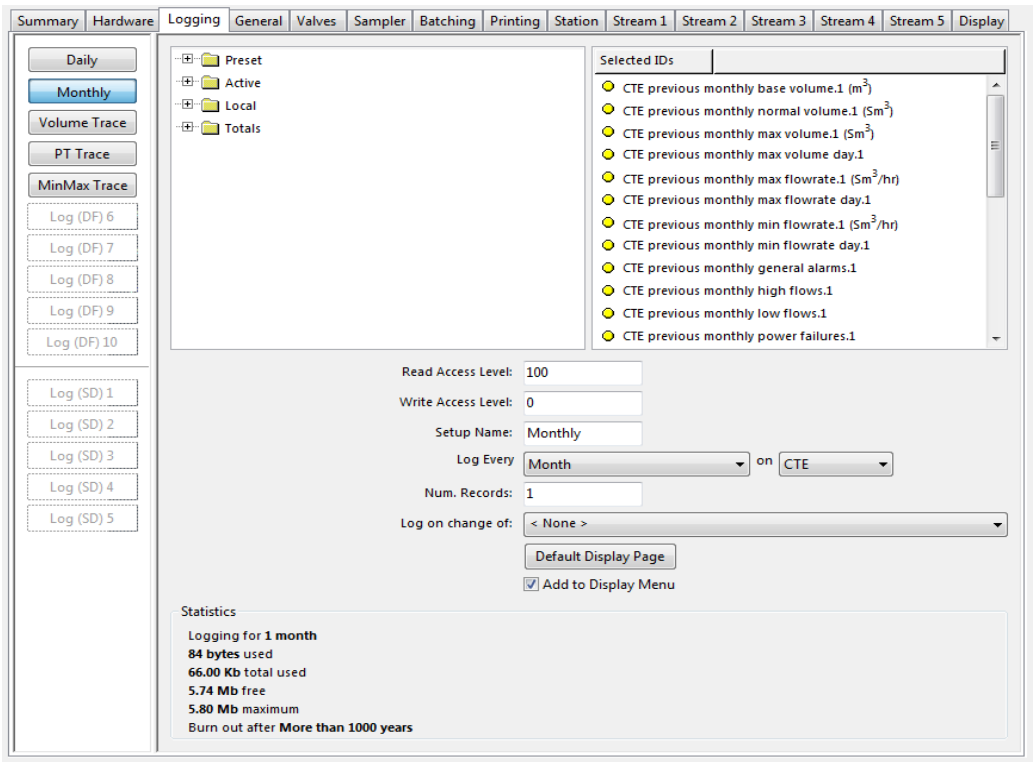
CTE IDs can be found in active\stream\CTE\previous_period. The order of IDs in each folder is set to match the protocol.

The logs are setup as follows:

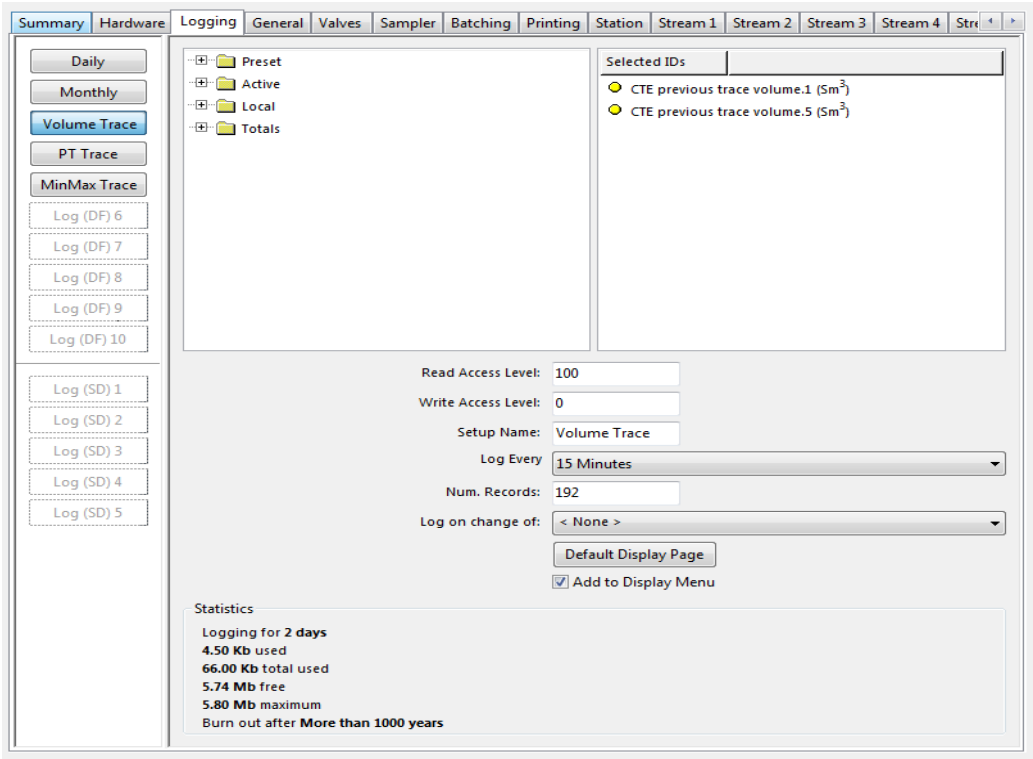
- Daily log



- Monthly log

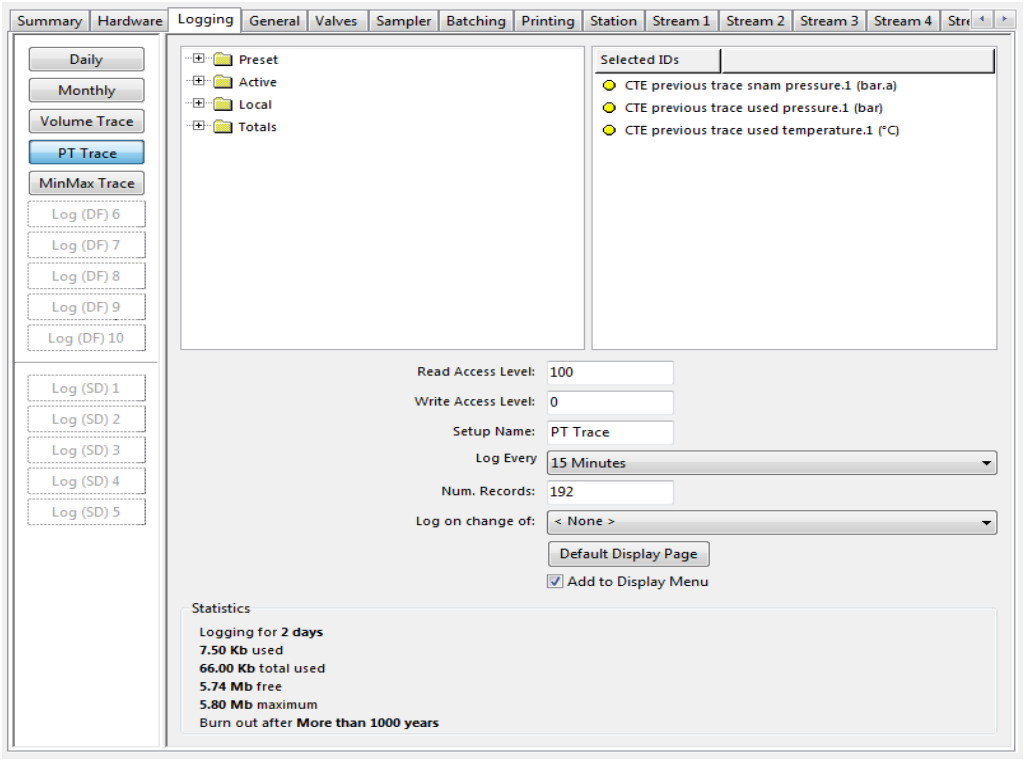



- Volume log

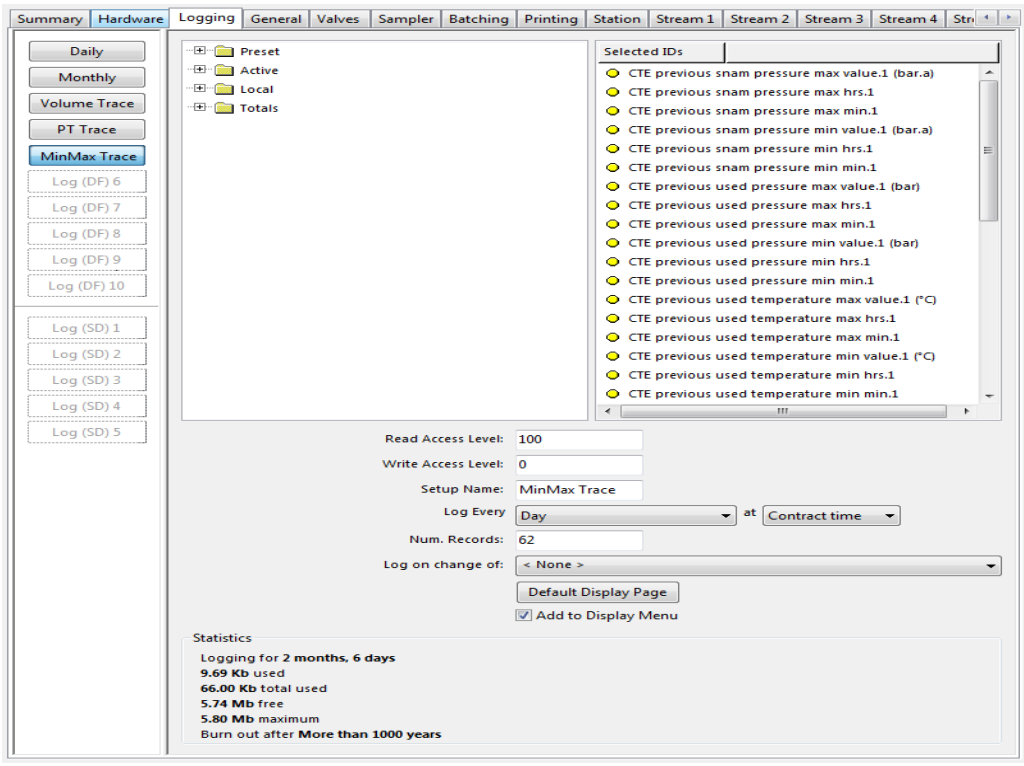



-Example shows stream 1 and 5 setup

- Pressure and Temperature Trace log




- Min/Max of Pressure/Temperature log



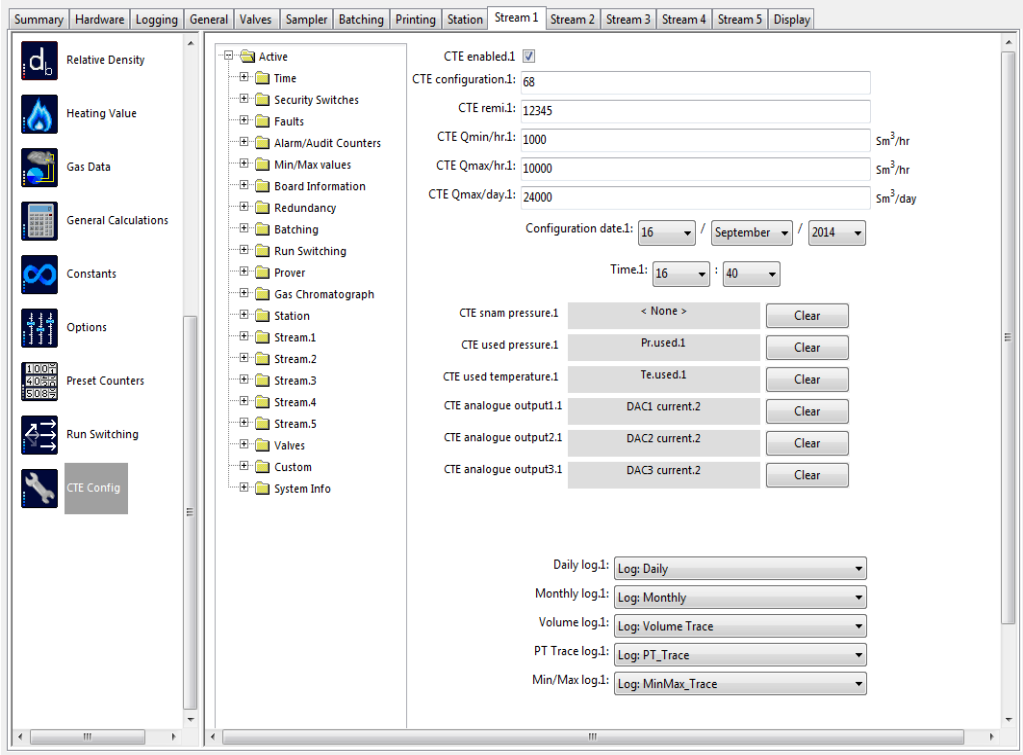
## Stream Setup

- CTE enabled - When enabled, turns on the calculation of CTE values.
- CTE configuration - Configuration number used in protocol header.
- CTE remi - Serial number used in protocol header.
- CTE Qmin/hr - Minimum hourly flow.
- CTE Qmax/hr - Maximum hourly flow.
- CTE Qmax/day - Maximum daily flow.
- Configuration date - Data returned when accessing programmed data.
- CTE snam pressure - if required, assign ID from active folder.
- CTE used pressure - if required, assign ID from active folder.
- CTE used temperature - if required, assign ID from active folder.
- CTE analogue output - if required, assign ID from active\board_information\slot.n\Analogue_Outputn\DACn.current.
- CTE analogue output2 - if required, assign ID from active\board_information\slot.n\Analogue_Outputn\DACn.current.
- CTE analogue output3 - if required, assign ID from active\board_information\slot.n\Analogue_Outputn\DACn.current.
- Daily log - If used, assign log for Daily Log.
- Monthly log - If used, assign log for Monthly Log.
- Volume log - If used, assign log for Volume Log.
- PT Trace log - If used, assign log for PT Trace Log.
- Min/Max log - If used, assign log for Min/Max Log.

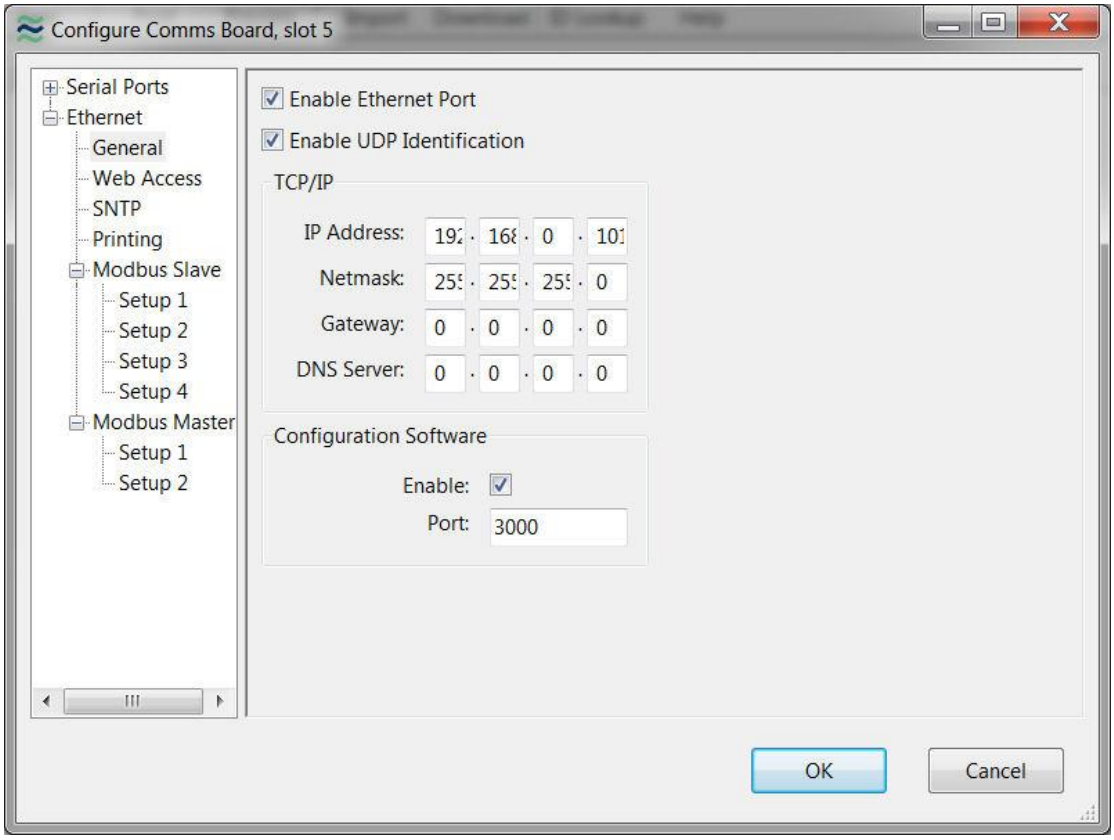
Note: The analogue outputs are used whilst accessing the instantaneous data. The corresponding analogue output must be setup accordingly.

Note: If no log is assigned to any of the above, any protocol requests requiring access to log data will be ignored

# Example of stream setup



# Ethernet




# Ethernet General

This page enables the General settings for the Ethernet Port.

The Ethernet is enabled by the tick box Enable Ethernet Port.

The option of User Datagram Protocol UDP can be enabled by tick box.

For TCP I/P operation, the IP Address, Net Mask and Gateway, must be entered in the Data Entry boxes.

If it is intended that the configuration software will be used via the Ethernet then this is enabled by the tick box.

# Web Access

Web Access is enabled by the tick box.

Authentication can be set to None or Basic.

A Username, password and Realm must be entered.

# SNTP

Enabling the SNTP configuration allows the flow computer time to be synchronised across a network. The flow computer works with time servers using version 3 or 4 of the SNTP protocol.

The Operating Mode selects how the flow computer communicates with the time server. The available options are either Unicast or Broadcast.

Unicast is where the flow computer will request the time from a specified time server. Broadcast is where the flow computer waits for a broadcast packet from a time server, and then confirms the results by using a unicast request.

The following settings control the time synchronisation.

| | |
|---|---|
| Port | The port used for the unicast request. The SNTP standard specifies that this should be 123. |
| Min time adjustment | The minimum amount of time the flow computer clock can be adjusted by. |
| Max time adjustment | The maximum amount of time the flow computer clock can be adjusted by. |
| Max time without adjustment | The maximum number of seconds that the flow computer can be expected to operate without receiving a new time from the time server. If this time is exceeded without receiving a new time from a time server then the flow computer will generate a warning. |
| Invalid time update limit | The maximum number of bad updates that can be received before a warning is generated. |
| Ignore max adjust on startup | Indicates if the Max time adjustment value should be ignored for the first valid time received by the flow computer after powerup. |
| Offset from GMT | This is the number of minutes +/- GMT the flow computer local time is. |
| Unicast Server timeout | This is the timeout that applies to each server. After this timeout expires the next available server in the list is tried. It is recommended that this value is a factor of the Max time without adjustment. |
| Unicast poll interval | This is how often the flow computer polls the time server. It is recommended that this value is not divisible by 60. |
| Unicast number of servers | This is how many time servers the flow computer can connect to. |
| Unicast time server | This is the IP address of each server. |
| Broadcast timeout | This is the time that the flow computer waits for a broadcast. It is recommended that this value is a factor of the Max time without adjustment. |
| Broadcast domain. | IP address on the Client subnet for the Client operating in broadcast mode to listen for time updates from broadcast servers |

# Network Printing

Data can be printed over the Ethernet connection using one of two protocols:

## FTP

To configure printing over FTP the printers IP address must be known, and also any required usernames and passwords to access the printer. To obtain the printers IP address print a test page from the printer, and the printers default username and password should be listed in the printers manual.

Note: When using FTP to print data the Printer or Print Server must be able to accept FTP connections. A majority of Network enabled printers and Print servers support this protocol.

## SMTP

To configure printing using SMTP an E-Mail consisting of HTML data will be sent to the required recipients. To configure this style of printing you will need to assign the flow computer an E-Mail address with your E-Mail server and also have access to the E-Mail server account details.

| | |
|---|---|
| FC E-Mail Address | The E-Mail address of the flow computer, e.g., flowcomputer@example.com |
| SMTP Server | The address of the outgoing mail server, e.g., smtp.company.com |
| SMTP Server Password | The password required to access the mail server |
| Domain | The domain name of the server, e.g., example.com |

Once the Server settings have been configured up to a maximum of 5 E-Mail recipients can be added. These can be configured to be To: recipients, Cc: recipients or Bcc: recipients.

# Modbus Slave

Note: Familiarity with Network Communication and the Modbus Protocol is assumed on the part of the operator. See Section 8 Modbus Slave Details

# Modbus Master

Note: Familiarity with Serial Communication and the Modbus Protocol is assumed on the part of the operator. See Section 9 Modbus Master Details.

## Master Type

The Master Type page configures the Modbus Master device that will be connected to this port.

- For an Ultrasonic Meter Select Ultrasonic Single for a single Stream or Multiple for more than one stream.
- For a Gas Chromatograph Select the type that will be used.

The interpacket delay defines that delay between data packets, default is 100mS, but it can be re-configured to accommodate different devices.

The ID refers to the Modbus id of the connected device.

For Gas Chromatographs Data associated with the specific configuration of the interface to the GC and the data that it will send , will need to be configured.

# 7. Serial Printer

## Settings

The Settings Page enables or configures all communication settings associated with this output.

| | |
|---|---|
| Baud Rate | Set between 300 and 38400 |
| Parity | None, odd, even, mark or space |
| Stop Bits | 1 or 2 stop bits |
| Mode | RS232 or RS485 |
| Word size | 7 bits or 8 bits |
| Page Width | in characters maximum 255 |
| Page Height | in characters maximum 255 |

## Print Jobs

The Print Jobs page defines the configuration of the items, to be printed and under what conditions they are to be printed. To configure a Print Job:

**Print Setups**

| | |
|---|---|
| **New** | Create a new printout |
| **Rename** | Rename an existing setup |
| **Delete** | Delete an existing setup |

There is no limit to the number of separate Printer Reports that can be created, each should be given a different Printout Name and can then be referred to when the various Print Jobs are set-up.

Set under what circumstances the Print Job will be printed.

- For Interval based printing set the tick box print on interval and then set the Print interval period from the pull down menu list. It is possible to set a Print Interval offset, when interval printing. This has the effect of delaying a print by the offset time, so for example if the system was set to print hourly on the hour with a Print interval offset of 5 mins , then the printout would actually occur at 5 mins past the hour. This feature is intended to be used when multiple units are sharing one printer.
- For Event based printing set the tick box print on event and then select the event or events, when the print should occur , from the tree of events.
- Print on change of id parameter, can also be configured, by selecting the parameter to monitor from the pull down tree. This function is intended to be used when a particular parameter, changes state, however , care should be taken when selecting the id as a print will be generated on each change.
- If a manual Print of this print job is required then enable the Show on Print menu tick box. This will enable the Print Job to be shown on the flow computer *Print Jobs* main menu item.

## Configure Report

Press the Configure Report Button this will open the Configure Report Window. With

a Tree of Variables on the Left hand side and a blank print report on the right hand side.

Variable data or Log data which includes Alarm and Audit data, to be printed can be selected from the Tree and dragged and dropped onto the page. Once on the page the item or block of data, can be positioned where required.

User entered text can be typed anywhere on the page, position the cursor on the page, where the text is to be typed and left click the mouse, type the text as required.

Alterations to the variables on the page can be made, by right clicking the selected item and following the options provided.

The configure print report page is split in two different sections:

**Variables & Log Data**

Normally the Data Tree contains all variable items and these can be selected and dragged across to the Printer set-up page. To select Logged items the Logged Data button should be operated and any available logged data will be shown instead.

**Page Selection**

| | |
|---|---|
| **<<** | go to first page |
| **<** | go to previous page |
| **Page n** | go to page number n |
| **>** | go to next page |
| **>>** | go to last page |
| **New Page** | create a new page |
| **Delete Page** | delete the current page |
| **Undo** | undo an action |
| **Zoom (50%)** | zoom in or out of the page |

**Page Setup**

A group of Text can be selected by operating the right mouse key this will show the selected text surrounded by a Green line any new or duplicate position will be shown by a blue shaded box options then exist to:-

**Delete**
**Copy**
**Cut**

A variable item can be selected by the right mouse key. The options then exist to:-

| | |
|---|---|
| **Delete** | |
| **Copy** | |
| **Cut** | |
| **Change Formatting** | Shortcut to Format Menu. |
| **Hide Name** | Removes Name Field |
| **Hide Value** | Removes Value Field |
| **Hide Units** | Removes Units Field |

A log or group of log records can be selected by the right mouse key. The options then exist to:-

**Delete**
**Copy**
**Cut**

**Change Formatting** Shortcut to Format Menu.

| | |
|---|---|
| **Width** | Sets Total number of characters |
| **Decimal places** | Sets Number of decimal places |
| **Max field width** | Sets Maximum Field width in characters |

**Create Log Statistic** allows a group of log records to be selected and a statistic to be created this can then be selected from the options:

| | |
|---|---|
| **Sum** | Sum of all items in log record |
| **Average** | Average of all items in log record |
| **Min** | Minimum value in the list |
| **Max** | Maximum value in the list |

**Change number of rows** Enter number of rows for this selection in the report

**Change Time Period** Change the Time period of the log record with options as follows:-

**All** Will select the required number of records from the selected log records, starting from the most recent record. Irrespective of log interval times, missing records or start of day times.

**Hours** This option should be used to create an Hourly report made up of log records with an interval of less than 1 hour. The pull down menu has a number of options , which determine which log records will be used to create the report. Current hour means any log records in the current hour will be used. –N Hour means records from the hour N ago will be used. Any missing records will be shown using the missing record symbol typically – in the appropriate time slot of the record.

Current hour
-1 Hour
|
-23 Hours

**Days** This option should be used to create a Daily report made up of log records with an interval of less than 1 day (typically 1 Hour). The pull down menu has a number of options , which determine which log records will be used to create the report. Current Day means any log records in the current Day will be used. –N Day means records from the Day N ago will be used. Any missing records will be shown using the missing record symbol typically – in the appropriate time slot of the record.

Current Day (current time back to Contract Time)
-1 Day
|
-31 Days

**Months** This option should be used to create a Monthly report made up of log records with an interval of less than 1 month (typically 1 Day). The pull down menu has a number of options , which determine which log records will be used to create the report. Current

Month means any log records in the current month will be used. –N Month means records from the Month N ago will be used. Any missing records will be shown using the missing record symbol typically – in the appropriate time slot of the record.

Current Month( current time back to Month Day 1)
-1 Month
|
-12 Months

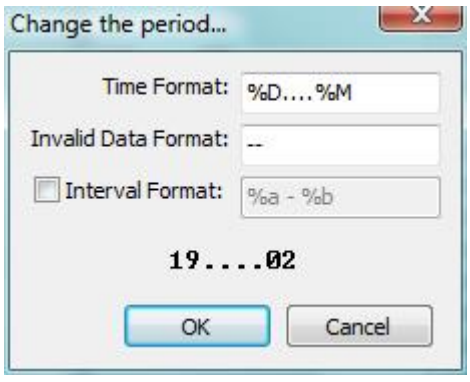
**Order** Change the time date order of the records
**oldest first**
**newest first**

For a Time and Date Column in a log or group of log records this can be selected by the right mouse key. The options then exist to:-

**Delete**
**Copy**
**Cut**
**Change Formatting** Shortcut to Time Date Format Menu.
**Time Format** Set which Time and Date items to include and which separator characters to use. Enter Time and Date items as follows:-

| | |
|---|---|
| %D | day |
| %M | month |
| %Y | 2 digit year |
| %y | 4 digit year |
| %h | hours |
| %m | minutes |
| %s | seconds |

**Invalid Data Format** Sets Characters used if no time is available in the report.
**Interval Format Tick box** Enables or disables the time date format from / to e.g. 10:00 – 11:00
Example of Format screen will be shown below the selection items, as shown.




**Change number of rows** Enter number of rows for this selection in the report
**Change Period** Change the Time period of the log record
**All** Complete log record
**Hours**

Current hour — current hour or
1 Hour — last 1 hours
|
23 Hours — last n Hours

**Days**

Contract Time — current day from Contract Time or
1 Day — last 1 day
|
31 Days — last n days

**Months**

Contract Time — current month from contract time or
1 Month — last 1 month
|
12 Months — last n months

**Order** — Change the time date order of the records
**oldest first**
**newest first**

Alarm or Audit log group of records can be selected by the right mouse key. The options then exist to:-

**Delete**
**Copy**
**Cut**
**Change number of rows** — Enter number of rows for this selection in the report
**Change Period** — Change the Time period of the log record

**All**

**Hours**

Current hour
1 Hour
|
23 Hours

**Days**

Contract Time
1 Day
|
31 Days

**Months**

Contract Time
1 Month
|
12 Months

**Order** — Change the time date order of the records
**oldest first**
**newest first**

# 8. Modbus Slave Details

The Modbus Slave set-up page allows the operator to set-up MODBUS Slave COMMUNICATION data lists that can then be accessed via the selected communication port of the unit.

The Modbus page is divided into a number of sections

**a) Settings** **Set Basic operation parameters for this port**

| | |
|---|---|
| **Modbus id** | Normally 1 to 255 |
| **Setup Name** | Name of Setup (Text) |
| **Protocol** | ASCII or RTU |
| **Baud Rate** | 300 to 38.4 K |
| **Parity** | None, Odd, Even, Space, Mark |
| **Stop Bits** | 1 or 2 |
| **Mode** | RS232 or RS485 |
| **Word Size** | 7 or 8 bits |
| **Use modbus timeout** | When enabled this option resets the modbus timeout counter when a valid modbus packet is received. |
| **Use address offsets** | When enabled the used defined and function dependent address offsets are added to the received modbus starting address |
| **Log Offset** | When accessing a log record that is setup for Direct or Indexed access, the Log Offset applies an offset to the accessed log record.<br>The Log Offset is not used for logs setup for Event access.<br><br>Example:<br>With an Offset of 1, and requesting log 1, the actual log accessed would be 0 (Most Recent or Oldest log record).<br>With an Offset of 0, and requesting log 1, the actual log accessed would be 1. |
| **First Log** | When accessing a log record that is setup for Direct or Indexed access, this selection changes which log is accessed for log 0. The alternatives are Newest first or Oldest first. The selection does not alter the retrieval of log data setup using Event access. For Event access data, data is always presented as oldest record first. |
| **Invalid data action** | When accessing log data, by any method, this selection allows inaccessible log data to:<br>1) Fill the record with 0x00<br>2) Fill the record with 0xFF<br>3) Generate an exception |
| **Log Event number** | When Modbus is to be setup for Event Logging, this should be set for the log number which will be used to store the Events.<br>When this is selected, the records contained within the setup are checked for value changes (preset data only), and alarm events associated with each address. When a change or alarm event occurs, a log event is generated in the Event Log.<br><br>Alarm events associated with each address are setup in Modbus Events |

**b) Addresses**

**Data Tree** This contains all the possible data that can be accessed via a MODBUS communication port. Any required data item or data file can be dragged across to the MODBUS set-up window to be included in the active set-up. The Data Tree is divided into 3 separate sections:-

**Variables:** All standard data available in the unit, further subdivided into :-

- **Preset :** Configuration or fixed data
- **Active :** Calculation or result data
- **Local :** Setting data
- **Counters :** All Totals.

**Log Data :** Any available logging data

**Status Bits :** Alarm or Status bits to be read as individual bits.

**Modbus Set-up** The Modbus set-up window assigns the necessary MODBUS communication set-up to each data item or block of data items that are dragged into the Window from the data tree. The items that need to be configured, and the options for each data item are as follows:-

**Address** any address in the range 0H to FFFFH or 0D to 65535D
A modbus setup may contain multiple records with the same address. When this is setup addresses with the identical address have a '-'. When this is done the registers field is defined in the first record, and defines the records for entire structure. This is especially useful when accessing Log data via the Indexed and Event methods.

**Variable** id name of Variable from Data Tree

**Type**

| Number type | can be selected from : |
|---|---|
| Char | 8 bit |
| Unsigned Char | 8 bit |
| Short | 16 bit |
| Unsigned Short | 16 bit |
| Integer | 32 bit |
| Unsigned Int | 32 bit |
| Float | 32 bit |
| Double | 64 bit |
| Modbus Time | 64 bit |
| Default | |

**Order**

| Byte order | can be selected from : |
|---|---|
| 12345678 | (1234) |
| 21436587 | |
| 34127856 | (2143) |
| 43218765 | |
| 56781234 | (3412) |
| 65872143 | |
| 78563412 | (4321) |
| 87654321 | |

**Size** This is the size of register type

**Registers** Number of records associated with address

**Latch** This can be selected from:
None
Latch

**Indexing Method** This can be selected from

None: This can be the only selection for non-log items.

For log items, the selection has to be one of the following:

Direct: The log record required is specified by the log number (log #)

Indexed. The log record required is specified by the "number of records" parameter in the modbus request.

Event. When requested, the "number of records" parameter in the modbus request is ignored. The response is the number of log events which have occurred since the Log was last read and acknowledged. If no events have occurred then the response is "no data". If many events have occurred, and fill the available modbus response, the oldest events will be transmitted. More recent events will be transmitted after the last request has been acknowledged. To obtain the number of events waiting to be transmitted, this is obtained by accessing the "Modbus Log Event Index".

To Acknowledge events, the "Force single Coil" command is issued to the Event address.

**Access** can be selected from :
Read only
Read Write
Read Write to Data Flash

*Note. Read /Write is only applicable to items with write access (Red id)

**Record** Log Record Number zero (0) being the most recent log record. For normal Variables and status this is shown as –

**Scaling** From version 0.38.0.0 it is possible to set a group of scaling values for both the scale and the range.

Scaling. Used to enable and disable the scaling functionality

Range Min. Lower value of ID scaling

Range Max. Upper value of ID scaling

Scale Min. Lower value of Modbus scaling

Scale Max. Upeer value of Modbus scaling

*Note. When modbus value is written, value is scaled between "scale_max - scale_min", output is value "range_max" - "range_min". When modbus value is read, value is scaled between "range_max - range_min", output is value "scaled_max" - "scaled_min".

**Repeat** From version 0.38.1.0 it is possible to set a repeat value for a group of logging ID's. This repeat value is then used by the unit to duplicate the records the set amount of times.

Repeat. The number of times that the group of ID's will be repeated

Start/End. Indicates the start ID and the End ID

**General Set up Rules:**
Each of the above parameters can be set by selecting the variable name to be formatted and left clicking on it, a selection for each of the above items will appear and the format can be set. It is possible to select to change individual items using the Set Selection option, a block of items using the Set Block option, or all items using the Set All option. Variables, Log Data or Status Bit Data can all be mixed together in the same Modbus set up.

Status Bits should be accessed using Modbus Function codes 01 and 02. The Maximum number of register addresses is 65535. When configuring a Log Record to be read via Modbus, drag and drop the item or group of items into the Modbus table. This item or group of items will be the latest Log record. If it is required to configure earlier records to be read, then highlight a variable or group of variables and then right click on the record tab. Select either the Duplicate Records or Duplicate Selection function and then enter the number of log records that will be read. Duplicates of the items will appear in the Modbus setup under ascending Record numbers. These correspond to each record back in time , from zero which is the latest available record.

**Buttons:**

**Import from file** - This allows the user to import an existing list which has previously been created and the exported as a .mbsl file.

**Export to file** - This allows the user to save an existing list in either .mbsl or .xml formats. The .mbsl format is usable within the windows 3000 configuration software only. A modbus slave can be configured for both serial and ethernet communication and so both have slightly different settings and require slightly different xml formats, both of which are shown in the below.

**Clear** - This allows the user to clear ALL of the current list data

**Serial .xml format:**

```
<Setup_name>
        <portSettings>
                <protocol></protocol>
                <baud></baud>
                <parity></parity>
                <stopbits></stopbits>
                <mode></mode>
                <wordsize></wordsize
                >
        </portSettings>
        <list>
                <entry>
                        <address></address>
                        <idName></idName>
                        <variable></variable>
                        <member></member>
                        <type></type>
                        <bytes></bytes>
                        <order></order>
                        <latch></latch>
                        <latchAddress></latchAddress>
                        <flags></flags>
                        <mask></mask>
                        <logRef></logRef>
                        <logRecord></logRecord>
                        <index></index>
                        <registers></registers>
                        <rangeMin></rangeMin>
                        <rangeMax></rangeMax>
                        <scaleMin></scaleMin>
                        <scaleMax></scaleMax>
                </entry>
        </list>
</Setup_name>
```

**Ethernet .xml format:**

```
<Setup_name>
        <portSettings>
                <IP></IP>
                <port></port
                >
                <ID></ID>
        </portSettings>
        <list>
                <entry>
                        <address></address>
                        <idName></idName>
                        <variable></variable>
                        <member></member>
                        <type></type>
                        <bytes></bytes>
                        <order></order>
                        <latch></latch>
                        <latchAddress></latchAddress>
                        <flags></flags>
                        <mask></mask>
                        <logRef></logRef>
                        <logRecord></logRecord>
                        <index></index>
                        <registers></registers>
                        <rangeMin></rangeMin>
                        <rangeMax></rangeMax>
                        <scaleMin></scaleMin>
                        <scaleMax></scaleMax>
                </entry>
        </list>
</Setup_name>
```

# NUMBER FORMATS

## UNSIGNED CHAR 8 bit

Data items are sent as 8 bit Unsigned Char or Boolean format Range 0 to 255

## UNSIGNED SHORT INTEGER FORMAT 16 bit

Data items are sent as 16 bit Short Integer format Range 0 to 65535

## UNSIGNED LONG INTEGER FORMAT 32 bit

Data items are sent as 32 bit Long Integer format Range 0 to 4294967295

## CHAR FORMAT 8 bit

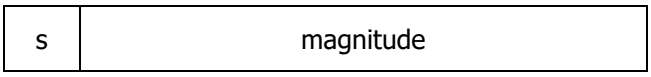
8 bit Character Range -128 to 127

## SHORT INTEGER FORMAT 16 bit

Data items are sent as 16 bit Long Integer format Range –32768 to 32767

**←increasing significance**

**Int**




15 0 Number of bits

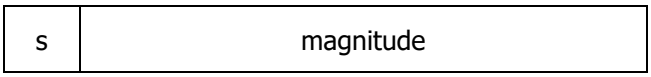
s = Sign bit ( 0 = positive , 1 = negative )

## LONG INTEGER FORMAT 32 bit

Data items are sent as 32 bit Long Integer format Range –2147483648 to 2147483647

**←increasing significance**

**long int**




31 0 Number of bits

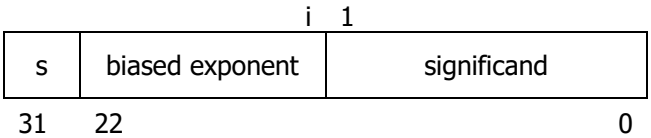
s = Sign bit ( 0 = positive , 1 = negative )

## FLOAT FORMAT 32 bit

Data items are sent as 32 bit IEEE Float format Range $\mathbf{3.4\times10^{-38}\ to 3.4\times10^{38}}$

**←increasing significance**

**float**



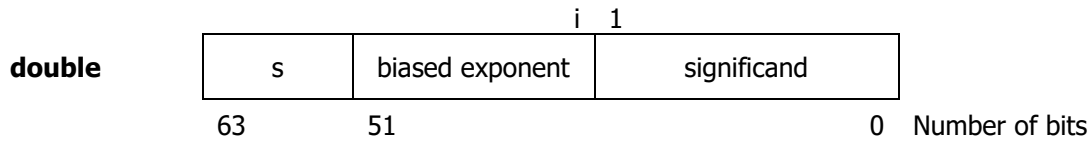

31 22 0 Number of bits

s = Sign bit ( 0 = positive , 1 = negative )
i = Position of implicit binary point
1 = Integer bit of significand
Exponent bias (normalised value) 127 (7FH)

## DOUBLE FORMAT 64 bit

Data items are sent as 64 bit IEEE Float format Range $1.7\times10^{-308}$ to $1.7\times10^{308}$

**←increasing significance**




s = Sign bit ( 0 = positive , 1 = negative )
i = Position of implicit binary point
1 = Integer bit of significand
Exponent bias (normalised value) 1023 (3FFH)

## TIME FORMAT 64 bit

All Times and Dates available to be read or written via MODBUS are in the Modbus TIME format which is a 64 bit number with the following attributes:-

***SSMMHHWDDDmmYYmS***

Where

**SS** Seconds valid numbers in the range 0 to 59
**MM** Minutes valid numbers in the range 0 to 59
**HH** Hours valid numbers in the range 0 to 23 (0=midnight)
**WD** Week Day Number valid numbers in the range 1 to 7 (1=Sunday)
**DD** Day valid numbers in the range 1 to 31
**mm** Month valid numbers in the range 1 to 12
**YY** Years valid numbers in the range 0 to 99 (assumed to be 20xx)
**mS** Mille Second
When writing Time and Date mS should be set to 00
When reading Time and Date mS will return:-

| | |
|---|---|
| 00 | zero |
| 25 | 250 mS |
| 50 | 500 mS |
| 75 | 750 mS |
| 255 | Invalid Clock (RTC device error) |

# MODBUS ASCII COMMUNICATIONS PACKET DEFINITIONS

**Data Read**

Read requests

**:KKFCssssnnnnLL<CRLF>**

Responses to a Valid Read Requests:

**:KKFCbb<DATA>LL<CRLF**

Responses to an Invalid Read Requests

**:KK8FCccLL<CRLF>**

Nothing

No reply will be received if either the request contains less than 17 characters, or a request packet that does not contain valid hex characters is received or the checksum is invalid.

**Where:**

**a)** **:** (colon) is an ASCII colon character, all characters before this are ignored except <CRLF>

**b)** **KK** is the Modbus identification number this must be set to the Modbus identification number of the unit

**c)** **FC** is the Read Function Code the following codes are supported:-

**01**hex is the Modbus code "Read Coil Status"

**02**hex is the Modbus code "Read Input Status"

**03**hex is the Modbus code "Read Holding registers"

**04**hex is the Modbus code "Read Input registers"

**d)** **8FC**hex is the Modbus code Exception response for an invalid message where the MSB of the function code field is set to 1 hence function code 03 will be returned as 83.

**e)** **ssss** is the start address in the range 0000 to FFFF (0 to 63535 decimal).

**f)** **nnnn** number of registers in the range 0001 to 00FF (1 to 255 decimal).

**g)** **bb** is the number of bytes to be transferred.

**h)** **LL** is the LRC a checksum formed by adding the bytes of each pair of hex. Digits and then subtracting the result from 0, modulo 256

**i)** **<DATA>** data nnnn items

**j)** **<CRLF>** Carriage return, line feed in ASCII i.e. 0DH and 0AH

**k)** **cc** which is an error code this can be:

i) 01 Illegal Function
ii) 02 Illegal Data Address
iii) 03 Illegal Data Value

**Data Write**

Write requests Force Single Coil

**:KK05ssss<DATA>LL<CRLF>**

Write requests Preset Multiple Registers

**:KK10ssssnnnnbb<DATA>LL<CRLF>**

Write requests Preset Single Register

**:KK06ssss<DATA>LL<CRLF>**

Valid Write Requests Force Single Coil

**:KK05ssss<DATA>LL<CRLF>**

Valid Write Requests Preset Multiple Registers

**:KK10ssssnnnnLL<CRLF>**

Valid Write Requests Preset Single Register

**:KK06ssss<DATA>LL<CRLF>**

Responses to an Invalid Write Requests

**:KK8FCccLL<CRLF>**

Nothing

No reply will be received if either the request contains less than 17 characters, or a request packet that does not contain valid hex characters is received or the checksum is invalid.

**Where:**

**a)** **:** (colon) is an ASCII colon character, all characters before this are ignored except <CRLF>

**b)** **KK** is the Modbus identification number this must be set to the Modbus identification number of the unit

**c)** **FC** is the Read Function Code the following codes are supported:-

**05**hex is the Modbus code "Force Single Coil"

**06**hex is the Modbus code for "Preset single register"

**10**hex is the Modbus code "Preset Multiple registers"

**d)** **8FC**hex is the Modbus code Exception response for an invalid message where the MSB of the function code field is set to 1 hence function code 10 will be returned as 90.

**e)** **ssss** is the start address in the range 0000 to FFFF (0 to 63535 decimal).

**f)** **nnnn** number of registers in the range 0001 to 00FF (1 to 255 decimal).

**g)** **bb** is the number of bytes to be transferred.

**h)** **LL** is the LRC a checksum formed by adding the bytes of each pair of hex. Digits and then subtracting the result from 0, modulo 256

**i)** **<DATA>** data nnnn items

**j)** **<CRLF>** Carriage return, line feed in ASCII i.e. 0DH and 0AH

**k)** **cc** which is an error code this can be:

i) 01 Illegal Function
ii) 02 Illegal Data Address
iii) 03 Illegal Data Value

# MODBUS RTU COMMUNICATIONS PACKET DEFINITIONS

**Data Read**

Read requests

**[T1-T2-T3-T4]KKFCssssnnnn<CRC>[T1-T2-T3-T4]**

Responses to a Valid Read Requests:

**[T1-T2-T3-T4]KKFCbb<DATA><CRC>[T1-T2-T3-T4]**

Responses to an Invalid Read Requests

**[T1-T2-T3-T4]KK8FCcc<CRC>[T1-T2-T3-T4]**

Nothing

No reply will be received if either the request does not contain valid characters or the checksum is invalid.

**Where:**

**a)** **[T1-T2-T3-T4]** is at least 3.5 character times of silent interval

**b)** **KK** is the identification number this must be set to the identification number of the unit

**c)** **FC** is the Read Function Code the following codes are supported:-

**01**hex is the Modbus code "Read Coil Status"

**02**hex is the Modbus code "Read Input Status"

**03**hex is the Modbus code "Read Holding registers"

**04**hex is the Modbus code "Read Input registers"

**d)** **8FC**hex is the Modbus code Exception response for an invalid message where the MSB of the function code field is set to 1 hence function code 03 will be returned as 83.

**e)** **ssss** is the start address in the range 0000 to FFFF (0 to 63535 decimal).

**f)** **nnnn** number of registers in the range 0001 to 00FF (1 to 255 decimal).

**g)** **bb** is the number of bytes to be transferred.

**h)** **<CRC>** Checksum calculated as a 16 bit CRC as follows

1. Load a 16 bit register with 0000H (all zeros), call this the CRC register.
2. EX-OR the first 8 bit byte of the message with the low -order byte of the 16-bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (towards the LSB), zero filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0 ) then Repeat Step 3 (another shift), (If LSB was 1) then EX-OR the CRC register with the Poly value of A001H
5. Repeat steps 3 and 4 until 8 shifts have been performed. When this is done a complete 8 bit byte will have been processed.
6. Repeat steps 2 to 5 for the next 8 bit byte of the message. Continue doing this until all bytes have been processed.
7. The final contents of the CRC register is the CRC value.

**i)** **<DATA>** data nnnn items

**j)** **cc** which is an error code this can be:

i) 01 Illegal Function
ii) 02 Illegal Data Address
iii) 03 Illegal Data Value

**Data Write**

Write requests Force Single Coil

**[T1-T2-T3-T4]KK05ssss<DATA><CRC>[T1-T2-T3-T4]**

Write requests Preset Multiple Registers

**[T1-T2-T3-T4]KK10ssssnnnnbb<DATA><CRC>[T1-T2-T3-T4]**

Write requests Preset Single Register

**[T1-T2-T3-T4]KK06ssss<DATA><CRC>[T1-T2-T3-T4]**

Valid Write Requests Force Single Coil

**[T1-T2-T3-T4]KK05ssss<DATA><CRC>[T1-T2-T3-T4]**

Valid Write Requests Preset Multiple Registers

**[T1-T2-T3-T4]KK10ssssnnnn<CRC>[T1-T2-T3-T4]**

Valid Write Requests Preset Single Register

**[T1-T2-T3-T4]KK06ssss<DATA><CRC>[T1-T2-T3-T4]**

Responses to an Invalid Write Requests

**[T1-T2-T3-T4]KK8FCcc<CRC>[T1-T2-T3-T4]**

**Where:**

**a)** **[T1-T2-T3-T4]** is at least 3.5 character times of silent interval

**b)** **KK** is the identification number this must be set to the identification number of the unit

**c)** **FC** is the Read Function Code the following codes are supported:-

**05**hex is the Modbus code "Force Single Coil"

**06**hex is the Modbus code for "Preset single register"

**10**hex is the Modbus code "Preset Multiple registers"

**d)** **8FC**hex is the Modbus code Exception response for an invalid message where the MSB of the function code field is set to 1 hence function code 10 will be returned as 90.

**e)** **ssss** is the start address in the range 0000 to FFFF (0 to 63535 decimal).

**f)** **nnnn** number of registers in the range 0001 to 00FF (1 to 255 decimal).

**g)** **bb** is the number of bytes to be transferred.

**h)** **<CRC>** Checksum calculated as a 16 bit CRC as follows

1. Load a 16 bit register with 0000H (all zeros), call this the CRC register.
2. EX-OR the first 8 bit byte of the message with the low -order byte of the 16-bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (towards the LSB), zero filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0 ) then Repeat Step 3 (another shift), (If LSB was 1) then EX-OR the CRC register with the Poly value of A001H
5. Repeat steps 3 and 4 until 8 shifts have been performed. When this is done a complete 8 bit byte will have been processed.
6. Repeat steps 2 to 5 for the next 8 bit byte of the message. Continue doing this until all bytes have been processed.
7. The final contents of the CRC register is the CRC value.

**i)** **<DATA>** data nnnn items

**j)** **cc** which is an error code this can be:

i) 01 Illegal Function
ii) 02 Illegal Data Address
iii) 03 Illegal Data Value

# 9. Modbus Master Details

The Modbus Master set-up page allows the operator to set-up MODBUS Master COMMUNICATION packets to the following supported devices.

The Modbus Master Page is divided into two sections:-

Settings which sets the basic Port configuration set up and is similar for all types

| | |
|---|---|
| Protocol | ASCII or RTU |
| Baud | 300 to 38400 |
| Parity | None, odd, even, space or mark |
| Stop bits | 1 or 2 stop bits |
| Mode | RS232 or RS485 |
| Word Size | 7 or 8 bits |

Master Type which selects the connected device from the List below and each device will have a unique set up page to configure the items that are specific to that device type.

Supported Gas Chromatographs:-
ABB 8000 Chromatograph
ABB 8000S Chromatograph
ABB 8200 Chromatograph
Daniels 2350 Modbus Master
Daniels 2551 Modbus Master
Daniels 2251 Modbus Master
Siemens Maxum II Chromatograph
Siemens Maxum II Biogas Chromatograph
Siemens Sitrans CV Chromatograph
Yamatake Model HGC303 Chromatograph
Encal 3000 Chromatograph

Supported Ultrasonic Meters:-
Daniels Senior Sonic Ultrasonic Meter
Instromet QSonic Ultrasonic Meter
Elster Series 6 Ultrasonic Meter
FlowSIC600 Ultrasonic Meter
Krohne Altosonic 5 Ultrasonic Meter
Krohne Altosonic V Ultrasonic Meter
Krohne UFM3030 Ultrasonic Meter
Krohne Altosonic V12 Ultrasonic Meter
Panametrics GM868 Ultrasonic Meter
Panametrics IGM878 Ultrasonic Meter
Caldon LEFM200 Ultrasonic Meter
Transus UIM Ultrasonic Meter

Supported Coriolis meters:-
Endress& Hauser Proline Promass 84 Coriolis Meter
Krohne MFC010 Coriolis Meter
Krohne MFC300 Coriolis Meter
Krohne MFC400 Coriolis Meter
Micro Motion 2000 Series Coriolis Meter

Supported Multivariable transmitters :-
Bristol 3808MVT

# ABB 8000 Chromatograph

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3034 | GC Stream Number | 1, 2 or 3 | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis<br>0=Calibration | unsigned 16 bit integer |
| 3046 | GC Status register 1<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |
| 3047 | GC status register 2<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |

Unit will continue to read the above registers until the following conditions are correct

3034 = Stream Number

3059 = 1 i.e. Analysis

3046 = 0 i.e. OK

3047 = 0 i.e. OK

When these conditions are met it will continue to read addresses 3001 to 3016 & 7001 to 7016 & appropriate registers in the range 7033 to 7089.

Example codes 3001 to 3016 can appear in any order

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3001 | Component code for C6+ | 108 | unsigned 16 bit integer |
| 3002 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3003 | Component code for Methane | 100 | unsigned 16 bit integer |
| 3004 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3005 | Component code for Ethane | 101 | unsigned 16 bit integer |
| 3006 | Component code for Propane | 102 | unsigned 16 bit integer |
| 3007 | Component code for i-Butane | 103 | unsigned 16 bit integer |
| 3008 | Component code for n-Butane | 104 | unsigned 16 bit integer |
| 3009 | Component code for neo-pentane | 107 | unsigned 16 bit integer |
| 3010 | Component code for i-pentane | 105 | unsigned 16 bit integer |
| 3011 | Component code for n-pentane | 106 | unsigned 16 bit integer |
| 3012 | Component code for H2 | 112 | unsigned 16 bit integer |
| 3013 | Component code for Helium | 113 | unsigned 16 bit integer |
| 3014 | Component code for Oxygen | 116 | unsigned 16 bit integer |
| 3015 | Component code for CO | 115 | unsigned 16 bit integer |
| 3016 | Component code for H2O | 144 | unsigned 16 bit integer |

Example codes 7001 to 7016 can appear in any order

| Address | Function | Number Format |
|---|---|---|
| 7001 | Mol % C6+ | IEEE 32 bit Float |
| 7002 | Mol % N2 | IEEE 32 bit Float |
| 7003 | Mol % Methane | IEEE 32 bit Float |
| 7004 | Mol % CO2 | IEEE 32 bit Float |
| 7005 | Mol % Ethane | IEEE 32 bit Float |
| 7006 | Mol % Propane | IEEE 32 bit Float |
| 7007 | Mol % i-Butane | IEEE 32 bit Float |
| 7008 | Mol % n-Butane | IEEE 32 bit Float |
| 7009 | Mol % neo-Pentane | IEEE 32 bit Float |
| 7010 | Mol % i-Pentane | IEEE 32 bit Float |
| 7011 | Mol % n-Pentane | IEEE 32 bit Float |
| 7012 | Mol % H2 | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7013 | Mol % Helium | IEEE 32 bit Float |
| 7014 | Mol % Oxygen | IEEE 32 bit Float |
| 7015 | Mol % CO | IEEE 32 bit Float |
| 7016 | Mol % Water Vapour | IEEE 32 bit Float |
| 7033 | Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7034 | Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7035 | Relative Density | IEEE 32 bit Float |
| 7037 | Wobbe index (Superior) | IEEE 32 bit Float |
| 7038 | Component Sum | IEEE 32 bit Float |
| 7087 | Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7088 | Wobbe index (Inferior) | IEEE 32 bit Float |
| 7089 | Wobbe index (Inferior) | IEEE 32 bit Float |

# ABB 8000S Chromatograph

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3034 | GC Stream Number | 1, 2 or 3 | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis<br>0=Calibration | unsigned 16 bit integer |
| 3046 | GC Status register 1<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |
| 3047 | GC status register 2<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |

Unit will continue to read the above registers until the following conditions are correct

3034 = Stream Number

3059 = 1 i.e. Analysis

3046 = 0 i.e. OK

3047 = 0 i.e. OK

When these conditions are met it will continue to read addresses 3001 to 3016 & 7001 to 7016 & appropriate registers in the range 7033 to 7089.

Example codes 3001 to 3016 can appear in any order

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3001 | Component code for C6+ | 108 | unsigned 16 bit integer |
| 3002 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3003 | Component code for Methane | 100 | unsigned 16 bit integer |
| 3004 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3005 | Component code for Ethane | 101 | unsigned 16 bit integer |
| 3006 | Component code for Propane | 102 | unsigned 16 bit integer |
| 3007 | Component code for i-Butane | 103 | unsigned 16 bit integer |
| 3008 | Component code for n-Butane | 104 | unsigned 16 bit integer |
| 3009 | Component code for neo-pentane | 107 | unsigned 16 bit integer |
| 3010 | Component code for i-pentane | 105 | unsigned 16 bit integer |
| 3011 | Component code for n-pentane | 106 | unsigned 16 bit integer |
| 3012 | Component code for H2 | 112 | unsigned 16 bit integer |
| 3013 | Component code for Helium | 113 | unsigned 16 bit integer |
| 3014 | Component code for Oxygen | 116 | unsigned 16 bit integer |
| 3015 | Component code for CO | 115 | unsigned 16 bit integer |
| 3016 | Component code for H2O | 144 | unsigned 16 bit integer |

Example codes 7X01 to 7X16 can appear in any order

| Address | Function | Number Format |
|---|---|---|
| 7401 | Stream 1 Mol % C6+ | IEEE 32 bit Float |
| 7402 | Stream 1 Mol % N2 | IEEE 32 bit Float |
| 7403 | Stream 1 Mol % Methane | IEEE 32 bit Float |
| 7404 | Stream 1 Mol % CO2 | IEEE 32 bit Float |
| 7405 | Stream 1 Mol % Ethane | IEEE 32 bit Float |
| 7406 | Stream 1 Mol % Propane | IEEE 32 bit Float |
| 7407 | Stream 1 Mol % i-Butane | IEEE 32 bit Float |
| 7408 | Stream 1 Mol % n-Butane | IEEE 32 bit Float |
| 7409 | Stream 1 Mol % neo-Pentane | IEEE 32 bit Float |
| 7410 | Stream 1 Mol % i-Pentane | IEEE 32 bit Float |
| 7411 | Stream 1 Mol % n-Pentane | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7412 | Stream 1 Mol % H2 | IEEE 32 bit Float |
| 7413 | Stream 1 Mol % Helium | IEEE 32 bit Float |
| 7414 | Stream 1 Mol % Oxygen | IEEE 32 bit Float |
| 7415 | Stream 1 Mol % CO | IEEE 32 bit Float |
| 7416 | Stream 1 Mol % Water Vapour | IEEE 32 bit Float |
| 7433 | Stream 1 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7434 | Stream 1 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7435 | Stream 1 Relative Density | IEEE 32 bit Float |
| 7437 | Stream 1 Wobbe index (Superior) | IEEE 32 bit Float |
| 7438 | Stream 1 Component Sum | IEEE 32 bit Float |
| 7487 | Stream 1 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7488 | Stream 1 Wobbe index (Inferior) | IEEE 32 bit Float |
| 7489 | Stream 1 Wobbe index (Inferior) | IEEE 32 bit Float |

| Address | Function | Number Format |
|---|---|---|
| 7601 | Stream 2 Mol % C6+ | IEEE 32 bit Float |
| 7602 | Stream 2 Mol % N2 | IEEE 32 bit Float |
| 7603 | Stream 2 Mol % Methane | IEEE 32 bit Float |
| 7604 | Stream 2 Mol % CO2 | IEEE 32 bit Float |
| 7605 | Stream 2 Mol % Ethane | IEEE 32 bit Float |
| 7606 | Stream 2 Mol % Propane | IEEE 32 bit Float |
| 7607 | Stream 2 Mol % i-Butane | IEEE 32 bit Float |
| 7608 | Stream 2 Mol % n-Butane | IEEE 32 bit Float |
| 7609 | Stream 2 Mol % neo-Pentane | IEEE 32 bit Float |
| 7610 | Stream 2 Mol % i-Pentane | IEEE 32 bit Float |
| 7611 | Stream 2 Mol % n-Pentane | IEEE 32 bit Float |
| 7612 | Stream 2 Mol % H2 | IEEE 32 bit Float |
| 7613 | Stream 2 Mol % Helium | IEEE 32 bit Float |
| 7614 | Stream 2 Mol % Oxygen | IEEE 32 bit Float |
| 7615 | Stream 2 Mol % CO | IEEE 32 bit Float |
| 7616 | Stream 2 Mol % Water Vapour | IEEE 32 bit Float |
| 7633 | Stream 2 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7634 | Stream 2 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7635 | Stream 2 Relative Density | IEEE 32 bit Float |
| 7637 | Stream 2 Wobbe index (Superior) | IEEE 32 bit Float |
| 7638 | Stream 2 Component Sum | IEEE 32 bit Float |
| 7687 | Stream 2 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7688 | Stream 2 Wobbe index (Inferior) | IEEE 32 bit Float |
| 7689 | Stream 2 Wobbe index (Inferior) | IEEE 32 bit Float |

| Address | Function | Number Format |
|---|---|---|
| 7801 | Stream 3 Mol % C6+ | IEEE 32 bit Float |
| 7802 | Stream 3 Mol % N2 | IEEE 32 bit Float |
| 7803 | Stream 3 Mol % Methane | IEEE 32 bit Float |
| 7804 | Stream 3 Mol % CO2 | IEEE 32 bit Float |
| 7805 | Stream 3 Mol % Ethane | IEEE 32 bit Float |
| 7806 | Stream 3 Mol % Propane | IEEE 32 bit Float |
| 7807 | Stream 3 Mol % i-Butane | IEEE 32 bit Float |
| 7808 | Stream 3 Mol % n-Butane | IEEE 32 bit Float |
| 7809 | Stream 3 Mol % neo-Pentane | IEEE 32 bit Float |
| 7810 | Stream 3 Mol % i-Pentane | IEEE 32 bit Float |
| 7811 | Stream 3 Mol % n-Pentane | IEEE 32 bit Float |
| 7812 | Stream 3 Mol % H2 | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7813 | Stream 3 Mol % Helium | IEEE 32 bit Float |
| 7814 | Stream 3 Mol % Oxygen | IEEE 32 bit Float |
| 7815 | Stream 3 Mol % CO | IEEE 32 bit Float |
| 7816 | Stream 3 Mol % Water Vapour | IEEE 32 bit Float |
| 7833 | Stream 3 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7834 | Stream 3 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7835 | Stream 3 Relative Density | IEEE 32 bit Float |
| 7837 | Stream 3 Wobbe index (Superior) | IEEE 32 bit Float |
| 7838 | Stream 3 Component Sum | IEEE 32 bit Float |
| 7887 | Stream 3 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7888 | Stream 3 Wobbe index (Inferior) | IEEE 32 bit Float |
| 7889 | Stream 3 Wobbe index (Inferior) | IEEE 32 bit Float |

| Address | Function | Number Format |
|---|---|---|
| 8001 | Stream 4 Mol % C6+ | IEEE 32 bit Float |
| 8002 | Stream 4 Mol % N2 | IEEE 32 bit Float |
| 8003 | Stream 4 Mol % Methane | IEEE 32 bit Float |
| 8004 | Stream 4 Mol % CO2 | IEEE 32 bit Float |
| 8005 | Stream 4 Mol % Ethane | IEEE 32 bit Float |
| 8006 | Stream 4 Mol % Propane | IEEE 32 bit Float |
| 8007 | Stream 4 Mol % i-Butane | IEEE 32 bit Float |
| 8008 | Stream 4 Mol % n-Butane | IEEE 32 bit Float |
| 8009 | Stream 4 Mol % neo-Pentane | IEEE 32 bit Float |
| 8010 | Stream 4 Mol % i-Pentane | IEEE 32 bit Float |
| 8011 | Stream 4 Mol % n-Pentane | IEEE 32 bit Float |
| 8012 | Stream 4 Mol % H2 | IEEE 32 bit Float |
| 8013 | Stream 4 Mol % Helium | IEEE 32 bit Float |
| 8014 | Stream 4 Mol % Oxygen | IEEE 32 bit Float |
| 8015 | Stream 4 Mol % CO | IEEE 32 bit Float |
| 8016 | Stream 4 Mol % Water Vapour | IEEE 32 bit Float |
| 8033 | Stream 4 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 8034 | Stream 4 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 8035 | Stream 4 Relative Density | IEEE 32 bit Float |
| 8037 | Stream 4 Wobbe index (Superior) | IEEE 32 bit Float |
| 8038 | Stream 4 Component Sum | IEEE 32 bit Float |
| 8087 | Stream 4 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 8088 | Stream 4 Wobbe index (Inferior) | IEEE 32 bit Float |
| 8089 | Stream 4 Wobbe index (Inferior) | IEEE 32 bit Float |

# ABB 8200 Chromatograph

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3034 | GC Stream Number | 1, 2 or 3 | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis<br>0=Calibration | unsigned 16 bit integer |
| 3046 | GC Status register 1<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |
| 3047 | GC status register 2<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |

Unit will continue to read the above registers until the following conditions are correct:

3034 = Stream Number
3059 = 1 i.e. Analysis
3046 = 0 i.e. OK
3047 = 0 i.e. OK

When these conditions are met addresses 3001 to 3016 will be read.
Example codes 3001 to 3016 can appear in any order.

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3001 | Component code for C3 | 102 | unsigned 16 bit integer |
| 3002 | Component code for iC4 | 103 | unsigned 16 bit integer |
| 3003 | Component code for nC4 | 104 | unsigned 16 bit integer |
| 3004 | Component code for neo C5 | 107 | unsigned 16 bit integer |
| 3005 | Component code for iC5 | 105 | unsigned 16 bit integer |
| 3006 | Component code for nC5 | 106 | unsigned 16 bit integer |
| 3007 | Component code for C6+ | 108 111 | unsigned 16 bit integer |
| 3008 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3009 | Component code for C1 | 100 | unsigned 16 bit integer |
| 3010 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3011 | Component code for C2 | 101 | unsigned 16 bit integer |
| 3012 | Component code for C6s | - | unsigned 16 bit integer |
| 3013 | Component code for C7s | - | unsigned 16 bit integer |
| 3014 | Component code for C8s | - | unsigned 16 bit integer |
| 3015 | Component code for C9s | - | unsigned 16 bit integer |
| 3016 | Spare | - | unsigned 16 bit integer |

| Address | Function | Number Format |
|---|---|---|
| 7401 | Stream 1 Mol % C3 | IEEE 32 bit Float |
| 7402 | Stream 1 Mol % iC4 | IEEE 32 bit Float |
| 7403 | Stream 1 Mol % nC4 | IEEE 32 bit Float |
| 7404 | Stream 1 Mol % neoC5 | IEEE 32 bit Float |
| 7405 | Stream 1 Mol % iC5 | IEEE 32 bit Float |
| 7406 | Stream 1 Mol % nC5 | IEEE 32 bit Float |
| 7407 | Stream 1 Mol % C6+ | IEEE 32 bit Float |
| 7408 | Stream 1 Mol % N2 | IEEE 32 bit Float |
| 7409 | Stream 1 Mol % C1 | IEEE 32 bit Float |
| 7410 | Stream 1 Mol % CO2 | IEEE 32 bit Float |
| 7411 | Stream 1 Mol % C2 | IEEE 32 bit Float |
| 7412 | Stream 1 Mol % C6s | IEEE 32 bit Float |
| 7413 | Stream 1 Mol % C7s | IEEE 32 bit Float |
| 7414 | Stream 1 Mol % C8s | IEEE 32 bit Float |
| 7415 | Stream 1 Mol % C9s | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7416 | Stream 1 Spare | IEEE 32 bit Float |
| 7433 | Stream 1 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7434 | Stream 1 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7435 | Stream 1 Relative Density | IEEE 32 bit Float |
| 7436 | Stream 1 Compressibility | IEEE 32 bit Float |
| 7437 | Stream 1 Wobbe index (Superior) | IEEE 32 bit Float |
| 7438 | Stream 1 Component Sum | IEEE 32 bit Float |
| 7439 | Stream 1 Total GPM | IEEE 32 bit Float |
| 7440 | Stream 1 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7441 | Stream 1 Normal Density | IEEE 32 bit Float |
| 7442 | Stream 1 Wobbe index (Inferior) | IEEE 32 bit Float |
| 7443 | Stream 1 Methane Number | IEEE 32 bit Float |
| 7444 | Stream 1 Speed of Sound | IEEE 32 bit Float |

Followed by the composition information from the relevant stream.
Example codes 7X01 to 7X16 can appear in any order.

| Address | Function | Number Format |
|---|---|---|
| 7601 | Stream 2 Mol % C3 | IEEE 32 bit Float |
| 7602 | Stream 2 Mol % iC4 | IEEE 32 bit Float |
| 7603 | Stream 2 Mol % nC4 | IEEE 32 bit Float |
| 7604 | Stream 2 Mol % neoC5 | IEEE 32 bit Float |
| 7605 | Stream 2 Mol % iC5 | IEEE 32 bit Float |
| 7606 | Stream 2 Mol % nC5 | IEEE 32 bit Float |
| 7607 | Stream 2 Mol % C6+ | IEEE 32 bit Float |
| 7608 | Stream 2 Mol % N2 | IEEE 32 bit Float |
| 7609 | Stream 2 Mol % C1 | IEEE 32 bit Float |
| 7610 | Stream 2 Mol % CO2 | IEEE 32 bit Float |
| 7611 | Stream 2 Mol % C2 | IEEE 32 bit Float |
| 7612 | Stream 2 Mol % C6s | IEEE 32 bit Float |
| 7613 | Stream 2 Mol % C7s | IEEE 32 bit Float |
| 7614 | Stream 2 Mol % C8s | IEEE 32 bit Float |
| 7615 | Stream 2 Mol % C9s | IEEE 32 bit Float |
| 7616 | Stream 2 Spare | IEEE 32 bit Float |
| 7633 | Stream 2 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7634 | Stream 2 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7635 | Stream 2 Relative Density | IEEE 32 bit Float |
| 7636 | Stream 2 Compressibility | IEEE 32 bit Float |
| 7637 | Stream 2 Wobbe index (Superior) | IEEE 32 bit Float |
| 7638 | Stream 2 Component Sum | IEEE 32 bit Float |
| 7639 | Stream 2 Total GPM | IEEE 32 bit Float |
| 7640 | Stream 2 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7641 | Stream 2 Normal Density | IEEE 32 bit Float |
| 7642 | Stream 2 Wobbe index (Inferior) | IEEE 32 bit Float |
| 7643 | Stream 2 Methane Number | IEEE 32 bit Float |
| 7644 | Stream 2 Speed of Sound | IEEE 32 bit Float |

| Address | Function | Number Format |
|---|---|---|
| 7801 | Stream 3 Mol % C3 | IEEE 32 bit Float |
| 7802 | Stream 3 Mol % iC4 | IEEE 32 bit Float |
| 7803 | Stream 3 Mol % nC4 | IEEE 32 bit Float |
| 7804 | Stream 3 Mol % neoC5 | IEEE 32 bit Float |
| 7805 | Stream 3 Mol % iC5 | IEEE 32 bit Float |
| 7806 | Stream 3 Mol % nC5 | IEEE 32 bit Float |
| 7807 | Stream 3 Mol % C6+ | IEEE 32 bit Float |
| 7808 | Stream 3 Mol % N2 | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7809 | Stream 3 Mol % C1 | IEEE 32 bit Float |
| 7810 | Stream 3 Mol % CO2 | IEEE 32 bit Float |
| 7811 | Stream 3 Mol % C2 | IEEE 32 bit Float |
| 7812 | Stream 3 Mol % C6s | IEEE 32 bit Float |
| 7813 | Stream 3 Mol % C7s | IEEE 32 bit Float |
| 7814 | Stream 3 Mol % C8s | IEEE 32 bit Float |
| 7815 | Stream 3 Mol % C9s | IEEE 32 bit Float |
| 7816 | Stream 3 Spare | IEEE 32 bit Float |
| 7833 | Stream 3 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7834 | Stream 3 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7835 | Stream 3 Relative Density | IEEE 32 bit Float |
| 7836 | Stream 3 Compressibility | IEEE 32 bit Float |
| 7837 | Stream 3 Wobbe index (Superior) | IEEE 32 bit Float |
| 7838 | Stream 3 Component Sum | IEEE 32 bit Float |
| 7839 | Stream 3 Total GPM | IEEE 32 bit Float |
| 7840 | Stream 3 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7841 | Stream 3 Normal Density | IEEE 32 bit Float |
| 7842 | Stream 3 Wobbe index (Inferior) | IEEE 32 bit Float |
| 7843 | Stream 3 Methane Number | IEEE 32 bit Float |
| 7844 | Stream 3 Speed of Sound | IEEE 32 bit Float |

| Address | Function | Number Format |
|---|---|---|
| 8001 | Stream 4 Mol % C3 | IEEE 32 bit Float |
| 8002 | Stream 4 Mol % iC4 | IEEE 32 bit Float |
| 8003 | Stream 4 Mol % nC4 | IEEE 32 bit Float |
| 8004 | Stream 4 Mol % neoC5 | IEEE 32 bit Float |
| 8005 | Stream 4 Mol % iC5 | IEEE 32 bit Float |
| 8006 | Stream 4 Mol % nC5 | IEEE 32 bit Float |
| 8007 | Stream 4 Mol % C6+ | IEEE 32 bit Float |
| 8008 | Stream 4 Mol % N2 | IEEE 32 bit Float |
| 8009 | Stream 4 Mol % C1 | IEEE 32 bit Float |
| 8010 | Stream 4 Mol % CO2 | IEEE 32 bit Float |
| 8011 | Stream 4 Mol % C2 | IEEE 32 bit Float |
| 8012 | Stream 4 Mol % C6s | IEEE 32 bit Float |
| 8013 | Stream 4 Mol % C7s | IEEE 32 bit Float |
| 8014 | Stream 4 Mol % C8s | IEEE 32 bit Float |
| 8015 | Stream 4 Mol % C9s | IEEE 32 bit Float |
| 8016 | Stream 4 Spare | IEEE 32 bit Float |
| 8033 | Stream 4 Superior Heating Value (Dry) | IEEE 32 bit Float |
| 8034 | Stream 4 Superior Heating Value (Sat) | IEEE 32 bit Float |
| 8035 | Stream 4 Relative Density | IEEE 32 bit Float |
| 8036 | Stream 4 Compressibility | IEEE 32 bit Float |
| 8037 | Stream 4 Wobbe index (Superior) | IEEE 32 bit Float |
| 8038 | Stream 4 Component Sum | IEEE 32 bit Float |
| 8039 | Stream 4 Total GPM | IEEE 32 bit Float |
| 8040 | Stream 4 Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 8041 | Stream 4 Normal Density | IEEE 32 bit Float |
| 8042 | Stream 4 Wobbe index (Inferior) | IEEE 32 bit Float |
| 8043 | Stream 4 Methane Number | IEEE 32 bit Float |
| 8044 | Stream 4 Speed of Sound | IEEE 32 bit Float |

# Daniels 2350 Modbus Master

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3034 | GC Stream Number | 1, 2 .. X | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis<br>0=Calibration | unsigned 16 bit integer |
| 3062 | Process Gas Chromatograph State | 0=Idle<br>1=Analysing<br>2=Calibrating | unsigned 16 bit integer |
| 3046 | GC Hardware Status register 1 | 0 = OK | unsigned 16 bit integer |
| 3047 | GC Hardware Status register 2 | 0 = OK | unsigned 16 bit integer |
| 3048 | GC Software Status register 1 | 0 = OK | unsigned 16 bit integer |
| 3049 | GC Software Status register 2 | 0 = OK | unsigned 16 bit integer |
| 3050 | GC Software Status register 3 | 0 = OK | unsigned 16 bit integer |
| 3051 | GC Software Status register 4 | 0 = OK | unsigned 16 bit integer |
| 3052 | GC Software Status register 5 | 0 = OK | unsigned 16 bit integer |
| 3053 | GC Software Status register 6 | 0 = OK | unsigned 16 bit integer |
| 3054 | GC Software Status register 7 | 0 = OK | unsigned 16 bit integer |
| 3055 | GC Software Status register 8 | 0 = OK | unsigned 16 bit integer |
| 3056 | GC Software Status register 9 | 0 = OK | unsigned 16 bit integer |
| 3057 | GC Software Status register 10 | 0 = OK | unsigned 16 bit integer |
| 3058 | New Data | 0 = No New Data | unsigned 16 bit integer |

Unit will continue to read the above registers until the following conditions are correct
3034 = Stream Number
3059 = 1 i.e. Analysis
3062 = 1 i.e. Analysing
3046 = 0 i.e. OK
3047 = 0 i.e. OK

When these conditions are met it will continue to read addresses 3001 to 3016 &

7001 to 7016 & appropriate registers in the range 7033 to 7089.

Example codes 3001 to 3016 can appear in any order.

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3001 | Component code for C6+ | 108 | unsigned 16 bit integer |
| 3002 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3003 | Component code for Methane | 100 | unsigned 16 bit integer |
| 3004 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3005 | Component code for Ethane | 101 | unsigned 16 bit integer |
| 3006 | Component code for Propane | 102 | unsigned 16 bit integer |
| 3007 | Component code for i-Butane | 103 | unsigned 16 bit integer |
| 3008 | Component code for n-Butane | 104 | unsigned 16 bit integer |
| 3009 | Component code for neo-pentane | 107 | unsigned 16 bit integer |
| 3010 | Component code for i-pentane | 105 | unsigned 16 bit integer |
| 3011 | Component code for n-pentane | 106 | unsigned 16 bit integer |
| 3012 | Component code for H2 | 112 | unsigned 16 bit integer |
| 3013 | Component code for Helium | 113 | unsigned 16 bit integer |
| 3014 | Component code for Oxygen | 116 | unsigned 16 bit integer |
| 3015 | Component code for CO | 115 | unsigned 16 bit integer |
| 3016 | Component code for H2O | 144 | unsigned 16 bit integer |

## Gas Analysis results.

Example codes 7001 to 7016 can appear in any order.

| Address | Function | Number Format |
|---|---|---|
| 7001 | Mol % C6+ | IEEE 32 bit Float |
| 7002 | Mol % N2 | IEEE 32 bit Float |
| 7003 | Mol % Methane | IEEE 32 bit Float |
| 7004 | Mol % CO2 | IEEE 32 bit Float |
| 7005 | Mol % Ethane | IEEE 32 bit Float |
| 7006 | Mol % Propane | IEEE 32 bit Float |
| 7007 | Mol % i-Butane | IEEE 32 bit Float |
| 7008 | Mol % n-Butane | IEEE 32 bit Float |
| 7009 | Mol % neo-Pentane | IEEE 32 bit Float |
| 7010 | Mol % i-Pentane | IEEE 32 bit Float |
| 7011 | Mol % n-Pentane | IEEE 32 bit Float |
| 7012 | Mol % H2 | IEEE 32 bit Float |
| 7013 | Mol % Helium | IEEE 32 bit Float |
| 7014 | Mol % Oxygen | IEEE 32 bit Float |
| 7015 | Mol % CO | IEEE 32 bit Float |
| 7016 | Mol % Water Vapour | IEEE 32 bit Float |
| 7033 | Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7034 | Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7035 | Relative Density | IEEE 32 bit Float |
| 7037 | Wobbe index (Superior) | IEEE 32 bit Float |
| 7038 | Composition Sum | IEEE 32 bit Float |
| 7087 | Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7089 | Wobbe index (Inferior) | IEEE 32 bit Float |

# Daniels 2551 Modbus Master

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3034 | GC Stream Number | 1, 2 .. X | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis<br>0=Calibration | unsigned 16 bit integer |
| 3062 | Process Gas Chromatograph State | 0=Idle<br>1=Analysing<br>2=Calibrating | unsigned 16 bit integer |
| 3046 | GC Hardware Status register 1 | 0 = OK | unsigned 16 bit integer |
| 3047 | GC Hardware Status register 2 | 0 = OK | unsigned 16 bit integer |
| 3048 | GC Software Status register 1 | 0 = OK | unsigned 16 bit integer |
| 3049 | GC Software Status register 2 | 0 = OK | unsigned 16 bit integer |
| 3050 | GC Software Status register 3 | 0 = OK | unsigned 16 bit integer |
| 3051 | GC Software Status register 4 | 0 = OK | unsigned 16 bit integer |
| 3052 | GC Software Status register 5 | 0 = OK | unsigned 16 bit integer |
| 3053 | GC Software Status register 6 | 0 = OK | unsigned 16 bit integer |
| 3054 | GC Software Status register 7 | 0 = OK | unsigned 16 bit integer |
| 3055 | GC Software Status register 8 | 0 = OK | unsigned 16 bit integer |
| 3056 | GC Software Status register 9 | 0 = OK | unsigned 16 bit integer |
| 3057 | GC Software Status register 10 | 0 = OK | unsigned 16 bit integer |
| 3058 | New Data | 0 = No New Data | unsigned 16 bit integer |

Unit will continue to read the above registers until the following conditions are correct
3034 = Stream Number
3059 = 1 i.e. Analysis
3062 = 1 i.e. Analysing
3046 = 0 i.e. OK
3047 = 0 i.e. OK

When these conditions are met it will continue to read addresses 3001 to 3016 &

7001 to 7016 & appropriate registers in the range 7033 to 7089.

Example codes 3001 to 3016 can appear in any order.

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3001 | Component code for C6+ | 108 | unsigned 16 bit integer |
| 3002 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3003 | Component code for Methane | 100 | unsigned 16 bit integer |
| 3004 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3005 | Component code for Ethane | 101 | unsigned 16 bit integer |
| 3006 | Component code for Propane | 102 | unsigned 16 bit integer |
| 3007 | Component code for i-Butane | 103 | unsigned 16 bit integer |
| 3008 | Component code for n-Butane | 104 | unsigned 16 bit integer |
| 3009 | Component code for neo-pentane | 107 | unsigned 16 bit integer |
| 3010 | Component code for i-pentane | 105 | unsigned 16 bit integer |
| 3011 | Component code for n-pentane | 106 | unsigned 16 bit integer |
| 3012 | Component code for H2 | 112 | unsigned 16 bit integer |
| 3013 | Component code for Helium | 113 | unsigned 16 bit integer |
| 3014 | Component code for Oxygen | 116 | unsigned 16 bit integer |
| 3015 | Component code for CO | 115 | unsigned 16 bit integer |
| 3016 | Component code for H2O | 144 | unsigned 16 bit integer |

## Gas Analysis results.

Example codes 7001 to 7016 can appear in any order.

| Address | Function | Number Format |
|---|---|---|
| 7001 | Mol % C6+ | IEEE 32 bit Float |
| 7002 | Mol % N2 | IEEE 32 bit Float |
| 7003 | Mol % Methane | IEEE 32 bit Float |
| 7004 | Mol % CO2 | IEEE 32 bit Float |
| 7005 | Mol % Ethane | IEEE 32 bit Float |
| 7006 | Mol % Propane | IEEE 32 bit Float |
| 7007 | Mol % i-Butane | IEEE 32 bit Float |
| 7008 | Mol % n-Butane | IEEE 32 bit Float |
| 7009 | Mol % neo-Pentane | IEEE 32 bit Float |
| 7010 | Mol % i-Pentane | IEEE 32 bit Float |
| 7011 | Mol % n-Pentane | IEEE 32 bit Float |
| 7012 | Mol % H2 | IEEE 32 bit Float |
| 7013 | Mol % Helium | IEEE 32 bit Float |
| 7014 | Mol % Oxygen | IEEE 32 bit Float |
| 7015 | Mol % CO | IEEE 32 bit Float |
| 7016 | Mol % Water Vapour | IEEE 32 bit Float |
| 7033 | Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7034 | Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7035 | Relative Density | IEEE 32 bit Float |
| 7037 | Wobbe index (Superior) | IEEE 32 bit Float |
| 7038 | Composition Sum | IEEE 32 bit Float |
| 7087 | Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7089 | Wobbe index (Inferior) | IEEE 32 bit Float |

# Daniels 2251 Modbus Master

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3034 | GC Stream Number | 1, 2 .. X | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis<br>0=Calibration | unsigned 16 bit integer |
| 3046 | GC Status register 1<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |
| 3047 | GC status register 2<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |

Unit will continue to read the above registers until the following conditions are correct
3034 = Stream Number
3059 = 1 i.e. Analysis
3062 = 1 i.e. Analysing
3046 = 0 i.e. OK
3047 = 0 i.e. OK

When these conditions are met it will continue to read addresses 3001 to 3016 & 7001 to 7016 & appropriate registers in the range 7033 to 7089.

Example codes 3001 to 3016 can appear in any order

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3001 | Component code for C6+ | 108 | unsigned 16 bit integer |
| 3002 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3003 | Component code for Methane | 100 | unsigned 16 bit integer |
| 3004 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3005 | Component code for Ethane | 101 | unsigned 16 bit integer |
| 3006 | Component code for Propane | 102 | unsigned 16 bit integer |
| 3007 | Component code for i-Butane | 103 | unsigned 16 bit integer |
| 3008 | Component code for n-Butane | 104 | unsigned 16 bit integer |
| 3009 | Component code for neo-pentane | 107 | unsigned 16 bit integer |
| 3010 | Component code for i-pentane | 105 | unsigned 16 bit integer |
| 3011 | Component code for n-pentane | 106 | unsigned 16 bit integer |
| 3012 | Component code for H2 | 112 | unsigned 16 bit integer |
| 3013 | Component code for Helium | 113 | unsigned 16 bit integer |
| 3014 | Component code for Oxygen | 116 | unsigned 16 bit integer |
| 3015 | Component code for CO | 115 | unsigned 16 bit integer |
| 3016 | Component code for H2O | 144 | unsigned 16 bit integer |

## Gas Analysis results.

Example codes 7001 to 7016 can appear in any order.

| Address | Function | Number Format |
|---|---|---|
| 7001 | Mol % C6+ | IEEE 32 bit Float |
| 7002 | Mol % N2 | IEEE 32 bit Float |
| 7003 | Mol % Methane | IEEE 32 bit Float |
| 7004 | Mol % CO2 | IEEE 32 bit Float |
| 7005 | Mol % Ethane | IEEE 32 bit Float |
| 7006 | Mol % Propane | IEEE 32 bit Float |
| 7007 | Mol % i-Butane | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7008 | Mol % n-Butane | IEEE 32 bit Float |
| 7009 | Mol % neo-Pentane | IEEE 32 bit Float |
| 7010 | Mol % i-Pentane | IEEE 32 bit Float |
| 7011 | Mol % n-Pentane | IEEE 32 bit Float |
| 7012 | Mol % H2 | IEEE 32 bit Float |
| 7013 | Mol % Helium | IEEE 32 bit Float |
| 7014 | Mol % Oxygen | IEEE 32 bit Float |
| 7015 | Mol % CO | IEEE 32 bit Float |
| 7016 | Mol % Water Vapour | IEEE 32 bit Float |
| 7033 | Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7034 | Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7035 | Relative Density | IEEE 32 bit Float |
| 7037 | Wobbe index (Superior) | IEEE 32 bit Float |
| 7038 | Composition Sum | IEEE 32 bit Float |
| 7087 | Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7089 | Wobbe index (Inferior) | IEEE 32 bit Float |

# Siemens Maxum II Chromatograph

| Address | Modbus Function | Function | Values | Alarms |
|---|---|---|---|---|
| 1100 | Read Coil Status | Analyser Online | 0 = Running<br>1 = Stopped | No alarm<br>Acc Offline alarm |
| 1101 | Read Coil Status | Stream 1 Active | 0 = Not Active<br>1 = Active | Nacc Stream alarm<br>No alarm |
| 1105 | Read Coil Status | Stream 20 Validation | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 1107 | Read Coil Status | Stream 30 Active | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 1109 | Read Coil Status | Calibration Status | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 1111 | Read Coil Status | New Data Ready | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 30001 | Read Input Registers | Chromatograph Status | 1000 = No Errors<br>Anything else | No alarm<br>Acc Status Alarm |

| Address | Modbus Function | Function |
|---|---|---|
| 40102 | Read Holding Registers | Methane Molar % |
| 40104 | Read Holding Registers | Ethane Molar % |
| 40106 | Read Holding Registers | Propane Molar % |
| 40108 | Read Holding Registers | i-Butane Molar % |
| 40110 | Read Holding Registers | n-Butane Molar % |
| 40112 | Read Holding Registers | i-Pentane Molar % |
| 40114 | Read Holding Registers | n-Pentane Molar % |
| 40116 | Read Holding Registers | neo-Pentane Molar % |
| 40118 | Read Holding Registers | n-Hexane+ Molar % |
| 40120 | Read Holding Registers | Carbon Dioxide Molar % |
| 40122 | Read Holding Registers | Nitrogen Molar % |
| 40124 | Read Holding Registers | Un-Normalised Total |
| 40126 | Read Holding Registers | GCV (MJ/kg) |
| 40128 | Read Holding Registers | GCV (MJ/m3) |
| 40130 | Read Holding Registers | NCV (MJ/kg) |
| 40132 | Read Holding Registers | NCV (MJ/m3) |
| 40134 | Read Holding Registers | Relative density |
| 40136 | Read Holding Registers | Wobbe (MJ/kg) |
| 40138 | Read Holding Registers | Wobbe (MJ/m3) |
| 40140 | Read Holding Registers | Standard density |

# Siemens Maxum II Biogas Chromatograph

| Address | Modbus Function | Function | Values | Alarms |
|---|---|---|---|---|
| 1099 | Read Coil Status | Analyser Online | 0 = Running<br>1 = Stopped | No alarm<br>Acc Offline alarm |
| 1100 | Read Coil Status | Stream 1 Active | 0 = Not Active<br>1 = Active | Nacc Stream alarm<br>No alarm |
| 1104 | Read Coil Status | Stream 20 Validation | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 1106 | Read Coil Status | Stream 30 Active | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 1108 | Read Coil Status | Calibration Status | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 1110 | Read Coil Status | New Data Ready | 0 = Not Active<br>1= Active | No alarm<br>No alarm |
| 30001 | Read Input Registers | Chromatograph Status | 1000 = No Errors<br>Anything else | No alarm<br>Acc Status Alarm |
| 30002 | Read Input Registers | Alarm Code | | |

| Address | Modbus Function | Function |
|---|---|---|
| 40101 | Read Holding Registers | Methane Molar % |
| 40103 | Read Holding Registers | Ethane Molar % |
| 40105 | Read Holding Registers | Propane Molar % |
| 40107 | Read Holding Registers | i-Butane Molar % |
| 40109 | Read Holding Registers | n-Butane Molar % |
| 40111 | Read Holding Registers | i-Pentane Molar % |
| 40113 | Read Holding Registers | n-Pentane Molar % |
| 40115 | Read Holding Registers | neo-Pentane Molar % |
| 40117 | Read Holding Registers | n-Hexane+ Molar % |
| 40119 | Read Holding Registers | Carbon Dioxide Molar % |
| 40121 | Read Holding Registers | Nitrogen Molar % |
| 40123 | Read Holding Registers | Oxygen Molar % |
| 40125 | Read Holding Registers | Hydrogen Sulphide ppm |
| 40151 | Read Holding Registers | Un-Normalised Total |
| 40153 | Read Holding Registers | GCV (MJ/kg) |
| 40155 | Read Holding Registers | GCV (MJ/m3) |
| 40157 | Read Holding Registers | NCV (MJ/kg) |
| 40159 | Read Holding Registers | NCV (MJ/m3) |
| 40161 | Read Holding Registers | Relative density |
| 40163 | Read Holding Registers | Wobbe (MJ/kg) |
| 40165 | Read Holding Registers | Wobbe (MJ/m3) |
| 40167 | Read Holding Registers | Standard density |

# Siemens Sitrans CV Chromatograph

| Address | Modbus Function | Function | Values | Alarms |
|---|---|---|---|---|
| 1 | Read Holding Registers | Health State | 0 = Unknown | No alarm |
| | | | 1 = Ready | No alarm |
| | | | 2 = Warning | No alarm |
| | | | 3 = Alarm | No alarm |
| 2 | Read Holding Registers | Alarm | 0 = Healthy | No alarm |
| | | | In Alarm | Acc Composition Alarm |
| 3 | Read Holding Registers | Warning | No Action | |
| 4 | Read Holding Registers | Out Of Range | No Action | |
| 5 | Read Holding Registers | Revision | No Action | |
| 6 | Read Holding Registers | Operational Mode | 0 = Unknown | No alarm |
| | | | 1 = Hold | No alarm |
| | | | 2 = Cyclic | No alarm |
| | | | 3 = Single | No alarm |
| | | | 4 = Calibration | Nacc Calibration |
| 7 | Read Holding Registers | Stream | 1, 2 ….. X | |
| 100 | Read Holding Registers | Un-Normalised Total | | |
| 102 | Read Holding Registers | Oxygen Molar % | | |
| 104 | Read Holding Registers | Nitrogen Molar % | | |
| 106 | Read Holding Registers | Carbon Dioxide Molar % | | |
| 108 | Read Holding Registers | Methane Molar % | | |
| 110 | Read Holding Registers | Ethane Molar % | | |
| 112 | Read Holding Registers | Propane Molar % | | |
| 114 | Read Holding Registers | i-Butane Molar % | | |
| 116 | Read Holding Registers | n-Butane Molar % | | |
| 118 | Read Holding Registers | neo-Pentane Molar % | | |
| 120 | Read Holding Registers | i-Pentane Molar % | | |
| 122 | Read Holding Registers | n-Pentane Molar % | | |
| 124 | Read Holding Registers | n-Hexane+ Molar % | | |
| 126 | Read Holding Registers | GCV (MJ/m3) | | |
| 128 | Read Holding Registers | NCV (MJ/m3) | | |
| 130 | Read Holding Registers | Standard density | | |
| 132 | Read Holding Registers | Relative density | | |
| 134 | Read Holding Registers | Wobbe (MJ/m3) | | |
| 136 | Read Holding Registers | Hydrogen Molar % | | |

# Yamatake Model HGC303 Chromatograph

| Address | Function | Code | Number Format |
|---|---|---|---|
| 3058 | New data available flag | 1 = Ready<br>0 = Copy Data | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1 = Analysis<br>0 = Calibration | unsigned 16 bit integer |
| 3047 | GC status register<br>(See GC manual for details) | 0 = OK | unsigned 16 bit integer |

Unit will continue to read the above 3 registers until the following conditions are correct:
3058 = 1 i.e. Ready
3059 = 1 i.e. Analysis
3047 = 0 i.e. OK

When these conditions are met it will continue to read addresses 7001 to 7020.

| Address | Function | Number Format |
|---|---|---|
| 7001 | Mol % C6+ | IEEE 32 bit Float |
| 7002 | Mol % Propane | IEEE 32 bit Float |
| 7003 | Mol % i-Butane | IEEE 32 bit Float |
| 7004 | Mol % n-Butane | IEEE 32 bit Float |
| 7005 | Mol % neo-Pentane | IEEE 32 bit Float |
| 7006 | Mol % i-Pentane | IEEE 32 bit Float |
| 7007 | Mol % n-Pentane | IEEE 32 bit Float |
| 7008 | Mol % N2 | IEEE 32 bit Float |
| 7009 | Mol % Methane | IEEE 32 bit Float |
| 7010 | Mol % CO2 | IEEE 32 bit Float |
| 7011 | Mol % Ethane | IEEE 32 bit Float |
| 7012 | Superior Heating Value | IEEE 32 bit Float |
| 7013 | Not Used | |
| 7014 | Wobbe index (Superior) | IEEE 32 bit Float |
| 7015 | Not Used | |
| 7016 | Not Used | |
| 7017 | Not Used | |
| 7018 | Not Used | |
| 7019 | Not Used | |
| 7020 | Relative Density | IEEE 32 bit Float |

# Encal 3000 Chromatograph

The chromatograph information is always read.

| Address | Modbus Function | Function | Values | Alarms >/th> |
|---|---|---|---|---|
| 6989 | Read Holding Registers | Serial Number | | |
| 6990 | Read Holding Registers | Number of Runs | | |
| 6991 | Read Holding Registers | Instrument State | 0 = Initialising<br>1 = Flushing<br>2 = Running<br>3 = Stabilising<br>4 = Ready<br>5 = Error<br>6 = Recoverable Error<br>7 = Broken<br>8 = Not Ready<br>9 = Waiting<br>10 = Reconditioning | No alarm<br>No alarm<br>No alarm<br>No alarm<br>Acc Instrument Alarm<br>Acc Instrument Alarm<br>Acc Instrument Alarm<br>Acc Instrument Alarm<br>Acc Instrument Alarm<br>Acc Instrument Alarm<br>No alarm |
| 6992 | Read Holding Registers | Sequence State | 0 = Idle<br>1 = Manual<br>2 = Sequence<br>3 = Calibration<br>4 = Verification<br>5 = Recalculation<br>6 = Flushing | Acc Sequence Alarm<br>Acc Sequence Alarm<br>No alarm<br>No alarm<br>No alarm<br>Acc Sequence Alarm<br>No alarm |
| 6993 | Read Holding Registers | Sample Type | 0 = Analysis<br>1 = Calibration<br>2 = Blank / Baseline<br>3 = Verification | No alarm<br>No alarm<br>No alarm<br>Acc Sample Alarm |
| 6994 | Read Holding Registers | Running Time | | |
| 6995 | Read Holding Registers | Calibration Alarm | 0 = No Alarm<br>1 = Alarm | No alarm<br>Nacc Calibrate Alarm |
| 6996 | Read Holding Registers | Last Stream Number | | |
| 6997 | Read Holding Registers | Current Stream | | |
| 6998 | Read Holding Registers | Next Stream | | |

Followed by the data specific to the last stream. If any stream has the alarm status register set, it is optional if this represents an Accountable or Non-Accountable alarm.

| Address | Modbus Function | Contents | Data Type |
|---|---|---|---|
| 7000 | Read Holding Registers | Stream 1 Nitrogen Molar % | IEEE 32 bit Float |
| 7001 | Read Holding Registers | Stream 1 Methane Molar % | IEEE 32 bit Float |
| 7002 | Read Holding Registers | Stream 1 Carbon Dioxide Molar% | IEEE 32 bit Float |
| 7003 | Read Holding Registers | Stream 1 Ethane Molar % | IEEE 32 bit Float |
| 7004 | Read Holding Registers | Stream 1 Hydrogen Sulphide Molar % | IEEE 32 bit Float |
| 7005 | Read Holding Registers | Stream 1 Carbonyl Sulphide Molar % | IEEE 32 bit Float |
| 7006 | Read Holding Registers | Stream 1 Propane Molar % | IEEE 32 bit Float |
| 7007 | Read Holding Registers | Stream 1 iButane Molar % | IEEE 32 bit Float |
| 7008 | Read Holding Registers | Stream 1 nButane Molar % | IEEE 32 bit Float |
| 7009 | Read Holding Registers | Stream 1 neoPentane Molar % | IEEE 32 bit Float |
| 7010 | Read Holding Registers | Stream 1 iPentane Molar % | IEEE 32 bit Float |
| 7011 | Read Holding Registers | Stream 1 nPentane Molar % | IEEE 32 bit Float |
| 7012 | Read Holding Registers | Stream 1 nHexane Molar % | IEEE 32 bit Float |
| 7013 | Read Holding Registers | Stream 1 nHeptane Molar % | IEEE 32 bit Float |

| | | | |
|---|---|---|---|
| 7014 | Read Holding Registers | Stream 1 nOctane Molar % | IEEE 32 bit Float |
| 7015 | Read Holding Registers | Stream 1 nNonane Molar % | IEEE 32 bit Float |
| 7016 | Read Holding Registers | Stream 1 nDecane Molar % | IEEE 32 bit Float |
| 7017 | Read Holding Registers | Stream 1 Heating Value Superior | IEEE 32 bit Float |
| 7018 | Read Holding Registers | Stream 1 Relative density | IEEE 32 bit Float |
| 7019 | Read Holding Registers | Stream 1 Compressibility | IEEE 32 bit Float |
| 7020 | Read Holding Registers | Stream 1 WOBBE Superior | IEEE 32 bit Float |
| 7021 | Read Holding Registers | Stream 1 Heating Value Inferior | IEEE 32 bit Float |
| 7022 | Read Holding Registers | Stream 1 WOBBE Inferior | IEEE 32 bit Float |
| 7023 | Read Holding Registers | Stream 1 Absolute Density | IEEE 32 bit Float |
| 7024 | Read Holding Registers | Stream 1 Alarm Status | 32 bit Integer |
| 7025 | Read Holding Registers | Stream 1 Benzene Molar % | IEEE 32 bit Float |
| 7026 | Read Holding Registers | Stream 1 Cyclohexane Molar % | IEEE 32 bit Float |
| 7027 | Read Holding Registers | Stream 1 Methylcyclohexane Molar % | IEEE 32 bit Float |
| 7028 | Read Holding Registers | Stream 1 Toluene Molar % | IEEE 32 bit Float |
| 7029 | Read Holding Registers | Stream 1 n-Undecane Molar % | IEEE 32 bit Float |
| 7030 | Read Holding Registers | Stream 1 n-Dodecane Molar % | IEEE 32 bit Float |
| 7031 | Read Holding Registers | Stream 1 Oxygen Molar % | IEEE 32 bit Float |
| 7032 | Read Holding Registers | Stream 1 Hydrogen Molar % | IEEE 32 bit Float |
| 7033 | Read Holding Registers | Stream 1 Helium Molar % | IEEE 32 bit Float |
| 7200 | Read Holding Registers | Stream 2 Nitrogen Molar % | IEEE 32 bit Float |
| 7201 | Read Holding Registers | Stream 2 Methane Molar % | IEEE 32 bit Float |
| 7202 | Read Holding Registers | Stream 2 Carbon Dioxide Molar % | IEEE 32 bit Float |
| 7203 | Read Holding Registers | Stream 2 Ethane Molar % | IEEE 32 bit Float |
| 7204 | Read Holding Registers | Stream 2 Hydrogen Sulphide Molar % | IEEE 32 bit Float |
| 7205 | Read Holding Registers | Stream 2 Carbonyl Sulphide Molar % | IEEE 32 bit Float |
| 7206 | Read Holding Registers | Stream 2 Propane Molar % | IEEE 32 bit Float |
| 7207 | Read Holding Registers | Stream 2 iButane Molar % | IEEE 32 bit Float |
| 7208 | Read Holding Registers | Stream 2 nButane Molar % | IEEE 32 bit Float |
| 7209 | Read Holding Registers | Stream 2 neoPentane Molar % | IEEE 32 bit Float |
| 7210 | Read Holding Registers | Stream 2 iPentane Molar % | IEEE 32 bit Float |
| 7211 | Read Holding Registers | Stream 2 nPentane Molar % | IEEE 32 bit Float |
| 7212 | Read Holding Registers | Stream 2 nHeptane Molar % | IEEE 32 bit Float |
| 7213 | Read Holding Registers | Stream 2 nOctane Molar % | IEEE 32 bit Float |
| 7214 | Read Holding Registers | Stream 2 nNonane Molar % | IEEE 32 bit Float |
| 7215 | Read Holding Registers | Stream 2 nDecane Molar % | IEEE 32 bit Float |
| 7216 | Read Holding Registers | Stream 2 Heating Value Superior | IEEE 32 bit Float |
| 7217 | Read Holding Registers | Stream 2 Relative density | IEEE 32 bit Float |
| 7218 | Read Holding Registers | Stream 2 Compressibility | IEEE 32 bit Float |
| 7219 | Read Holding Registers | Stream 2 WOBBE Superior | IEEE 32 bit Float |
| 7220 | Read Holding Registers | Stream 2 Heating Value Inferior | IEEE 32 bit Float |
| 7221 | Read Holding Registers | Stream 2 WOBBE Inferior | IEEE 32 bit Float |
| 7222 | Read Holding Registers | Stream 2 Absolute Density | IEEE 32 bit Float |
| 7223 | Read Holding Registers | Stream 2 Alarm Status | 32 bit Integer |
| 7224 | Read Holding Registers | Stream 2 Benzene Molar % | IEEE 32 bit Float |
| 7225 | Read Holding Registers | Stream 2 Cyclohexane Molar % | IEEE 32 bit Float |
| 7226 | Read Holding Registers | Stream 2 Methylcyclohexane Molar % | IEEE 32 bit Float |
| 7227 | Read Holding Registers | Stream 2 Toluene Molar % | IEEE 32 bit Float |
| 7228 | Read Holding Registers | Stream 2 Undecane Molar % | IEEE 32 bit Float |
| 7229 | Read Holding Registers | Stream 2 Dodecane Molar % | IEEE 32 bit Float |
| 7230 | Read Holding Registers | Stream 2 Oxygen Molar % | IEEE 32 bit Float |
| 7231 | Read Holding Registers | Stream 2 Hydrogen Molar % | IEEE 32 bit Float |
| 7232 | Read Holding Registers | Stream 2 Helium Molar % | IEEE 32 bit Float |
| 7300 | Read Holding Registers | Stream 3 Nitrogen Molar % | IEEE 32 bit Float |
| 7301 | Read Holding Registers | Stream 3 Methane Molar % | IEEE 32 bit Float |

| | | | |
|---|---|---|---|
| 7302 | Read Holding Registers | Stream 3 Carbon Dioxide Molar % | IEEE 32 bit Float |
| 7303 | Read Holding Registers | Stream 3 Ethane Molar % | IEEE 32 bit Float |
| 7304 | Read Holding Registers | Stream 3 Hydrogen Sulphide Molar % | IEEE 32 bit Float |
| 7305 | Read Holding Registers | Stream 3 Carbonyl Sulphide Molar % | IEEE 32 bit Float |
| 7306 | Read Holding Registers | Stream 3 Propane Molar % | IEEE 32 bit Float |
| 7307 | Read Holding Registers | Stream 3 iButane Molar % | IEEE 32 bit Float |
| 7308 | Read Holding Registers | Stream 3 nButane Molar % | IEEE 32 bit Float |
| 7309 | Read Holding Registers | Stream 3 neoPentane Molar % | IEEE 32 bit Float |
| 7310 | Read Holding Registers | Stream 3 iPentane Molar % | IEEE 32 bit Float |
| 7311 | Read Holding Registers | Stream 3 nPentane Molar % | IEEE 32 bit Float |
| 7312 | Read Holding Registers | Stream 3 nHeptane Molar % | IEEE 32 bit Float |
| 7313 | Read Holding Registers | Stream 3 nOctane Molar % | IEEE 32 bit Float |
| 7314 | Read Holding Registers | Stream 3 nNonane Molar % | IEEE 32 bit Float |
| 7315 | Read Holding Registers | Stream 3 nDecane Molar % | IEEE 32 bit Float |
| 7316 | Read Holding Registers | Stream 3 Heating Value Superior | IEEE 32 bit Float |
| 7317 | Read Holding Registers | Stream 3 Relative density | IEEE 32 bit Float |
| 7318 | Read Holding Registers | Stream 3 Compressibility | IEEE 32 bit Float |
| 7319 | Read Holding Registers | Stream 3 WOBBE Superior | IEEE 32 bit Float |
| 7320 | Read Holding Registers | Stream 3 Heating Value Inferior | IEEE 32 bit Float |
| 7321 | Read Holding Registers | Stream 3 WOBBE Inferior | IEEE 32 bit Float |
| 7322 | Read Holding Registers | Stream 3 Absolute Density | IEEE 32 bit Float |
| 7323 | Read Holding Registers | Stream 3 Alarm Status | 32 bit Integer |
| 7324 | Read Holding Registers | Stream 3 Benzene Molar % | IEEE 32 bit Float |
| 7325 | Read Holding Registers | Stream 3 Cyclohexane Molar % | IEEE 32 bit Float |
| 7326 | Read Holding Registers | Stream 3 Methylcyclohexane Molar % | IEEE 32 bit Float |
| 7327 | Read Holding Registers | Stream 3 Toluene Molar % | IEEE 32 bit Float |
| 7328 | Read Holding Registers | Stream 3 Undecane Molar % | IEEE 32 bit Float |
| 7329 | Read Holding Registers | Stream 3 Dodecane Molar % | IEEE 32 bit Float |
| 7330 | Read Holding Registers | Stream 3 Oxygen Molar % | IEEE 32 bit Float |
| 7331 | Read Holding Registers | Stream 3 Hydrogen Molar % | IEEE 32 bit Float |
| 7332 | Read Holding Registers | Stream 3 Helium Molar % | IEEE 32 bit Float |
| 7400 | Read Holding Registers | Stream 4 Nitrogen Molar % | IEEE 32 bit Float |
| 7401 | Read Holding Registers | Stream 4 Methane Molar % | IEEE 32 bit Float |
| 7402 | Read Holding Registers | Stream 4 Carbon Dioxide Molar % | IEEE 32 bit Float |
| 7403 | Read Holding Registers | Stream 4 Ethane Molar % | IEEE 32 bit Float |
| 7404 | Read Holding Registers | Stream 4 Hydrogen Sulphide Molar % | IEEE 32 bit Float |
| 7405 | Read Holding Registers | Stream 4 Carbonyl Sulphide Molar % | IEEE 32 bit Float |
| 7406 | Read Holding Registers | Stream 4 Propane Molar % | IEEE 32 bit Float |
| 7407 | Read Holding Registers | Stream 4 iButane Molar % | IEEE 32 bit Float |
| 7408 | Read Holding Registers | Stream 4 nButane Molar % | IEEE 32 bit Float |
| 7409 | Read Holding Registers | Stream 4 neoPentane Molar % | IEEE 32 bit Float |
| 7410 | Read Holding Registers | Stream 4 iPentane Molar % | IEEE 32 bit Float |
| 7411 | Read Holding Registers | Stream 4 nPentane Molar % | IEEE 32 bit Float |
| 7412 | Read Holding Registers | Stream 4 nHeptane Molar % | IEEE 32 bit Float |
| 7413 | Read Holding Registers | Stream 4 nOctane Molar % | IEEE 32 bit Float |
| 7414 | Read Holding Registers | Stream 4 nNonane Molar % | IEEE 32 bit Float |
| 7415 | Read Holding Registers | Stream 4 nDecane Molar % | IEEE 32 bit Float |
| 7416 | Read Holding Registers | Stream 4 Heating Value Superior | IEEE 32 bit Float |
| 7417 | Read Holding Registers | Stream 4 Relative density | IEEE 32 bit Float |
| 7418 | Read Holding Registers | Stream 4 Compressibility | IEEE 32 bit Float |
| 7419 | Read Holding Registers | Stream 4 WOBBE Superior | IEEE 32 bit Float |
| 7420 | Read Holding Registers | Stream 4 Heating Value Inferior | IEEE 32 bit Float |
| 7421 | Read Holding Registers | Stream 4 WOBBE Inferior | IEEE 32 bit Float |
| 7422 | Read Holding Registers | Stream 4 Absolute Density | IEEE 32 bit Float |
| 7423 | Read Holding Registers | Stream 4 Alarm Status | 32 bit Integer |

| | | | |
|---|---|---|---|
| 7424 | Read Holding Registers | Stream 4 Benzene Molar % | IEEE 32 bit Float |
| 7425 | Read Holding Registers | Stream 4 Cyclohexane Molar % | IEEE 32 bit Float |
| 7426 | Read Holding Registers | Stream 4 Methylcyclohexane Molar % | IEEE 32 bit Float |
| 7427 | Read Holding Registers | Stream 4 Toluene Molar % | IEEE 32 bit Float |
| 7428 | Read Holding Registers | Stream 4 Undecane Molar % | IEEE 32 bit Float |
| 7429 | Read Holding Registers | Stream 4 Dodecane Molar % | IEEE 32 bit Float |
| 7430 | Read Holding Registers | Stream 4 Oxygen Molar % | IEEE 32 bit Float |
| 7431 | Read Holding Registers | Stream 4 Hydrogen Molar % | IEEE 32 bit Float |
| 7432 | Read Holding Registers | Stream 4 Helium Molar % | IEEE 32 bit Float |
| 7500 | Read Holding Registers | Stream 5 Nitrogen Molar % | IEEE 32 bit Float |
| 7501 | Read Holding Registers | Stream 5 Methane Molar % | IEEE 32 bit Float |
| 7502 | Read Holding Registers | Stream 5 Carbon Dioxide Molar % | IEEE 32 bit Float |
| 7503 | Read Holding Registers | Stream 5 Ethane Molar % | IEEE 32 bit Float |
| 7504 | Read Holding Registers | Stream 5 Hydrogen Sulphide Molar % | IEEE 32 bit Float |
| 7505 | Read Holding Registers | Stream 5 Carbonyl Sulphide Molar % | IEEE 32 bit Float |
| 7506 | Read Holding Registers | Stream 5 Propane Molar % | IEEE 32 bit Float |
| 7507 | Read Holding Registers | Stream 5 iButane Molar % | IEEE 32 bit Float |
| 7508 | Read Holding Registers | Stream 5 nButane Molar % | IEEE 32 bit Float |
| 7509 | Read Holding Registers | Stream 5 neoPentane Molar % | IEEE 32 bit Float |
| 7510 | Read Holding Registers | Stream 5 iPentane Molar % | IEEE 32 bit Float |
| 7511 | Read Holding Registers | Stream 5 nPentane Molar % | IEEE 32 bit Float |
| 7512 | Read Holding Registers | Stream 5 nHeptane Molar % | IEEE 32 bit Float |
| 7513 | Read Holding Registers | Stream 5 nOctane Molar % | IEEE 32 bit Float |
| 7514 | Read Holding Registers | Stream 5 nNonane Molar % | IEEE 32 bit Float |
| 7515 | Read Holding Registers | Stream 5 nDecane Molar % | IEEE 32 bit Float |
| 7516 | Read Holding Registers | Stream 5 Heating Value Superior | IEEE 32 bit Float |
| 7517 | Read Holding Registers | Stream 5 Relative density | IEEE 32 bit Float |
| 7518 | Read Holding Registers | Stream 5 Compressibility | IEEE 32 bit Float |
| 7519 | Read Holding Registers | Stream 5 WOBBE Superior | IEEE 32 bit Float |
| 7520 | Read Holding Registers | Stream 5 Heating Value Inferior | IEEE 32 bit Float |
| 7521 | Read Holding Registers | Stream 5 WOBBE Inferior | IEEE 32 bit Float |
| 7522 | Read Holding Registers | Stream 5 Absolute Density | IEEE 32 bit Float |
| 7523 | Read Holding Registers | Stream 5 Alarm Status | 32 bit Integer |
| 7524 | Read Holding Registers | Stream 5 Benzene Molar % | IEEE 32 bit Float |
| 7525 | Read Holding Registers | Stream 5 Cyclohexane Molar % | IEEE 32 bit Float |
| 7526 | Read Holding Registers | Stream 5 Methylcyclohexane Molar % | IEEE 32 bit Float |
| 7527 | Read Holding Registers | Stream 5 Toluene Molar % | IEEE 32 bit Float |
| 7528 | Read Holding Registers | Stream 5 Undecane Molar % | IEEE 32 bit Float |
| 7529 | Read Holding Registers | Stream 5 Dodecane Molar % | IEEE 32 bit Float |
| 7530 | Read Holding Registers | Stream 5 Oxygen Molar % | IEEE 32 bit Float |
| 7531 | Read Holding Registers | Stream 5 Hydrogen Molar % | IEEE 32 bit Float |
| 7532 | Read Holding Registers | Stream 5 Helium Molar % | IEEE 32 bit Float |

# Daniels Senior Sonic Ultrasonic Meter

The Daniels Senior Sonic ultrasonic meter is read using 3 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 62 - 65 | Unsigned Integer | 2 bytes | Path Status. Paths 1 - 4. |
| | 66 | Unsigned Integer | 2 bytes | Status |
| | 67 - 70 | Unsigned Integer | 2 bytes | Failure 1. Paths 1 - 4. |
| | 71 - 74 | Unsigned Integer | 2 bytes | Failure 2. Paths 1 - 4. |
| | | | | |
| 2 | 352 - 359 | Floating Point | 4 bytes | Flow velocity. Paths 1 - 4. |
| | 360 - 361 | Floating Point | 4 bytes | Average flow velocity. |
| | 362 - 369 | Floating Point | 4 bytes | Velocity of sound. Paths 1 - 4. |
| | 370 - 371 | Floating Point | 4 bytes | Average velocity of sound. |
| | | | | |
| 3 | 1500 - 1501 | Unsigned Integer | 4 bytes | Un corrected volume |
| | 1502 - 1503 | Unsigned Integer | 4 bytes | Normal Un corrected volume |
| | 1504 - 1505 | Unsigned Integer | 4 bytes | Cold. |
| | 1506 - 1507 | Unsigned Integer | 4 bytes | Data quality |
| | 1508 - 1509 | Unsigned Integer | 4 bytes | Un corrected volume fraction |
| | 1510 - 1511 | Unsigned Integer | 4 bytes | Normal Un corrected volume fraction |
| | 1512 - 1513 | Unsigned Integer | 4 bytes | Time Lapse |
| | 1514 - 1515 | Unsigned Integer | 4 bytes | Time of flow |
| | 1516 - 1517 | Unsigned Integer | 4 bytes | Time |
| | 1518 - 1519 | Unsigned Integer | 4 bytes | Max SEA 1 |
| | 1520 - 1521 | Unsigned Integer | 4 bytes | Max SEA 2 |
| | 1522 - 1523 | Unsigned Integer | 4 bytes | Max SEB 1 |
| | 1524 - 1525 | Unsigned Integer | 4 bytes | Max SEB 2 |
| | 1526 - 1527 | Unsigned Integer | 4 bytes | Max SEC 1 |
| | 1528 - 1529 | Unsigned Integer | 4 bytes | Max SEC 2 |
| | 1530 - 1531 | Unsigned Integer | 4 bytes | Max SED 1 |
| | 1532 - 1533 | Unsigned Integer | 4 bytes | Max SED 2 |

# Instromet QSonic Ultrasonic Meter

The Instromet QSonic meter is read using 2 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 1000 | Unsigned Integer | 2 bytes | Meter type |
| | 1001 | Unsigned Integer | 2 bytes | Paths |
| | 1002 | Unsigned Integer | 2 bytes | Sequence LO |
| | 1003 | Unsigned Integer | 2 bytes | Sequence HI |
| | 1004 | Unsigned Integer | 2 bytes | Sample |
| | 1005 - 1009 | Unsigned Integer | 2 bytes | Valid samples. Paths 1 - 5 |
| | 1010 - 1019 | Unsigned Integer | 2 bytes | Agc level. Paths 1 - 5 |
| | 1020 - 1029 | Unsigned Integer | 2 bytes | Agc limit. Paths 1 - 5 |
| | 1030 - 1034 | Unsigned Integer | 2 bytes | Diagnostic bits. Paths 1 - 5 |
| | 1035 | Unsigned Integer | 2 bytes | V status |
| | 1036 | Unsigned Integer | 2 bytes | Cr status |
| | 1037 | Unsigned Integer | 2 bytes | Checksum 1 |
| | 1038 | Unsigned Integer | 2 bytes | Checksum 2 |
| | 1039 | Unsigned Integer | 2 bytes | Current mode |
| | | | | |
| 2 | 1400 | Floating Point | 4 bytes | Velocity of Sound |
| | 1401 | Floating Point | 4 bytes | Velocity of Gas |
| | 1402 | Floating Point | 4 bytes | Pressure |
| | 1403 | Floating Point | 4 bytes | Temperature |
| | 1404 | Floating Point | 4 bytes | Line volume flow rate |
| | 1405 | Floating Point | 4 bytes | Base volume flow rate |
| | 1406 - 1410 | Floating Point | 4 bytes | Cpp. Paths 1 - 5 |
| | 1411 - 1415 | Floating Point | 4 bytes | Vpp. Paths 1 - 5 |
| | 1416 | Floating Point | 4 bytes | Positive volume total |
| | 1417 | Floating Point | 4 bytes | Negative volume total |
| | 1418 | Floating Point | 4 bytes | Error positive volume total |
| | 1419 | Floating Point | 4 bytes | Error negative volume total |
| | 1420 | Floating Point | 4 bytes | T spare |

# FlowSIC 600 Ultrasonic Meter

The FlowSIC 600 ultrasonic meter is read using 4 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 3001 | Unsigned Integer | 2 bytes | Type |
| | 3002 | Unsigned Integer | 2 bytes | Control |
| | 3003 | Unsigned Integer | 2 bytes | Status |
| | 3004 - 3007 | Unsigned Integer | 2 bytes | Path Status. Paths 1 to 4. |
| | 3008 - 3011 | Unsigned Integer | 2 bytes | Path Samples. Paths 1 to 4. |
| | 3012 - 3019 | Unsigned Integer | 2 bytes | AGC Level. Paths 1 to 4. |
| | | | | |
| 2 | 5001 | Unsigned Integer | 4 bytes | Device Serial Number |
| | 5002 | Unsigned Integer | 4 bytes | Software Version |
| | 5003 | Unsigned Integer | 4 bytes | Analogue Serial Number |
| | 5004 | Unsigned Integer | 4 bytes | CRC Constant |
| | 5005 | Unsigned Integer | 4 bytes | CRC Program |
| | 5006 | Unsigned Integer | 4 bytes | CRC Parameters |
| | | | | |
| 3 | 5010 | Unsigned Integer | 4 bytes | Positive Volume |
| | 5011 | Unsigned Integer | 4 bytes | Positive Volume Error |
| | 5012 | Unsigned Integer | 4 bytes | Negative Volume |
| | 5013 | Unsigned Integer | 4 bytes | Negative Volume Error |
| | 5014 | Unsigned Integer | 4 bytes | Counter Resolution |
| | | | | |
| 4 | 7001 | Floating Point | 4 bytes | Line volume flow rate |
| | 7002 | Floating Point | 4 bytes | Base volume flow rate |
| | 7003 | Floating Point | 4 bytes | Velocity of sound |
| | 7004 | Floating Point | 4 bytes | Velocity of gas |
| | 7005 - 7008 | Floating Point | 4 bytes | Path velocity of sound. Paths 1 to 4. |
| | 7009 - 7012 | Floating Point | 4 bytes | Path velocity of gas. Paths 1 to 4. |
| | 7013 - 7020 | Floating Point | 4 bytes | Snr receiver. Paths 1 to 4 |

# Krohne Altosonic V Ultrasonic Meter

The Krohne Altosonic V meter is read using 3 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 7000 | Floating Point | 4 bytes | Flow process |
| | 7001 | Floating Point | 4 bytes | Sound velocity average |
| | 7002 | Floating Point | 4 bytes | Temperature process variable |
| | 7003 | Floating Point | 4 bytes | Pressure process variable |
| | 7004 | Floating Point | 4 bytes | Density process variable |
| | 7005 | Floating Point | 4 bytes | Temperature body |
| | 7006 | Floating Point | 4 bytes | Flow standard |
| | 7007 | Floating Point | 4 bytes | Flow mass |
| | 7008 | Floating Point | 4 bytes | Flow channel1 |
| | 7009 | Floating Point | 4 bytes | Flow channel2 |
| | 7010 | Floating Point | 4 bytes | Flow channel3 |
| | 7011 | Floating Point | 4 bytes | Flow channel4 |
| | 7012 | Floating Point | 4 bytes | Flow channel5 |
| | 7013 | Floating Point | 4 bytes | Sound velocity path1 |
| | 7014 | Floating Point | 4 bytes | Sound velocity path2 |
| | 7015 | Floating Point | 4 bytes | Sound velocity path3 |
| | 7016 | Floating Point | 4 bytes | Sound velocity path4 |
| | 7017 | Floating Point | 4 bytes | Sound velocity path5 |
| | 7018 | Floating Point | 4 bytes | Remaining time |
| | 7019 | Floating Point | 4 bytes | Reynolds number |
| | 7020 | Floating Point | 4 bytes | Swirl number |
| | 7021 | Floating Point | 4 bytes | Viscosity internal |
| | 7031 | Floating Point | 4 bytes | Density standard |
| | 7032 | Floating Point | 4 bytes | Agc path1 |
| | 7033 | Floating Point | 4 bytes | Agc path2 |
| | 7034 | Floating Point | 4 bytes | Agc path3 |
| | 7035 | Floating Point | 4 bytes | Agc path4 |
| | 7036 | Floating Point | 4 bytes | Agc path5 |
| | 7044 | Floating Point | 4 bytes | Temperature density |
| | 7045 | Floating Point | 4 bytes | Pressure density |
| | 7066 | Floating Point | 4 bytes | Density density |
| | | | | |
| 2 | 6000 | Double precision | 8 bytes | Reset total process sum |
| | 6001 | Double precision | 8 bytes | Flow process |
| | 6002 | Double precision | 8 bytes | Sound velocity average |
| | 6003 | Double precision | 8 bytes | Reset total standard sum |
| | 6004 | Double precision | 8 bytes | Flow standard |
| | 6005 | Double precision | 8 bytes | Reset total mass sum |
| | 6006 | Double precision | 8 bytes | Flow mass |
| | 6007 | Double precision | 8 bytes | reserved |
| | 6008 | Double precision | 8 bytes | Reset total process forward |
| | 6009 | Double precision | 8 bytes | Reset total process reverse |
| | 6010 | Double precision | 8 bytes | Reset total standard forward |
| | 6011 | Double precision | 8 bytes | Reset total standard reverse |
| | 6012 | Double precision | 8 bytes | Reset total mass forward |
| | 6013 | Double precision | 8 bytes | Reset total mass reverse |
| | 6014 | Double precision | 8 bytes | Reset total external flow met pro |
| | 6015 | Double precision | 8 bytes | Reset total external flow met std |
| | 6016 | Double precision | 8 bytes | Reset total external flow met mas |

| | | | | |
|---|---|---|---|---|
| | 6017 | Double precision | 8 bytes | Process sum |
| | 6018 | Double precision | 8 bytes | Process forward |
| | 6019 | Double precision | 8 bytes | Process reverse |
| | | | | |
| 3 | 1000 | Coil | 1 bit | Basic flow measurement warning |
| | 1001 | Coil | 1 bit | Basic flow measurement error |
| | 1002 | Coil | 1 bit | System runtime warning |
| | 1003 | Coil | 1 bit | System runtime error |
| | 1004 | Coil | 1 bit | System set-up warning |
| | 1005 | Coil | 1 bit | System set-up error |
| | 1006 | Coil | 1 bit | Not Used |
| | 1007 | Coil | 1 bit | Not Used |
| | 1008 | Coil | 1 bit | Not Used |
| | 1009 | Coil | 1 bit | Not Used |
| | 1010 | Coil | 1 bit | Not Used |
| | 1011 | Coil | 1 bit | Not Used |
| | 1012 | Coil | 1 bit | Not Used |
| | 1013 | Coil | 1 bit | Not Used |
| | 1014 | Coil | 1 bit | Not Used |
| | 1015 | Coil | 1 bit | API group out of range |
| | 1016 | Coil | 1 bit | Not Used |
| | 1017 | Coil | 1 bit | Not Used |
| | 1018 | Coil | 1 bit | Not Used |
| | 1019 | Coil | 1 bit | Not Used |
| | 1020 | Coil | 1 bit | Not Used |
| | 1021 | Coil | 1 bit | Not Used |
| | 1022 | Coil | 1 bit | Not Used |
| | 1023 | Coil | 1 bit | Not Used |
| | 1024 | Coil | 1 bit | Not Used |
| | 1025 | Coil | 1 bit | Not Used |
| | 1026 | Coil | 1 bit | Not Used |
| | 1027 | Coil | 1 bit | Not Used |
| | 1028 | Coil | 1 bit | Not Used |
| | 1029 | Coil | 1 bit | Not Used |
| | 1030 | Coil | 1 bit | Not Used |
| | 1031 | Coil | 1 bit | Not Used |
| | 1032 | Coil | 1 bit | Over range data path 1 |
| | 1033 | Coil | 1 bit | Over range data path 2 |
| | 1034 | Coil | 1 bit | Over range data path 3 |
| | 1035 | Coil | 1 bit | Over range data path 4 |
| | 1036 | Coil | 1 bit | Over range data path 5 |
| | 1037 | Coil | 1 bit | Path failure path 1 |
| | 1038 | Coil | 1 bit | Path failure path 2 |
| | 1039 | Coil | 1 bit | Path failure path 3 |
| | 1040 | Coil | 1 bit | Path failure path 4 |
| | 1041 | Coil | 1 bit | Path failure path 5 |
| | 1042 | Coil | 1 bit | Deviation in sound velocity path 1 |
| | 1043 | Coil | 1 bit | Deviation in sound velocity path 2 |
| | 1044 | Coil | 1 bit | Deviation in sound velocity path 3 |
| | 1045 | Coil | 1 bit | Deviation in sound velocity path 4 |
| | 1046 | Coil | 1 bit | Deviation in sound velocity path 5 |

# Krohne UFM3030 Ultrasonic Meter

The Krohne UFM3030 meter is read using 3 modbus packets.

Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 7000 | Floating Point | 4 bytes | Flow process |
| 7001 | Floating Point | 4 bytes | Sound velocity average |
| 7002 | Floating Point | 4 bytes | Temperature process variable |
| 7003 | Floating Point | 4 bytes | Pressure process variable |
| 7004 | Floating Point | 4 bytes | Density process variable |
| 7005 | Floating Point | 4 bytes | Temperature body |
| 7006 | Floating Point | 4 bytes | Flow standard |
| 7007 | Floating Point | 4 bytes | Flow mass |
| 7008 | Floating Point | 4 bytes | Flow channel1 |
| 7009 | Floating Point | 4 bytes | Flow channel2 |
| 7010 | Floating Point | 4 bytes | Flow channel3 |
| 7011 | Floating Point | 4 bytes | Flow channel4 |
| 7012 | Floating Point | 4 bytes | Flow channel5 |
| 7013 | Floating Point | 4 bytes | Sound velocity path1 |
| 7014 | Floating Point | 4 bytes | Sound velocity path2 |
| 7015 | Floating Point | 4 bytes | Sound velocity path3 |
| 7016 | Floating Point | 4 bytes | Sound velocity path4 |
| 7017 | Floating Point | 4 bytes | Sound velocity path5 |
| 7018 | Floating Point | 4 bytes | Remaining time |
| 7019 | Floating Point | 4 bytes | Reynolds number |
| 7020 | Floating Point | 4 bytes | Swirl number |
| 7021 | Floating Point | 4 bytes | Viscosity internal |
| 7031 | Floating Point | 4 bytes | Density standard |
| 7032 | Floating Point | 4 bytes | Agc path1 |
| 7033 | Floating Point | 4 bytes | Agc path2 |
| 7034 | Floating Point | 4 bytes | Agc path3 |
| 7035 | Floating Point | 4 bytes | Agc path4 |
| 7036 | Floating Point | 4 bytes | Agc path5 |
| 7044 | Floating Point | 4 bytes | Temperature density |
| 7045 | Floating Point | 4 bytes | Pressure density |
| 7066 | Floating Point | 4 bytes | Density density |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 6000 | Double precision | 8 bytes | Reset total process sum |
| 6001 | Double precision | 8 bytes | Flow process |
| 6002 | Double precision | 8 bytes | Sound velocity average |
| 6003 | Double precision | 8 bytes | Reset total standard sum |
| 6004 | Double precision | 8 bytes | Flow standard |
| 6005 | Double precision | 8 bytes | Reset total mass sum |
| 6006 | Double precision | 8 bytes | Flow mass |
| 6007 | Double precision | 8 bytes | reserved |
| 6008 | Double precision | 8 bytes | Reset total process forward |
| 6009 | Double precision | 8 bytes | Reset total process reverse |
| 6010 | Double precision | 8 bytes | Reset total standard forward |

| | | | |
|---|---|---|---|
| 6011 | Double precision | 8 bytes | Reset total standard reverse |
| 6012 | Double precision | 8 bytes | Reset total mass forward |
| 6013 | Double precision | 8 bytes | Reset total mass reverse |
| 6014 | Double precision | 8 bytes | Reset total external flow met pro |
| 6015 | Double precision | 8 bytes | Reset total external flow met std |
| 6016 | Double precision | 8 bytes | Reset total external flow met mass |
| 6017 | Double precision | 8 bytes | Process sum |
| 6018 | Double precision | 8 bytes | Process forward |
| 6019 | Double precision | 8 bytes | Process reverse |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1000 | Coil | 1 bit | Basic flow measurement warning |
| 1001 | Coil | 1 bit | Basic flow measurement error |
| 1002 | Coil | 1 bit | System runtime warning |
| 1003 | Coil | 1 bit | System runtime error |
| 1004 | Coil | 1 bit | System set-up warning |
| 1005 | Coil | 1 bit | System set-up error |
| 1006 | Coil | 1 bit | Not Used |
| 1007 | Coil | 1 bit | Not Used |
| 1008 | Coil | 1 bit | Not Used |
| 1009 | Coil | 1 bit | Not Used |
| 1010 | Coil | 1 bit | Not Used |
| 1011 | Coil | 1 bit | Not Used |
| 1012 | Coil | 1 bit | Not Used |
| 1013 | Coil | 1 bit | Not Used |
| 1014 | Coil | 1 bit | Not Used |
| 1015 | Coil | 1 bit | API group out of range |
| 1016 | Coil | 1 bit | Not Used |
| 1017 | Coil | 1 bit | Not Used |
| 1018 | Coil | 1 bit | Not Used |
| 1019 | Coil | 1 bit | Not Used |
| 1020 | Coil | 1 bit | Not Used |
| 1021 | Coil | 1 bit | Not Used |
| 1022 | Coil | 1 bit | Not Used |
| 1023 | Coil | 1 bit | Not Used |
| 1024 | Coil | 1 bit | Not Used |
| 1025 | Coil | 1 bit | Not Used |
| 1026 | Coil | 1 bit | Not Used |
| 1027 | Coil | 1 bit | Not Used |
| 1028 | Coil | 1 bit | Not Used |
| 1029 | Coil | 1 bit | Not Used |
| 1030 | Coil | 1 bit | Not Used |
| 1031 | Coil | 1 bit | Not Used |
| 1032 | Coil | 1 bit | Over range data path 1 |
| 1033 | Coil | 1 bit | Over range data path 2 |
| 1034 | Coil | 1 bit | Over range data path 3 |
| 1035 | Coil | 1 bit | Over range data path 4 |
| 1036 | Coil | 1 bit | Over range data path 5 |
| 1037 | Coil | 1 bit | Path failure path 1 |
| 1038 | Coil | 1 bit | Path failure path 2 |
| 1039 | Coil | 1 bit | Path failure path 3 |
| 1040 | Coil | 1 bit | Path failure path 4 |

| | | | |
|---|---|---|---|
| 1041 | Coil | 1 bit | Path failure path 5 |
| 1042 | Coil | 1 bit | Deviation in sound velocity path 1 |
| 1043 | Coil | 1 bit | Deviation in sound velocity path 2 |
| 1044 | Coil | 1 bit | Deviation in sound velocity path 3 |
| 1045 | Coil | 1 bit | Deviation in sound velocity path 4 |
| 1046 | Coil | 1 bit | Deviation in sound velocity path 5 |

# Krohne Altosonic V12 Ultrasonic Meter

The Krohne Altosonic V12 meter is read using 3 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 7001 | Floating Point | 4 bytes | Gain AB1 |
| | 7003 | Floating Point | 4 bytes | Gain AB2 |
| | 7005 | Floating Point | 4 bytes | Gain AB3 |
| | 7007 | Floating Point | 4 bytes | Gain AB4 |
| | 7009 | Floating Point | 4 bytes | Gain AB5 |
| | 7011 | Floating Point | 4 bytes | Gain AB6 |
| | 7013 | Floating Point | 4 bytes | Gain BA1 |
| | 7015 | Floating Point | 4 bytes | Gain BA2 |
| | 7017 | Floating Point | 4 bytes | Gain BA3 |
| | 7019 | Floating Point | 4 bytes | Gain BA4 |
| | 7021 | Floating Point | 4 bytes | Gain BA5 |
| | 7023 | Floating Point | 4 bytes | Gain BA6 |
| | 7025 | Floating Point | 4 bytes | SNR AB1 |
| | 7027 | Floating Point | 4 bytes | SNR AB2 |
| | 7029 | Floating Point | 4 bytes | SNR AB3 |
| | 7031 | Floating Point | 4 bytes | SNR AB4 |
| | 7033 | Floating Point | 4 bytes | SNR AB5 |
| | 7035 | Floating Point | 4 bytes | SNR AB6 |
| | 7037 | Floating Point | 4 bytes | SNR BA1 |
| | 7039 | Floating Point | 4 bytes | SNR BA2 |
| | 7041 | Floating Point | 4 bytes | SNR BA3 |
| | 7043 | Floating Point | 4 bytes | SNR BA4 |
| | 7045 | Floating Point | 4 bytes | SNR BA5 |
| | 7047 | Floating Point | 4 bytes | SNR BA6 |
| | 7049 | Floating Point | 4 bytes | Temperature |
| | 7051 | Floating Point | 4 bytes | Viscosity |
| | 7053 | Floating Point | 4 bytes | Density |
| | 7055 | Floating Point | 4 bytes | Flow (m/s) |
| | 7057 | Floating Point | 4 bytes | Velocity of Gas |
| | 7059 | Floating Point | 4 bytes | Velocity of Sound |
| | 7061 | Floating Point | 4 bytes | Velocity of Gas 1 |
| | 7063 | Floating Point | 4 bytes | Velocity of Gas 2 |
| | 7065 | Floating Point | 4 bytes | Velocity of Gas 3 |
| | 7067 | Floating Point | 4 bytes | Velocity of Gas 4 |
| | 7069 | Floating Point | 4 bytes | Velocity of Gas 5 |
| | 7071 | Floating Point | 4 bytes | Velocity of Gas 6 |
| | 7073 | Floating Point | 4 bytes | Velocity of Sound 1 |
| | 7075 | Floating Point | 4 bytes | Velocity of Sound 2 |
| | 7077 | Floating Point | 4 bytes | Velocity of Sound 3 |
| | 7079 | Floating Point | 4 bytes | Velocity of Sound 4 |
| | 7081 | Floating Point | 4 bytes | Velocity of Sound 5 |
| | 7083 | Floating Point | 4 bytes | Velocity of Sound 6 |
| | 7085 | Floating Point | 4 bytes | Reliability 1 |
| | 7087 | Floating Point | 4 bytes | Reliability 2 |
| | 7089 | Floating Point | 4 bytes | Reliability 3 |
| | 7091 | Floating Point | 4 bytes | Reliability 4 |
| | 7093 | Floating Point | 4 bytes | Reliability 5 |
| | 7095 | Floating Point | 4 bytes | Reliability 6 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| 2 | 8003 | Unsigned Integer | 8 bytes | + Volume |
| | 8007 | Unsigned Integer | 8 bytes | - Volume |
| | 8011 | Unsigned Integer | 8 bytes | + Volume Error |
| | 8015 | Unsigned Integer | 8 bytes | - Volume Error |
| | | | | |
| 3 | 5001 | Unsigned Integer | 4 bytes | General Alarm |
| | 5003 | Unsigned Integer | 4 bytes | Path 1 Alarm |
| | 5005 | Unsigned Integer | 4 bytes | Path 2 Alarm |
| | 5007 | Unsigned Integer | 4 bytes | Path 3 Alarm |
| | 5009 | Unsigned Integer | 4 bytes | Path 4 Alarm |
| | 5011 | Unsigned Integer | 4 bytes | Path 5 Alarm |
| | 5013 | Unsigned Integer | 4 bytes | Path 6 Alarm |

# Panametrics GM868 Ultrasonic Meter

The Panametrics GM 868 ultrasonic meter is read using 1 modbus packet. This packet contains the following data:-

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 5 - 6 | Floating Point | 4 bytes | Actual volume flow rate |
| | 7 - 8 | Unsigned Integer | 4 bytes | Forward volume total |
| | 9 - 10 | Unsigned Integer | 4 bytes | Reverse volume total |
| | 11 | Unsigned Integer | 2 bytes | Total volume digits |
| | 12 13 | Unsigned Integer | 4 bytes | Mass flow |
| | 14 15 | Unsigned Integer | 4 bytes | Forward mass total |
| | 16 17 | Unsigned Integer | 4 bytes | Reverse mass total |
| | 18 | Unsigned Integer | 2 bytes | Total mass digits |
| | 19 20 | Unsigned Integer | 4 bytes | Timer |
| | 21 | Unsigned Integer | 2 bytes | Status |
| | 22 23 | Unsigned Integer | 4 bytes | VoS |
| | 24 25 | Floating Point | 4 bytes | Density |
| | 26 27 | Floating Point | 4 bytes | Signal strength upstream |
| | 28 29 | Floating Point | 4 bytes | Signal strength downstream |
| | 30 31 | Floating Point | 4 bytes | Temperature |
| | 32 33 | Floating Point | 4 bytes | Pressure |

# Panametrics IGM878 Ultrasonic Meter

The Panametrics IGM 878 ultrasonic meter is read using 1 modbus packet. This packet contains the following data:-

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 1 - 2 | Floating Point | 4 bytes | Actual volumetric flow rate |
| | 3 - 4 | Floating Point | 4 bytes | Speed of sound |
| | 5 | Unsigned Integer | 2 bytes | Status |
| | 6 - 7 | Floating Point | 4 bytes | Area average velocity. |
| | 8 - 9 | Floating Point | 4 bytes | Normal volumetric flow. |
| | 10 - 13 | Double Precision | 8 bytes | Actual volume forward total |
| | 14 - 17 | Double Precision | 8 bytes | Actual volume reverse total |
| | 18 - 21 | Double Precision | 8 bytes | Normal volume forward total |
| | 22 - 25 | Double Precision | 8 bytes | Normal volume reverse total |
| | 26 - 27 | Floating Point | 4 bytes | Mass flow rate |
| | 28 - 29 | Floating Point | 4 bytes | Mass forward total |
| | 30 - 31 | Floating Point | 4 bytes | Mass reverse total |
| | 32 - 33 | Floating Point | 4 bytes | Energy flow rate |
| | 34 - 35 | Floating Point | 4 bytes | Energy forward total |
| | 36 - 37 | Floating Point | 4 bytes | Energy reverse total |
| | 38 - 39 | Floating Point | 4 bytes | Pressure |
| | 40 - 41 | Floating Point | 4 bytes | Temperature |
| | 42 | Unsigned Integer | 2 bytes | Super compressibility factor |
| | 43 | Unsigned Integer | 2 bytes | Density |
| | 44 | Unsigned Integer | 2 bytes | Kinematic viscosity |
| | 45 | Unsigned Integer | 2 bytes | Heating Value |
| | 46 | Unsigned Integer | 2 bytes | Path A. Velocity of gas |
| | 47 | Unsigned Integer | 2 bytes | Path A. Velocity of sound |
| | 48 | Unsigned Integer | 2 bytes | Path A. Readings in error |
| | 49 | Unsigned Integer | 2 bytes | Path A. Last error |
| | 50 | Unsigned Integer | 2 bytes | Path B. Velocity of gas |
| | 51 | Unsigned Integer | 2 bytes | Path B. Velocity of sound |
| | 52 | Unsigned Integer | 2 bytes | Path B. Readings in error |
| | 53 | Unsigned Integer | 2 bytes | Path B. Last error |
| | 54 | Unsigned Integer | 2 bytes | Path C. Velocity of gas |
| | 55 | Unsigned Integer | 2 bytes | Path C. Velocity of sound |
| | 56 | Unsigned Integer | 2 bytes | Path C. Readings in error |
| | 57 | Unsigned Integer | 2 bytes | Path C. Last error |
| | 58 | Unsigned Integer | 2 bytes | Path D. Velocity of gas |
| | 59 | Unsigned Integer | 2 bytes | Path D. Velocity of sound |
| | 60 | Unsigned Integer | 2 bytes | Path D. Readings in error |
| | 61 | Unsigned Integer | 2 bytes | Path D. Last error |
| | 62 | Unsigned Integer | 2 bytes | Path E. Velocity of gas |
| | 63 | Unsigned Integer | 2 bytes | Path E. Velocity of sound |
| | 64 | Unsigned Integer | 2 bytes | Path E. Readings in error |
| | 65 | Unsigned Integer | 2 bytes | Path E. Last error |
| | 66 | Unsigned Integer | 2 bytes | Path F. Velocity of gas |
| | 67 | Unsigned Integer | 2 bytes | Path F. Velocity of sound |
| | 68 | Unsigned Integer | 2 bytes | Path F. Readings in error |
| | 69 | Unsigned Integer | 2 bytes | Path F. Last error |
| | 70 | Unsigned Integer | 2 bytes | Internal update rate |
| | 71 | Unsigned Integer | 2 bytes | Speed of sound high limit |
| | 72 | Unsigned Integer | 2 bytes | Speed of sound low limit |
| | 73 | Unsigned Integer | 2 bytes | Velocity high limit |

| | | | | |
|---|---|---|---|---|
| | 74 | Unsigned Integer | 2 bytes | Velocity low limit |
| | 75 | Unsigned Integer | 2 bytes | Signal strength high limit |
| | 76 | Unsigned Integer | 2 bytes | Signal strength low limit |
| | 77 | Unsigned Integer | 2 bytes | Amplitude high limit |
| | 78 | Unsigned Integer | 2 bytes | Amplitude low limit |
| | 79 | Unsigned Integer | 2 bytes | Number in average |
| | 80 | Unsigned Integer | 2 bytes | Version |
| | 81 | Unsigned Integer | 2 bytes | Checksum |
| | 82 | Unsigned Integer | 2 bytes | Number of paths |
| | 83 | Unsigned Integer | 2 bytes | Modbus address |

# Caldon LEFM200 Ultrasonic Meter

The Caldon LEFM200 Meter is read across 19 packets

Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 0-1 | Floating Point | 4 bytes | Transit Time Downstream Path 1 |
| 2-3 | Floating Point | 4 bytes | Transit Time Downstream Path 2 |
| 4-5 | Floating Point | 4 bytes | Transit Time Downstream Path 3 |
| 6-7 | Floating Point | 4 bytes | Transit Time Downstream Path 4 |
| 8-9 | Floating Point | 4 bytes | Flight Time Difference Path 1 |
| 10-11 | Floating Point | 4 bytes | Flight Time Difference Path 2 |
| 12-13 | Floating Point | 4 bytes | Flight Time Difference Path 3 |
| 14-15 | Floating Point | 4 bytes | Flight Time Difference Path 4 |
| 16 | Signed Integer | 2 bytes | SNR Rejected Path 1 |
| 17 | Signed Integer | 2 bytes | SNR Rejected Path 2 |
| 18 | Signed Integer | 2 bytes | SNR Rejected Path 3 |
| 19 | Signed Integer | 2 bytes | SNR Rejected Path 4 |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 24 | Signed Integer | 2 bytes | SNR Average Path 1 |
| 25 | Signed Integer | 2 bytes | SNR Average Path 2 |
| 26 | Signed Integer | 2 bytes | SNR Average Path 3 |
| 27 | Signed Integer | 2 bytes | SNR Average Path 4 |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 38-39 | Floating Point | 4 bytes | Flow 200 Series |
| 40-41 | Floating Point | 4 bytes | VoS Path 1 |
| 42-43 | Floating Point | 4 bytes | VoS Path 2 |
| 44-45 | Floating Point | 4 bytes | VoS Path 3 |
| 46-47 | Floating Point | 4 bytes | VoS Path 4 |
| 48-49 | Floating Point | 4 bytes | Path Fluid Velocity 1 |
| 50-51 | Floating Point | 4 bytes | Path Fluid Velocity 2 |
| 52-53 | Floating Point | 4 bytes | Path Fluid Velocity 3 |
| 54-55 | Floating Point | 4 bytes | Path Fluid Velocity 4 |

Packet 4 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 72 | Signed Integer | 2 bytes | Board Status |

Packet 5 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 74 | Signed Integer | 2 bytes | Path Status 1 |
| 75 | Signed Integer | 2 bytes | Path Status 2 |

| | | | |
|---|---|---|---|
| 76 | Signed Integer | 2 bytes | Path Status 3 |
| 77 | Signed Integer | 2 bytes | Path Status 4 |
| 78-79 | Floating Point | 4 bytes | Body Temperature |
| 80-81 | Floating Point | 4 bytes | Pressure |
| 82-83 | Floating Point | 4 bytes | Analog Input 1 |
| 84-85 | Floating Point | 4 bytes | Analog Input 2 |
| 86-87 | Floating Point | 4 bytes | Analog Input 3 |
| 88-89 | Floating Point | 4 bytes | Analog Input 4 |
| 90-91 | Floating Point | 4 bytes | Density Calculated |
| 92 | Signed Integer | 2 bytes | Product ID |

Packet 6 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 94-95 | Floating Point | 4 bytes | VNorm 1 |
| 96-97 | Floating Point | 4 bytes | VNorm 2 |
| 98-99 | Floating Point | 4 bytes | VNorm 3 |
| 100-101 | Floating Point | 4 bytes | VNorm 4 |

Packet 7 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 136-137 | Floating Point | 4 bytes | Meter Factor |
| 138-139 | Floating Point | 4 bytes | Log Reynolds No. |
| 140-141 | Floating Point | 4 bytes | Totalizer No. 1 resettable |
| 142-143 | Floating Point | 4 bytes | Totalizer No. 2 not resettable |
| 144-145 | Floating Point | 4 bytes | Totalizer neg |
| 146-147 | Floating Point | 4 bytes | Totalizer pos |
| 148 | Signed Integer | 2 bytes | Setup File Checksum |
| 149 | Signed Integer | 2 bytes | Setup Times Modified |
| 150-151 | Floating Point | 4 bytes | Temperature Fluid |
| 152-153 | Floating Point | 4 bytes | Density Input |

Packet 8 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 200 | Signed Integer | 2 bytes | SNR Path 1 upstream |
| 201 | Signed Integer | 2 bytes | SNR Path 2 upstream |
| 202 | Signed Integer | 2 bytes | SNR Path 3 upstream |
| 203 | Signed Integer | 2 bytes | SNR Path 4 upstream |
| 204 | Signed Integer | 2 bytes | SNR Path 1 downstream |
| 205 | Signed Integer | 2 bytes | SNR Path 2 downstream |
| 206 | Signed Integer | 2 bytes | SNR Path 3 downstream |
| 207 | Signed Integer | 2 bytes | SNR Path 4 downstream |
| 208-209 | Floating Point | 4 bytes | Meter Average |
| 210 | Signed Integer | 2 bytes | Analog Input Status |

Packet 9 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 212-213 | Floating Point | 4 bytes | Path Gain 1 Direct |
| 214-215 | Floating Point | 4 bytes | Path Gain 2 Direct |
| 216-217 | Floating Point | 4 bytes | Path Gain 3 Direct |

| | | | |
|---|---|---|---|
| 218-219 | Floating Point | 4 bytes | Path Gain 4 Direct |
| 220-221 | Floating Point | 4 bytes | Path Gain 1 Echo |
| 222-223 | Floating Point | 4 bytes | Path Gain 2 Echo |
| 224-225 | Floating Point | 4 bytes | Path Gain 3 Echo |
| 226-227 | Floating Point | 4 bytes | Path Gain 4 Echo |

Packet 10 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 234-235 | Floating Point | 4 bytes | Path 1 Ohm upstream pos |
| 236-237 | Floating Point | 4 bytes | Path 1 Ohm upstream neg |
| 238-239 | Floating Point | 4 bytes | Path 1 Ohm downstream pos |
| 240-241 | Floating Point | 4 bytes | Path 1 Ohm downstream neg |
| 242-243 | Floating Point | 4 bytes | Path 2 Ohm upstream pos |
| 244-245 | Floating Point | 4 bytes | Path 2 Ohm upstream neg |
| 246-247 | Floating Point | 4 bytes | Path 2 Ohm downstream pos |
| 248-249 | Floating Point | 4 bytes | Path 2 Ohm downstream neg |
| 250-251 | Floating Point | 4 bytes | Path 3 Ohm upstream pos |
| 252-253 | Floating Point | 4 bytes | Path 3 Ohm upstream neg |
| 254-255 | Floating Point | 4 bytes | Path 3 Ohm downstream pos |
| 256-257 | Floating Point | 4 bytes | Path 3 Ohm downstream neg |
| 258-259 | Floating Point | 4 bytes | Path 4 Ohm upstream pos |
| 260-261 | Floating Point | 4 bytes | Path 4 Ohm upstream neg |
| 262-263 | Floating Point | 4 bytes | Path 4 Ohm downstream pos |
| 264-265 | Floating Point | 4 bytes | Path 4 Ohm downstream neg |
| 266-267 | Floating Point | 4 bytes | Viscosity |
| 268 | Signed Integer | 2 bytes | Echo paths working and used for viscosity |

Packet 11 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 270-271 | Floating Point | 4 bytes | Non-fluid attenuation |
| 272-273 | Floating Point | 4 bytes | Fluid acoustic attenuation |

Packet 12 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 500-501 | Floating Point | 4 bytes | Transit time downstream path 5 |
| 502-503 | Floating Point | 4 bytes | Transit time downstream path 6 |
| 504-505 | Floating Point | 4 bytes | Transit time downstream path 7 |
| 506-507 | Floating Point | 4 bytes | Transit time downstream path 8 |
| 508-509 | Floating Point | 4 bytes | Flight time difference path 5 |
| 510-511 | Floating Point | 4 bytes | Flight time difference path 6 |
| 512-513 | Floating Point | 4 bytes | Flight time difference path 7 |
| 514-515 | Floating Point | 4 bytes | Flight time difference path 8 |
| 516 | Signed Integer | 2 bytes | SNR rejected path 5 |
| 517 | Signed Integer | 2 bytes | SNR rejected path 6 |
| 518 | Signed Integer | 2 bytes | SNR rejected path 7 |
| 519 | Signed Integer | 2 bytes | SNR rejected path 8 |

Packet 13 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 524 | Signed Integer | 2 bytes | SNR average path 5 |
| 525 | Signed Integer | 2 bytes | SNR average path 6 |
| 526 | Signed Integer | 2 bytes | SNR average path 7 |
| 527 | Signed Integer | 2 bytes | SNR average path 8 |

Packet 14 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 540-541 | Floating Point | 4 bytes | Velocity of Sound path 5 |
| 542-543 | Floating Point | 4 bytes | Velocity of Sound path 6 |
| 544-545 | Floating Point | 4 bytes | Velocity of Sound path 7 |
| 546-547 | Floating Point | 4 bytes | Velocity of Sound path 8 |
| 548-549 | Floating Point | 4 bytes | Path fluid velocity 5 |
| 550-551 | Floating Point | 4 bytes | Path fluid velocity 6 |
| 552-553 | Floating Point | 4 bytes | Path fluid velocity 7 |
| 554-555 | Floating Point | 4 bytes | Path fluid velocity 8 |

Packet 15 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 574 | Signed Integer | 2 bytes | Path status 5 |
| 575 | Signed Integer | 2 bytes | Path status 6 |
| 576 | Signed Integer | 2 bytes | Path status 7 |
| 578 | Signed Integer | 2 bytes | Path status 8 |

Packet 16 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 594-595 | Floating Point | 4 bytes | VNorm 5 |
| 596-597 | Floating Point | 4 bytes | VNorm 6 |
| 598-599 | Floating Point | 4 bytes | VNorm 7 |
| 600-601 | Floating Point | 4 bytes | VNorm 8 |

Packet 17 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 700 | Signed Integer | 2 bytes | SNR path 5 upstream |
| 701 | Signed Integer | 2 bytes | SNR path 6 upstream |
| 702 | Signed Integer | 2 bytes | SNR path 7 upstream |
| 703 | Signed Integer | 2 bytes | SNR path 8 upstream |
| 704 | Signed Integer | 2 bytes | SNR path 5 downstream |
| 705 | Signed Integer | 2 bytes | SNR path 6 downstream |
| 706 | Signed Integer | 2 bytes | SNR path 7 downstream |
| 707 | Signed Integer | 2 bytes | SNR path 8 downstream |

Packet 18 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 712-713 | Floating Point | 4 bytes | Path gain 5 direction |
| 714-715 | Floating Point | 4 bytes | Path gain 6 direction |
| 716-717 | Floating Point | 4 bytes | Path gain 7 direction |

| | | | |
|---|---|---|---|
| 718-719 | Floating Point | 4 bytes | Path gain 8 direction |
| 720-721 | Floating Point | 4 bytes | Path gain 5 echo |
| 722-723 | Floating Point | 4 bytes | Path gain 6 echo |
| 724-725 | Floating Point | 4 bytes | Path gain 7 echo |
| 726-727 | Floating Point | 4 bytes | Path gain 8 echo |

Packet 19 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 734-735 | Floating Point | 4 bytes | Path 5 Ohm upstream pos |
| 736-737 | Floating Point | 4 bytes | Path 5 Ohm upstream neg |
| 738-739 | Floating Point | 4 bytes | Path 5 Ohm downstream pos |
| 740-741 | Floating Point | 4 bytes | Path 5 Ohm downstream neg |
| 742-743 | Floating Point | 4 bytes | Path 6 Ohm upstream pos |
| 744-745 | Floating Point | 4 bytes | Path 6 Ohm upstream neg |
| 746-747 | Floating Point | 4 bytes | Path 6 Ohm downstream pos |
| 748-749 | Floating Point | 4 bytes | Path 6 Ohm downstream neg |
| 750-751 | Floating Point | 4 bytes | Path 7 Ohm upstream pos |
| 752-753 | Floating Point | 4 bytes | Path 7 Ohm upstream neg |
| 754-755 | Floating Point | 4 bytes | Path 7 Ohm downstream pos |
| 756-757 | Floating Point | 4 bytes | Path 7 Ohm downstream neg |
| 758-759 | Floating Point | 4 bytes | Path 8 Ohm upstream pos |
| 760-761 | Floating Point | 4 bytes | Path 8 Ohm upstream neg |
| 762-763 | Floating Point | 4 bytes | Path 8 Ohm downstream pos |
| 764-765 | Floating Point | 4 bytes | Path 8 Ohm downstream neg |

# Elster Series 6 Ultrasonic Meter

The Elster Series 6 compatible ultrasonic meters are read using 3 modbus packets.
Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1000 | Unsigned Integer | 2 bytes | Flowmeter identification code |
| 1001 | Unsigned Integer | 2 bytes | Number of acoustic paths |
| 1002 | Unsigned Integer | 2 bytes | Measurement interval sequence number: Low order bytes. |
| 1003 | Unsigned Integer | 2 bytes | Measurement interval sequence number: High order bytes. |
| 1004 | Unsigned Integer | 2 bytes | Number of acquired samples |
| 1005 - 1012 | Unsigned Integer | 2 bytes | Number of valid samples. Paths 1 - 8 |
| 1013 - 1028 | Unsigned Integer | 2 bytes | Gain required on the received pulses for proper measurement. Transducers 1A – 8B |
| 1029 - 1044 | Unsigned Integer | 2 bytes | Signal Noise Ratio of transducers. 1A – 8B |
| 1045 | Unsigned Integer | 2 bytes | Operational status of the flowmeter |
| 1046 | Unsigned Integer | 2 bytes | Operational status of the optional inputs |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1200 - 1207 | Unsigned Integer | 4 bytes | Diagnostic information. Paths 1 – 8. |
| 1208 | Unsigned Integer | 4 bytes | Accumulated actual volume forward. |
| 1209 | Unsigned Integer | 4 bytes | Accumulated actual volume reverse. |
| 1210 | Unsigned Integer | 4 bytes | Accumulated actual error volume forward. |
| 1211 | Unsigned Integer | 4 bytes | Accumulated actual error volume reverse. |
| 1212 | Unsigned Integer | 4 bytes | Program Checksum |
| 1213 | Unsigned Integer | 4 bytes | Parameter Checksum |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1400 | Floating Point | 4 bytes | Speed of Sound. N-Path average. |
| 1401 | Floating Point | 4 bytes | Velocity of Gas. N-Path avergae. |
| 1402 | Floating Point | 4 bytes | Absolute Pressure. |
| 1403 | Floating Point | 4 bytes | Absolute Temperature. |
| 1404 | Floating Point | 4 bytes | Volume flow at line conditions. |
| 1405 | Floating Point | 4 bytes | Volume flow at base conditions. |
| 1406 – 1413 | Floating Point | 4 bytes | Speed of Sound per acoustic path. Paths 1 – 8. |
| 1414 - 1421 | Floating Point | 4 bytes | Velocity of Gas per acoustic path. Paths 1 – 8. |
| 1422 | Floating Point | 4 bytes | Reserved. |
| 1423 | Floating Point | 4 bytes | Swirl angle estimation from the swirl paths. |
| 1424 | Floating Point | 4 bytes | Meter Factor. |

# Krohne Altosonic 5 Ultrasonic Meter

The Krohne Altosonic 5 meter is read and written using 10 modbus packets.
Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1065 | Integer | 2 bytes | Flow direction |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 4051 | Integer | 4 bytes | Alarms pipe |
| 4052 | Integer | 4 bytes | Alarms inputs |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 4056 | Integer | 4 bytes | Path unreliable |
| 4057 | Integer | 4 bytes | Path down |
| 4058 | Integer | 4 bytes | Path speed of sound |
| 4059 | Integer | 4 bytes | Path signal lost |

Packet 4 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 7002 | Floating Point | 4 bytes | Gross volume flow rate |
| 7003 | Floating Point | 4 bytes | Measured velocity at line conditions |
| 7004 | Floating Point | 4 bytes | Measured speed of sound |
| 7005 | Floating Point | 4 bytes | Gain average over CT pipe paths |
| 7006 | Floating Point | 4 bytes | Signal to noise over pipe CT paths |
| 7007 | Floating Point | 4 bytes | Reynolds number determined by profile |
| 7008 | Floating Point | 4 bytes | Reynolds number determined by viscosity |
| 7009 | Floating Point | 4 bytes | Viscosity determined by profile |
| 7010 | Floating Point | 4 bytes | Viscosity input |
| 7011 | Floating Point | 4 bytes | Swirl percentage |
| 7012 | Floating Point | 4 bytes | Symmetry percentage |
| 7013 | Floating Point | 4 bytes | Number of CT paths failing |
| 7014 | Floating Point | 4 bytes | Overall meter reliability |

Packet 5 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 7021 | Floating Point | 4 bytes | Meter body thermal expansion correction |
| 7022 | Floating Point | 4 bytes | Meter body compressibility expansion correction |
| 7023 | Floating Point | 4 bytes | Reynolds correction factor |
| 7024 | Floating Point | 4 bytes | Temperature body input |
| 7025 | Floating Point | 4 bytes | Temperature line input |
| 7026 | Floating Point | 4 bytes | Temperature sampler input |
| 7027 | Floating Point | 4 bytes | Pressure line input |
| 7028 | Floating Point | 4 bytes | Viscosity kinematic input |
| 7029 | Floating Point | 4 bytes | Viscosity dynamic input |
| 7030 | Floating Point | 4 bytes | Density input |

Packet 6 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 7046 - 7053 | Floating Point | 4 bytes | Path velocity. Paths 1 to 8. |

| | | | |
|---|---|---|---|
| 7054 - 7061 | Floating Point | 4 bytes | Path speed of sound. Paths 1 to 8. |
| 7062 - 7069 | Floating Point | 4 bytes | Path gain. Paths 1 to 8. |
| 7070 - 7077 | Floating Point | 4 bytes | Path SNR. Paths 1 to 8. |
| 7078 - 7089 | Floating Point | 4 bytes | Path reliability Paths 1 to 8. |

Packet 7 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 9008 | Double Precision | 8 bytes | Totalised during reliable status. Forward. |
| 9009 | Double Precision | 8 bytes | Totalised during reliable status. Reverse. |
| 9010 | Double Precision | 8 bytes | Totalised during unreliable status. Forward. |
| 9011 | Double Precision | 8 bytes | Totalised during unreliable status. Reverse. |
| 9012 | Double Precision | 8 bytes | Totalised always. Forward. |
| 9013 | Double Precision | 8 bytes | Totalised always. Reverse. |

Packet 8 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 14001 | ASCII String | 16 bytes | Custody transfer parameters. CRC. |
| 14002 | ASCII String | 16 bytes | Custody transfer application parameters. CRC. |
| 14003 | ASCII String | 16 bytes | Custody transfer software engine. CRC. |
| 14004 | ASCII String | 32 bytes | Flow meter type |
| 14005 | ASCII String | 32 bytes | Serial number |
| 14006 | ASCII String | 64 bytes | Project name/number |
| 14007 | ASCII String | 32 bytes | Tag number |

Packet 8a contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 14008 | ASCII String | 62 bytes | Meter size |
| 14009 | ASCII String | 40 bytes | End user name |
| 14010 | ASCII String | 40 bytes | Location |
| 14011 | ASCII String | 40 bytes | Station |

Packet 10 writes the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 8011 | Floating Point | 4 bytes | Input temperature body. |
| 8012 | Floating Point | 4 bytes | Input temperature line. |
| 8013 | Floating Point | 4 bytes | Input temperature sampler. |
| 8014 | Floating Point | 4 bytes | Input pressure line. |
| 8015 | Floating Point | 4 bytes | Input viscosity kinematic. |
| 8016 | Floating Point | 4 bytes | Input viscosity dynamic. |
| 8017 | Floating Point | 4 bytes | Input density. |

# Transus UIM Ultrasonic Meter

The Transus UIM ultrasonic meter is read using 6 modbus packets.

Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1001 | Floating Point | 4 bytes | Actual volume flowrate |
| 1003 | Floating Point | 4 bytes | Base volume flowrate |
| 1005 | Floating Point | 4 bytes | Velocity of gas |
| 1007 | Floating Point | 4 bytes | Velocity of sound |
| 1009 | Floating Point | 4 bytes | Reynolds factor |
| 1011 | Floating Point | 4 bytes | Not used |
| 1013 | Floating Point | 4 bytes | Mach factor |
| 1015 | Floating Point | 4 bytes | VoG Path 1 |
| 1017 | Floating Point | 4 bytes | VoG Path 2 |
| 1019 | Floating Point | 4 bytes | VoG Path 3 |
| 1021 | Floating Point | 4 bytes | VoG Path 4 |
| 1023 | Floating Point | 4 bytes | VoS Path 1 |
| 1025 | Floating Point | 4 bytes | VoS Path 2 |
| 1027 | Floating Point | 4 bytes | VoS Path 3 |
| 1029 | Floating Point | 4 bytes | VoS Path 4 |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 1087 | Floating Point | 4 bytes | Standard deviation Delta T path 1 |
| 1089 | Floating Point | 4 bytes | Standard deviation Delta T path 2 |
| 1091 | Floating Point | 4 bytes | Standard deviation Delta T path 3 |
| 1093 | Floating Point | 4 bytes | Standard deviation Delta T path 4 |
| 1095 | Floating Point | 4 bytes | Signal to noise ratio AB path 1 |
| 1097 | Floating Point | 4 bytes | Signal to noise ratio AB path 2 |
| 1099 | Floating Point | 4 bytes | Signal to noise ratio AB path 3 |
| 1101 | Floating Point | 4 bytes | Signal to noise ratio AB path 4 |
| 1103 | Floating Point | 4 bytes | Signal to noise ratio BA path 1 |
| 1105 | Floating Point | 4 bytes | Signal to noise ratio BA path 2 |
| 1107 | Floating Point | 4 bytes | Signal to noise ratio BA path 3 |
| 1109 | Floating Point | 4 bytes | Signal to noise ratio BA path 4 |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 2006 | Unsigned Integer | 2 bytes | Performance path 1 |
| 2007 | Unsigned Integer | 2 bytes | Performance path 2 |
| 2008 | Unsigned Integer | 2 bytes | Performance path 3 |
| 2009 | Unsigned Integer | 2 bytes | Performance path 4 |
| 2010 | Unsigned Integer | 2 bytes | AGC Level AB path 1 |
| 2011 | Unsigned Integer | 2 bytes | AGC Level AB path 2 |
| 2012 | Unsigned Integer | 2 bytes | AGC Level AB path 3 |
| 2013 | Unsigned Integer | 2 bytes | AGC Level AB path 4 |
| 2014 | Unsigned Integer | 2 bytes | AGC Level BA path 1 |
| 2015 | Unsigned Integer | 2 bytes | AGC Level BA path 2 |
| 2016 | Unsigned Integer | 2 bytes | AGC Level BA path 3 |
| 2017 | Unsigned Integer | 2 bytes | AGC Level BA path 4 |

Packet 4 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 4001 | Unsigned Integer | 4 bytes | Measurement status |
| 4003 | Unsigned Integer | 4 bytes | Reynolds number 1 |
| 4005 | Unsigned Integer | 4 bytes | Reynolds number 2 |
| 4007 | Unsigned Integer | 4 bytes | Forward volume integer portion |
| 4009 | Unsigned Integer | 4 bytes | Forward volume fractional portion |
| 4011 | Unsigned Integer | 4 bytes | Reverse volume integer portion |
| 4013 | Unsigned Integer | 4 bytes | Reverse volume fractional portion |
| 4015 | Unsigned Integer | 4 bytes | Forward alarm volume integer portion |
| 4017 | Unsigned Integer | 4 bytes | Forward alarm volume fractional portion |
| 4019 | Unsigned Integer | 4 bytes | Reverse alarm volume integer portion |
| 4021 | Unsigned Integer | 4 bytes | Reverse alarm volume fractional portion |
| 4023 | Unsigned Integer | 4 bytes | Diagnostic status AB path 1 |
| 4025 | Unsigned Integer | 4 bytes | Diagnostic status AB path 2 |
| 4027 | Unsigned Integer | 4 bytes | Diagnostic status AB path 3 |
| 4029 | Unsigned Integer | 4 bytes | Diagnostic status AB path 4 |
| 4031 | Unsigned Integer | 4 bytes | Diagnostic status BA path 1 |
| 4033 | Unsigned Integer | 4 bytes | Diagnostic status BA path 2 |
| 4035 | Unsigned Integer | 4 bytes | Diagnostic status BA path 3 |
| 4037 | Unsigned Integer | 4 bytes | Diagnostic status BA path 4 |
| | | | |

Packet 5 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 4101 | Unsigned Integer | 4 bytes | Firmware version |
| 4103 | Unsigned Integer | 4 bytes | Parameter version |
| 4105 | Unsigned Integer | 4 bytes | FPGA Firmware version Msw |
| 4107 | Unsigned Integer | 4 bytes | FPGA Firmware version Lsw |
| 4109 | Unsigned Integer | 4 bytes | Firmware CRC |
| 4111 | Unsigned Integer | 4 bytes | Parameter CRC |

Packet 6 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 11091 | Floating Point | 4 bytes | Meter factor forward |
| 11093 | Floating Point | 4 bytes | Meter factor reverse |

# Endress & Hauser Proline Promass 84 Coriolis Meter

The Endress & Hauser Proline Promass 84 meter is read using 9 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 2006 | Floating Point | 4 bytes | Mass Flow |
| | 2008 | Floating Point | 4 bytes | Volume Flow |
| | 2010 | Floating Point | 4 bytes | Corrected Volume Flow |
| | 2012 | Floating Point | 4 bytes | Density |
| | 2014 | Floating Point | 4 bytes | Reference Density |
| | 2016 | Floating Point | 4 bytes | Temperature |
| | | | | |
| 2 | 2100 | Unsigned Integer | 2 bytes | Mass Flow Units |
| | 2101 | Unsigned Integer | 2 bytes | Mass Units |
| | 2102 | Unsigned Integer | 2 bytes | Volume Flow Units |
| | 2103 | Unsigned Integer | 2 bytes | Volume Units |
| | 2104 | Unsigned Integer | 2 bytes | Corrected Volume Flow Units |
| | 2105 | Unsigned Integer | 2 bytes | Corrected Volume Units |
| | 2106 | Unsigned Integer | 2 bytes | Density Units |
| | 2107 | Unsigned Integer | 2 bytes | Reference Density Units |
| | 2108 | Unsigned Integer | 2 bytes | Temperature Units |
| | | | | |
| 3 | 2600 | Unsigned Integer | 2 bytes | Totaliser 1 Assignment |
| | 2601 | Unsigned Integer | 2 bytes | Totaliser 1 Mass Flow Units |
| | 2602 | Unsigned Integer | 2 bytes | Totaliser 1 Volume Flow Units |
| | 2603 | Unsigned Integer | 2 bytes | Totaliser 1 Corrected Volume Flow Units |
| | 2604 | Unsigned Integer | 2 bytes | Totaliser 1 Totaliser Mode |
| | | | | |
| 4 | 2800 | Unsigned Integer | 2 bytes | Totaliser 2 Assignment |
| | 2801 | Unsigned Integer | 2 bytes | Totaliser 2 Mass Flow Units |
| | 2802 | Unsigned Integer | 2 bytes | Totaliser 2 Volume Flow Units |
| | 2803 | Unsigned Integer | 2 bytes | Totaliser 2 Corrected Volume Flow Units |
| | 2804 | Unsigned Integer | 2 bytes | Totaliser 2 Totaliser Mode |
| | | | | |
| 5 | 3000 | Unsigned Integer | 2 bytes | Totaliser 3 Assignment |
| | 3001 | Unsigned Integer | 2 bytes | Totaliser 3 Mass Flow Units |
| | 3002 | Unsigned Integer | 2 bytes | Totaliser 3 Volume Flow Units |
| | 3003 | Unsigned Integer | 2 bytes | Totaliser 3 Corrected Volume Flow Units |
| | 3004 | Unsigned Integer | 2 bytes | Totaliser 3 Totaliser Mode |
| | | | | |
| 6 | 2609 | Floating Point | 4 bytes | Totaliser 1 Value |
| | 2611 | Floating Point | 4 bytes | Totaliser 1 Overflow |
| | | | | |
| 7 | 2809 | Floating Point | 4 bytes | Totaliser 2 Value |
| | 2811 | Floating Point | 4 bytes | Totaliser 2 Overflow |
| | | | | |
| 8 | 3009 | Floating Point | 4 bytes | Totaliser 3 Value |
| | 3011 | Floating Point | 4 bytes | Totaliser 3 Overflow |
| | | | | |
| 9 | 6858 | Unsigned Integer | 2bytes | Actual System Condition |

# Krohne MFC010 Coriolis Meter

The Krohne MFC010 series of meter are read using 7 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 1000 | Unsigned Integer | 2 bytes | Sensor Level A |
| | 1002 | Unsigned Integer | 2 bytes | Sensor Level B |
| | 1004 | Unsigned Integer | 2 bytes | Drive Level |
| | 1006 | Unsigned Integer | 2 bytes | System State |
| | 1008 | Unsigned Integer | 2 bytes | DCF1 |
| | | | | |
| 2 | 3000 | Unsigned Integer | 4 bytes | Mass Flow |
| | 3002 | Unsigned Integer | 4 bytes | Density |
| | 3004 | Unsigned Integer | 4 bytes | Temperature |
| | 3006 | Unsigned Integer | 4 bytes | Volume Flow |
| | 3008 | Unsigned Integer | 4 bytes | Concentration 1 Flow |
| | 3010 | Unsigned Integer | 4 bytes | Concentration 2 Flow |
| | 3012 | Unsigned Integer | 4 bytes | Concentration 1 |
| | 3014 | Unsigned Integer | 4 bytes | Concentration 2 |
| | 3016 | Unsigned Integer | 4 bytes | Velocity |
| | 3018 | Unsigned Integer | 4 bytes | Spare |
| | 3020 | Unsigned Integer | 4 bytes | Spare |
| | 3022 | Unsigned Integer | 4 bytes | Spare |
| | 3024 | Unsigned Integer | 4 bytes | Spare |
| | 3026 | Unsigned Integer | 4 bytes | Spare |
| | 3028 | Unsigned Integer | 4 bytes | Tube Frequency |
| | 3030 | Unsigned Integer | 4 bytes | Tube Strain |
| | 3032 | Unsigned Integer | 4 bytes | Cylinder Strain |
| | 3034 | Unsigned Integer | 4 bytes | DCF2 |
| | 3036 | Unsigned Integer | 4 bytes | DCF3 |
| | 3038 | Unsigned Integer | 4 bytes | DCF4 |
| | 3040 | Unsigned Integer | 4 bytes | DCF6 |
| | 3042 | Unsigned Integer | 4 bytes | DCF7 |
| | 3044 | Unsigned Integer | 4 bytes | DCF8 |
| | 3046 | Unsigned Integer | 4 bytes | Zero Calibration |
| | 3048 | Unsigned Integer | 4 bytes | Max Temperature |
| | 3050 | Unsigned Integer | 4 bytes | Min Temperature |
| | 3052 | Unsigned Integer | 4 bytes | Phase 2 Signal |
| | | | | |
| 3 | 5000 | Double Precision | 8 bytes | Mass Total |
| | 5002 | Double Precision | 8 bytes | Volume Total |
| | 5004 | Double Precision | 8 bytes | Concentration 1 Total |
| | 5006 | Double Precision | 8 bytes | Concentration 2 Total |
| | 5008 | Double Precision | 8 bytes | Additional Total |
| | | | | |
| 4 | 7000 | Unsigned Integer | 4 bytes | System Error |
| | 7002 | Unsigned Integer | 4 bytes | Process Warning |
| | 7004 | Unsigned Integer | 4 bytes | Stored System Error |
| | 7006 | Unsigned Integer | 4 bytes | Stored Process Warning |
| | | | | |
| 5 | 1000 | Unsigned Integer | 2 bytes | Supervisor Password |
| | 1002 | Unsigned Integer | 2 bytes | Service Password |
| | 1004 | Unsigned Integer | 2 bytes | Custody Password |

| | | | | |
|---|---|---|---|---|
| | 1006 | Unsigned Integer | 2 bytes | Modbus Format |
| | 1008 | Unsigned Integer | 2 bytes | Modbus Baud rate |
| | 1010 | Unsigned Integer | 2 bytes | Modbus Address |
| | 1012 | Unsigned Integer | 2 bytes | Flow Direction |
| | 1014 | Unsigned Integer | 2 bytes | Flow Mode |
| | 1016 | Unsigned Integer | 2 bytes | Process Control Function |
| | 1018 | Unsigned Integer | 2 bytes | Process Control Condition |
| | 1020 | Unsigned Integer | 2 bytes | Concentration Function |
| | 1022 | Unsigned Integer | 2 bytes | Sensor Type |
| | 1024 | Unsigned Integer | 2 bytes | Sensor Size |
| | 1026 | Unsigned Integer | 2 bytes | Sensor Material |
| | 1028 | Unsigned Integer | 2 bytes | Tube Amplitude |
| | 1030 | Unsigned Integer | 2 bytes | Concentration Type |
| | 1032 | Unsigned Integer | 2 bytes | Concentration Product |
| | 1034 | Unsigned Integer | 2 bytes | Concentration 5 Coefficient |
| | 1036 | Unsigned Integer | 2 bytes | Density Mode |
| | 1038 | Unsigned Integer | 2 bytes | Mass Flow Units |
| | 1040 | Unsigned Integer | 2 bytes | Density Units |
| | 1042 | Unsigned Integer | 2 bytes | Mass Total Units |
| | 1044 | Unsigned Integer | 2 bytes | Volume Total Units |
| | 1046 | Unsigned Integer | 2 bytes | Volume Flow Units |
| | 1048 | Unsigned Integer | 2 bytes | Temperature Units |
| | 1050 | Unsigned Integer | 2 bytes | Velocity Units |
| | 1052 | Unsigned Integer | 2 bytes | Add Total Source |
| | 1054 | Unsigned Integer | 2 bytes | Density Cal Product |
| | 1056 | Unsigned Integer | 2 bytes | Concentration Function |
| | 1058 | Unsigned Integer | 2 bytes | Concentration Product |
| | 1060 | Unsigned Integer | 2 bytes | CF25 |
| | 1062 | Unsigned Integer | 2 bytes | Year Manufacture |
| | | | | |
| 6 | 3000 | Floating Point | 4 bytes | CF1 |
| | 3002 | Floating Point | 4 bytes | CF2 |
| | 3004 | Floating Point | 4 bytes | CF3 |
| | 3006 | Floating Point | 4 bytes | CF4 |
| | 3008 | Floating Point | 4 bytes | CF5 |
| | 3010 | Floating Point | 4 bytes | CF6 |
| | 3012 | Floating Point | 4 bytes | CF7 |
| | 3014 | Floating Point | 4 bytes | CF8 |
| | 3016 | Floating Point | 4 bytes | CF9 |
| | 3018 | Floating Point | 4 bytes | CF10 |
| | 3020 | Floating Point | 4 bytes | CF11 |
| | 3022 | Floating Point | 4 bytes | CF12 |
| | 3024 | Floating Point | 4 bytes | CF13 |
| | 3026 | Floating Point | 4 bytes | CF14 |
| | 3028 | Floating Point | 4 bytes | CF15 |
| | 3030 | Floating Point | 4 bytes | CF16 |
| | 3032 | Floating Point | 4 bytes | CF17 |
| | 3034 | Floating Point | 4 bytes | CF18 |
| | 3036 | Floating Point | 4 bytes | CF19 |
| | 3038 | Floating Point | 4 bytes | CF20 |
| | 3040 | Floating Point | 4 bytes | Meter Correction |
| | 3042 | Floating Point | 4 bytes | Pipe Diameter |
| | 3044 | Floating Point | 4 bytes | Measurement Time |
| | 3046 | Floating Point | 4 bytes | Low Flow Threshold |
| | 3048 | Floating Point | 4 bytes | User Flow Offset |

| | | | | |
|---|---|---|---|---|
| | 3050 | Floating Point | 4 bytes | Process Control Max |
| | 3052 | Floating Point | 4 bytes | Process Control Min |
| | 3054 | Floating Point | 4 bytes | Density Ref Temperature |
| | 3056 | Floating Point | 4 bytes | Fixed Density |
| | 3058 | Floating Point | 4 bytes | Density Slope |
| | 3060 | Floating Point | 4 bytes | Concentration 2 Coefficient |
| | 3062 | Floating Point | 4 bytes | Concentration 3 Coefficient |
| | 3064 | Floating Point | 4 bytes | Concentration 4 Coefficient |
| | 3066 | Floating Point | 4 bytes | Concentration 6 Coefficient |
| | 3068 | Floating Point | 4 bytes | Concentration 7 Coefficient |
| | 3070 | Floating Point | 4 bytes | Concentration 8 Coefficient |
| | 3072 | Floating Point | 4 bytes | Concentration 9 Coefficient |
| | 3074 | Floating Point | 4 bytes | Concentration 10 Coefficient |
| | 3076 | Floating Point | 4 bytes | Concentration 11 Coefficient |
| | 3078 | Floating Point | 4 bytes | Concentration 12 Coefficient |
| | 3080 | Floating Point | 4 bytes | Concentration 10 Offset |
| | 3082 | Floating Point | 4 bytes | Mass Total Scale |
| | 3084 | Floating Point | 4 bytes | Volume Total Scale |
| | 3086 | Floating Point | 4 bytes | Mass Flow Scale |
| | 3088 | Floating Point | 4 bytes | Volume Flow Scale |
| | 3090 | Floating Point | 4 bytes | Density Scale |
| | 3092 | Floating Point | 4 bytes | Calibration Density |
| | 3094 | Floating Point | 4 bytes | Temperature Zero Cal |
| | 3096 | Floating Point | 4 bytes | Max Temperature Spec |
| | 3098 | Floating Point | 4 bytes | Min Temperature Spec |
| | 3100 | Floating Point | 4 bytes | Pressure Suppress Duration |
| | 3102 | Floating Point | 4 bytes | Pressure Suppress Cut Off |
| | 3104 | Floating Point | 4 bytes | Density Averaging |
| | 3106 | Floating Point | 4 bytes | Concentration Offset 2 |
| | 3108 | Floating Point | 4 bytes | CF21 |
| | 3110 | Floating Point | 4 bytes | CF22 |
| | 3112 | Floating Point | 4 bytes | CF23 |
| | 3114 | Floating Point | 4 bytes | CF24 |
| | 3116 | Floating Point | 4 bytes | CF26 |
| | 3118 | Floating Point | 4 bytes | CF27 |
| | 3120 | Floating Point | 4 bytes | Phase 2 Warning |
| | | | | |
| 7 | 7000 | Floating Point | 4 bytes | MFC010 Serial Number |
| | 7002 | Floating Point | 4 bytes | System Serial Number |
| | 7004 | Floating Point | 4 bytes | Meter Serial Number |
| | 7006 | Floating Point | 4 bytes | Enable Concentration |

# Krohne MFC300 Coriolis Meter

The Krohne MFC300 series of meter are read using 4 Modbus packets.
Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 30000 | Floating Point | 4 bytes | Flow Velocity |
| 30002 | Floating Point | 4 bytes | Volume Flow |
| 30004 | Floating Point | 4 bytes | Mass Flow |
| 30006 | Floating Point | 4 bytes | Temperature |
| 30008 | Floating Point | 4 bytes | Density |
| 30010 | Floating Point | 4 bytes | Concentration 1 |
| 30012 | Floating Point | 4 bytes | Concentration 2 |
| 30014 | Floating Point | 4 bytes | Concentration Flow 1 |
| 30016 | Floating Point | 4 bytes | Concentration Flow 2 |
| 30018 | Floating Point | 4 bytes | Diagnosis 1 |
| 30020 | Floating Point | 4 bytes | Diagnosis 2 |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 30050 | Double Precision | 8 bytes | Counter 1 value |
| 30054 | Double Precision | 8 bytes | Counter 2 value |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 30062 | Unsigned Integer | 4 bytes | Long Status Sensor |
| 30064 | Unsigned Integer | 4 bytes | Long Status Device |

Packet 4 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 40000 | Unsigned Integer | 2 bytes | Counter 1 Function |
| 40001 | Unsigned Integer | 2 bytes | Counter 1 Measurement |
| 40002 | Unsigned Integer | 2 bytes | Counter 2 Function |
| 40003 | Unsigned Integer | 2 bytes | Counter 2 Measurement |

# Krohne MFC400 Coriolis Meter

The Krohne MFC400 series of meter are read using 6 Modbus packets.
Packet 1 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 30000 | Floating Point | 4 bytes | Flow Velocity |
| 30002 | Floating Point | 4 bytes | Volume Flow |
| 30004 | Floating Point | 4 bytes | Mass Flow |
| 30006 | Floating Point | 4 bytes | Temperature |
| 30008 | Floating Point | 4 bytes | Density |

Packet 2 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 31000 | Floating Point | 4 bytes | Drive Level |
| 31002 | Floating Point | 4 bytes | Sensor A Level |
| 31004 | Floating Point | 4 bytes | Sensor B Level |
| 31006 | Floating Point | 4 bytes | Strain 1 |
| 31008 | Floating Point | 4 bytes | Strain 2 |
| 31010 | Floating Point | 4 bytes | Tube Frequency |
| 31012 | Floating Point | 4 bytes | 2 Phase Signal |

Packet 3 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 32000 | Double Precision | 8 bytes | Totaliser 1 value |
| 32000 | Double Precision | 8 bytes | Totaliser 2 value |

Packet 4 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 39100 | Unsigned Integer | 1 byte | NE 107 Device Status |

Packet 5 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 30500 | Unsigned Integer | 1 byte | NE 107 Status of Flow Velocity |
| 30501 | Unsigned Integer | 1 byte | NE 107 Status of Volume Flow |
| 30502 | Unsigned Integer | 1 byte | NE 107 Status of Mass Flow |
| 30503 | Unsigned Integer | 1 byte | NE 107 Status of Temperature |
| 30504 | Unsigned Integer | 1 byte | NE 107 Status of Density |
| 30505 | Unsigned Integer | 1 byte | NE 107 Status of Conc. 1 value |
| 30506 | Unsigned Integer | 1 byte | NE 107 Status of Conc. 2 value |
| 30507 | Unsigned Integer | 1 byte | NE 107 Status of Conc. 1 flow |
| 30508 | Unsigned Integer | 1 byte | NE 107 Status of Conc. 2 flow |

Packet 6 contains the following data:-

| Address | Type | Size | Name |
|---|---|---|---|
| 40000 | Unsigned Integer | 2 bytes | Totaliser 1 Function |
| 40001 | Unsigned Integer | 2 bytes | Totaliser 1 Measurement |
| 40002 | Unsigned Integer | 2 bytes | Totaliser 2 Function |
| 40003 | Unsigned Integer | 2 bytes | Totaliser 2 Measurement |

# Micro Motion 2000 Series Coriolis Meter

The Micro Motion 2000 series of meter are read using 11 modbus packets.

| Packet No. | Address | Type | Size | Name |
|---|---|---|---|---|
| 1 | 1 | Unsigned Integer | 2 bytes | Status Register |
| | | | | |
| 2 | 223 | Floating Point | 4 bytes | Frequency Set point |
| | 225 | Floating Point | 4 bytes | Frequency Represents |
| | 227 | Floating Point | 4 bytes | Frequency Pulse Width |
| | 229 | Floating Point | 4 bytes | Frequency Current |
| | | | | |
| 3 | 247 | Floating Point | 4 bytes | Mass Flow |
| | 249 | Floating Point | 4 bytes | Density |
| | 251 | Floating Point | 4 bytes | Temperature |
| | 253 | Floating Point | 4 bytes | Volume Flow |
| | | | | |
| 4 | 259 | Floating Point | 4 bytes | Mass Total |
| | 261 | Floating Point | 4 bytes | Volume Total |
| | 263 | Floating Point | 4 bytes | Mass Inventory |
| | 265 | Floating Point | 4 bytes | Volume Inventory |
| | | | | |
| 5 | 285 | Floating Point | 4 bytes | Tube Frequency |
| | 287 | Floating Point | 4 bytes | Left Pickoff Voltage |
| | 289 | Floating Point | 4 bytes | Right Pickoff Voltage |
| | | | | |
| 6 | 303 | Floating Point | 4 bytes | Density Calibration Constant |
| | | | | |
| 7 | 16 | Unsigned Integer | 2 bytes | Software Revision |
| | 17 | Unsigned Integer | 2 bytes | Flow Direction |
| | | | | |
| 8 | 39 | Unsigned Integer | 2 bytes | Mass Flow Unit |
| | 40 | Unsigned Integer | 2 bytes | Density Unit |
| | 41 | Unsigned Integer | 2 bytes | Temperature Unit |
| | 42 | Unsigned Integer | 2 bytes | Volume Unit |
| | | | | |
| 9 | 45 | Unsigned Integer | 2 bytes | Mass Total Unit |
| | 46 | Unsigned Integer | 2 bytes | Volume Total Unit |
| | | | | |
| 10 | 127 | Unsigned Integer | 2 bytes | Sensor Serial Number |
| | 128 | Unsigned Integer | 2 bytes | Sensor Serial Number |
| | 129 | Unsigned Integer | 2 bytes | Sensor Flange Type |
| | 130 | Unsigned Integer | 2 bytes | Sensor Flow Tube Construction |
| | 131 | Unsigned Integer | 2 bytes | Sensor Flow Tube Liner |
| | | | | |
| 11 | 1139 | Unsigned Integer | 2 bytes | Sensor Type Code |

# Bristol 3808MVT

The Bristol 3808MVT is read using 1 modbus packet. This packet contains the following data:

| Address | Type | Size | Name |
|---|---|---|---|
| 7401 | Floating Point | 4 bytes | Serial DP High range value |
| 7402 | Floating Point | 4 bytes | Serial pressure value |
| 7403 | Floating Point | 4 bytes | Serial temperature value |

If no response is received then the accountable DPHi, pressure and temperature serial alarms are set. They are cleared upon the next successful read.

# 10. Display Pages

The Display configuration is split into the following pages:

| | |
|---|---|
| General | Auto generate the display config based on the current configuration. Configure the default display page, Alarm and Audit list security options, and Supervisor mode. |
| Keyboard Config | Allows the creation of alternative character keyboards. |
| Templates | Creation of display page templates for use in display mode. |
| System Diagrams | The System Diagram Button allows the user to create a Supervisory style System Diagram of the Flow Computer system, with indication of current process variables and condition etc... |
| Display Config | For the creation and configuration of the standard display pages that are accessible via the Main menu on the Flow Computer front panel. |
| Edit Mode Config | For the creation and configuration of the Edit Mode Pages that are accessible via password to enable editing of variables on the Flow computer front panel. |

## 3D Graphs Allows the creation of xy or xyz graph types.

# General

**Display Pages**
Select the Generate button to reconfigure the Display Templates/System Diagrams and Display Config pages based on the current configuration.

This page also allows the configuration of the following items:

**Default Display Page**
The Default display button allows the operator to select a particular page to be the default or return page if no activity is recorded on the touch screen or rotary control after a preset period of time.

Any page that is shown on the main menu can be selected to be the default page , this is either selected from the pull down list when the Default button is operated. If the page is not shown in the available list it can be added by operating the Default button on the set up page for that display or by right clicking on the set up page for that display and selecting Set as Default.

This operation will add the display page to the default list , all that is then required is to select a time out period in minutes, after which the display will revert to the selected page. If the function is not required then disable should be selected from the pull down list of pages.

**Alarm/Audit Security Config**
This configuration page allows the user to determine if certain display/clear functions are available to the operator irrespective of the security switch settings of the unit.
The functions concerned are:-

Clear Alarm Log
Acknowledge Alarms
Clear Audit Log

Each of these functions can individually be enabled or disabled in each of the security switch setting modes, of open, partial and full security.

The function is enabled or disabled by using the pull down menu for each function.

The default settings of this operation is all three functions are enabled for open security and all three are disabled for Partial and Full Security.

**Supervisor Mode**
The Supervisor Mode allows the operator to configure the operation of the Supervisor Mode Main menu item.

To enable the Supervisor Mode, select the Mode pull down item and select Enabled.
Enter a Password , which can be Alpha Numeric and must be at least 5 characters.

If it is required to Commit Data changes Instantly enable the tick box , the alternative is to commit the changes only when a Display button is operated.

If it is required to automatically log out of the Supervisor Mode after a preset time interval in minutes, enable the tick box and enter the desired time.

# Display Configuration

In the Display Mode it is possible to create new Menu display pages or sub menu pages or to alter or delete existing pages.

There are by default 5 display main menu items in a flow computer that can be changed added to or deleted. All other display pages cannot be configured by the User.

- Totals
- Line Conditions
- Relative Density
- Heating Value
- Composition

The Heating Value and Composition pages also contain sub-menu pages

The Display set up page contains 4 separate windows:

- Main id Tree
- Main Menus selection list
- Sub Menus selection list
- View of currently selected page.

To Add a new Main Menus:

1. Scroll down the Main Menus: selection list, to the bottom.
2. Press the button New item
3. A blank page will appear, with the words "Drag Variables here".
4. This prompts the user to select the items to be displayed from the id tree and drag and drop them into the blank page. It is recommended to select one item at this stage and drag and drop it into the page.
5. A display page will replace the blank page, with the one item in a display box.
6. The User can now select the display Template from a list of available types.
   - 10 Centre 10 items per page in 1 column in the page centre.
   - 8 Centre 8 items per page in 1 column in the page centre.
   - 4 Centre 4 items per page in 1 column in the page centre.
   - 2 by 10 20 items per page in 2 column of 10.
   - VU 10 items per page plus 3 VU meters.
   - Any User entered Template
7. Once the Template has been selected, the remaining items to be displayed can be dragged and dropped from the id tree, into the required positions. Items can be deleted, by highlighting and using the delete key or by right clicking and using the Delete item option.
8. The Page Title can be altered , by Highlighting the Black Bar "New Page" at the top of the new display page and typing the Title to be used.
9. To create a description for the display page to be included in the Main Menu, click on the New Item in the Main Menu list and type the description as you want it to appear on the Main Menu.
10. A Bit map image can be included in the Main Menu item Selection button if required. This can either be created using the Bit Map Editor, or can be imported as a stored file.
11. To initialise the Bit Map Editor, click on the dotted icon outline box in the Main Menu List. The Bit Map editor , allows the User to create new or modify existing Bit Maps, using different size and shape brushes and the available colour palate. Files can be imported into the Bit Map Editor from memory or exported and stored in memory. Once the Bit Map is complete , click OK and

it will be shown in position in the Main Menu list.

12. To Edit the description or to edit the Bit Map click the Edit button. When complete click OK and items will be updated, or Cancel to return to the Display Window.

To Modify an existing Main Menus:

1. Scroll down the Main Menus: selection list to the item to be modified.
2. Select that Main Menu item
3. The current contents of the pages under that Main Menu item will be shown in the Page Window.
4. Items can be added into the pages by dragging and dropping.
5. Items can be removed by pressing the delete key.
6. New pages can be generated or added, either by :-
    1. Scrolling the display window down to the very end , and then dragging and dropping items to be displayed into the blank space below the footer of the last display page. Automatically a new page will be generated.
    OR by
    2. Using the Buttons to the left hand side of the Page display **Insert new page After this page** or **Insert new page Before this page**. These buttons will inset a new blank page in the indicated position. The page type to be inserted can be selected from **Page Type** , Template or System Diagram.
    The User can now select Page Type Template from a list of available types.
        - 10 Centre 10 items per page in 1 column in the page centre.
        - 8 Centre 8 items per page in 1 column in the page centre.
        - 4 Centre 4 items per page in 1 column in the page centre.
        - 2 by 10 20 items per page in 2 column of 10.
        - VU 10 items per page plus 3 VU meters.
        - Any User entered Template

        OR

        The User can select Page Type System from a list of available pages. This method allows the User to set up Menu items that contain both data pages (Template Based) and System Diagrams
7. All other procedures for altering display items are covered under the previous section Adding a Main Menus item.

To Add a new Sub Menus:

1. Scroll down the Main Menus: selection list until you reach the Main menu item which will have Sub menus, highlight this item.
2. In the Sub Menus: window press the button New item
3. A blank page will appear with the words "Drag Variables here".
4. All items that were originally under the Main menu page will now be moved to the first sub menu page. The User can continue to add data items to the subsequent sub menu pages.
5. This prompts the user to select the items to be displayed from the id tree and drag and drop them into the blank page. It is recommended to select one item at this stage and drag and drop it into the page.
6. A display page will replace the blank page, with the one item in a display box.
7. The User can now select the display Template from a list of available types.
    - 10 Centre 10 items per page in 1 column in the page centre.
    - 8 Centre 8 items per page in 1 column in the page centre.
    - 4 Centre 4 items per page in 1 column in the page centre.
    - 2 by 10 20 items per page in 2 column of 10.
    - VU 10 items per page plus 3 VU meters.
    - Any User entered Template

8. Once the Template has been selected, the remaining items to be displayed can be dragged and dropped from the id tree, into the required positions. Items can be deleted, by highlighting and using the delete key or by right clicking and using the Delete item option.
9. The Page Title can be altered by Highlighting the Black Bar "New Page" at the top of the new display page and typing the Title to be used.
10. To create a description for the display page to be included in the Sub Menu, click on the New Item in the Sub Menu list and type the description as you want it to appear on the Sub Menu.
11. A Bit map image can be included in the Sub Menu item Selection button if required. This can either be created using the Bit Map Editor, or can be imported as a stored file.
12. To initialise the Bit Map Editor, click on the dotted icon outline box in the Sub Menu List. The Bit Map editor allows the User to create new or modify existing Bit Maps, using different size and shape brushes and the available colour palate. Files can be imported into the Bit Map Editor from memory or exported and stored in memory. Once the Bit Map is complete , click OK and it will be shown in position in the Main Menu list.
13. To Edit the description or to edit the Bit Map click the Edit button. When complete click OK and items will be updated, or Cancel to return to the Display Window.

To Modify an existing Sub Menus:

1. Scroll down the Sub Menus selection list to the item to be modified.
2. Select that Sub Menu item
3. The current contents of the pages under that Sub Menu item will be shown in the Page Window.
4. Items can be added into the pages by dragging and dropping.
5. Items can be removed by pressing the delete key.
6. New pages can be generated or added, either by :-
    1. Scrolling the display window down to the very end , and then dragging and dropping items to be displayed into the blank space below the footer of the last display page. Automatically a new page will be generated.
       OR by
    2. Using the Buttons to the left hand side of the Page display **Insert new page After this page** or **Insert new page Before this page**. These buttons will inset a new blank page in the indicated position. The page type to be inserted can be selected from Page Type , Template or System Diagram.
       The User can now select Page Type Template from a list of available types.
        - 10 Centre 10 items per page in 1 column in the page centre.
        - 8 Centre 8 items per page in 1 column in the page centre.
        - 4 Centre 4 items per page in 1 column in the page centre.
        - 2 by 10 20 items per page in 2 column of 10.
        - VU 10 items per page plus 3 VU meters.
        - Any User entered Template

       OR
       The User can select Page Type System Diagram from a list of available pages.
       This method allows the User to set up Menu items that contain both data pages (Template Based) and System Diagrams
7. All other procedures for altering display items are covered under the previous section Adding a Sub Menus item.

# Editable

The Edit Mode Configuration set up page contains 4 separate windows:

a. Main id Tree
b. Users selection list
c. Sub Menus selection list
d. View of currently selected page.

By default the Users selection list will contain 3Users:

User 1 Password 1111
User 2 Password 2222
User 3 Password 3333

To Add a new User page:

1. Scroll down the Users selection list to the bottom.
2. Press the button New item
3. A blank page will appear, with the words "Drag Variables here".
4. This prompts the user to select the items to be displayed and to be editable for the New User when logged into the Edit Mode, via the front panel display. These items are selected from the id tree and are dragged and dropped into the blank page. It is recommended to select one item at this stage and drag and drop it into the page.
5. A display page will replace the blank page, with the one item in a display box.
6. The user can now select the display Template from a list of available types.
    i. 10 Centre 10 items per page in 1 column in the page centre.
    ii. 8 Centre 8 items per page in 1 column in the page centre.
    iii. 4 Centre 4 items per page in 1 column in the page centre.
7. Once the Template has been selected, the remaining items to be displayed can be dragged and dropped from the id tree, into the required positions. Items can be deleted, by highlighting and using the delete key or by right clicking and using the Delete item option.
8. The Page Title can be altered, by Highlighting the Black Bar "New Page" at the top of the new display page and typing the Title to be used.
9. To change the description and password word of the New User press the Edit button on the New User in the Users list.
10. A small Window will appear, prompting for a Name and Password Enter the new User name and a Numeric password up to 8 digits.
11. If this User is to be allowed access to Change any Calibration in the flow computer then tick the Calibration Access tick box.

To Modify an existing User page.

1. Scroll down the Users: selection list, to the item to be modified.
2. Select that User
3. The current contents of the pages under that Users name, will be shown in the Page Window.
4. Items can be added into the pages by dragging and dropping.
5. Items can be removed by pressing the delete key.
6. Additional pages can be added, by scrolling the display window down to the very end, and then dragging and dropping items to be displayed into the blank space below the footer of the last display page. Automatically a new page will be generated.
7. All other procedures for altering display items are covered under the previous section

Adding a new User.

To Add a new Sub Menu:

1. Scroll down the Main Menus: selection list until you reach the User item which will have Sub menus, highlight this item.
2. In the Sub Menus: window press the button New item
3. A blank page will appear, with the words "Drag Variables here".
4. All items that were originally under the User page, will now be moved to the first sub menu page. The user can continue to add data items to the subsequent sub menu pages.
5. This prompts the user to select the items to be displayed from the id tree and drag and drop them into the blank page. It is recommended to select one item at this stage and drag and drop it into the page.
6. A display page will replace the blank page, with the one item in a display box.
7. The User can now select the display Template from a list of available types.
   10 Centre 10 items per page in 1 column in the page centre.
   8 Centre 8 items per page in 1 column in the page centre.
   4 Centre 4 items per page in 1 column in the page centre.
8. Once the Template has been selected, the remaining items to be displayed can be dragged and dropped from the id tree, into the required positions. Items can be deleted, by highlighting and using the delete key or by right clicking and using the Delete item option.
9. The Page Title can be altered, by Highlighting the Black Bar "New Page" at the top of the new display page and typing the Title to be used.
10. To create a description for the display page to be included in the Sub Menu, click on the New Item in the Sub Menu list and type the description as you want it to appear on the Sub Menu.
11. A Bit map image can be included in the Sub Menu item Selection button if required. This can either be created using the Bit Map Editor, or can be imported as a stored file.
12. To initialise the Bit Map Editor, click on the dotted icon outline box in the Sub Menu List. The Bit Map editor, allows the User to create new or modify existing Bit Maps, using different size and shape brushes and the available colour palate. Files can be imported into the Bit Map Editor from memory or exported and stored in memory. Once the Bit Map is complete, click OK and it will be shown in position in the Main Menu list.
13. To Edit the description or to edit the Bit Map click the Edit button. When complete click OK and items will be updated, or Cancel to return to the Display Window.

To Modify an existing Sub Menu:

1. Scroll down the Sub Menus: selection list, to the item to be modified.
2. Select that Sub Menu item
3. The current contents of the pages under that Sub Menu item, will be shown in the Page Window.
4. Items can be added into the pages by dragging and dropping.
5. Items can be removed by pressing the delete key.
6. Additional pages can be added, by scrolling the display window down to the very end, and then dragging and dropping items to be displayed into the blank space below the footer of the last display page. Automatically a new page will be generated.
7. All other procedures for altering display items are covered under the previous section Adding a Sub Menus item.

# Supervisor Mode

The Supervisor Mode allows the operator to configure the operation of the Supervisor Mode Main menu item.

To enable the Supervisor Mode, select the Mode pull down item and select Enabled.

Enter a Password , which can be Alpha Numeric and must be at least 5 characters.

If it is required to Commit Data changes Instantly enable the tick box , the alternative is to commit the changes only when a Display button is operated.

If it is required to automatically log out of the Supervisor Mode after a preset time interval in minutes, enable the tick box and enter the desired time.

# Alarm/Audit Security Config

This configuration page allows the user to determine if certain display/clear functions are available to the operator irrespective of the security switch settings of the unit.
The functions concerned are:-
Clear Alarm Log
Acknowledge Alarms
Clear Audit Log
Each of these functions can individually be enabled or disabled in each of the security switch setting modes , of open, partial and full security.
The function is enabled or disabled by using the pull down menu for each function.
The default settings of this operation is all three functions are enabled for open security and all three are disabled for Partial and Full Security.

# System Diagram

When selected in its default mode the System Diagram display will show a typical system connection appropriate to the Meter type being used. The window is divided into two parts: a display of the System diagram and a panel that contains the configuration options for any selected item. Clicking the Page Items button will display a window containing a list of the individual components that make up that Diagram. The User can modify this example diagram, remove it completely and start again or just remove all items and the Supervisory tab will then be removed from the Main Menu.

Multiple System diagram pages can be designed: when the New button is selected the operator is given the option to enter a new name for the new page and then select either a blank page or a typical Stream or station page. These pages can then be customised as required.

New Items can be added to the display by clicking the New Item button or Right clicking on the System diagram and selecting from the following list:

| | | |
|---|---|---|
| ID | | Display any variable id |
| Text | | Display text box |
| Solid Box | | Solid rectangular box |
| Transmitter... | | Transmitter status indicator. You can select from some default transmitters (Pressure/Temperature/Differential Pressure(Low/Mid/High)). |
| Valve... | | Valve status indicator |
| Button | | Display an operator button (Some default Button configurations are available in the menu). |
| Generic Status | | Status Indicator (Circular) |
| Custom Bitmap... | | Add a custom Bitmap from Memory |
| Meters | Turbine | Bitmap of a Turbine Meter |
| | Ultrasonic | Bitmap of an Ultrasonic Meter |
| | Orifice | Bitmap of an Orifice plate |
| | Venturi | Bitmap of a Venturi nozzle |
| | Annubar | Bitmap of an Annubar flow element cross section |
| System Components | Gas Chromatograph | Bitmap of a Gas Chromatograph |
| | Flow Computer | Bitmap of a Flow Computer |
| | Detector Switch | Prover Detector switches 1 to 4 |
| | Prover Ball | Prover Ball |
| | Sample | Sample Can |
| | Tank | Storage Tank |
| | Small Volume Prover | Small Volume Piston Prover |
| Pipes | Thin Horizontal | Thin Horizontal pipe section |
| | Thin Vertical | Thin Vertical pipe section |
| | Thick Horizontal | Thick Horizontal pipe section |
| | Thick Vertical | Thick Vertical pipe section |
| | Vertical join from left | |

| | | |
|---|---|---|
| | Horizontal join from top | |
| | Vertical join from right | |
| | Horizontal join from bottom | |
| | Cross | |
| | Corner right down | |
| | Corner up right | |
| | Corner right up | |
| | Prover Curve (Thick) | |
| | Prover Curve (Thin) | |
| | Fade left | |
| | Fade right | |
| Lines | Horizontal | Thin Horizontal Line Section |
| | Vertical | Thin Vertical Line Section |
| Arrows | Arrow (Up) | Up Indication arrow |
| | Arrow (Down) | Down Indication arrow |
| | Arrow (Left) | Left Indication arrow |
| | Arrow (Right) | Right Indication arrow |
| | Piston | Piston Prover |

After a New Item is selected, a basic outline will appear on the display. Left click on this item to display the items configuration options in the window to the right of the System Diagram window. It can also be moved or resized by dragging the mouse when the relevant positional cursor is displayed.

Right clicking on the display item will bring up an additional menu with the following options:-

| | |
|---|---|
| Mirror | Mirror image on a vertical plane |
| Flip | Mirror image on a horizontal plane |
| Rotate 90 degrees Clockwise | |
| Rotate 90 degrees Anti-clockwise | |
| Duplicate | Creates a duplicate of the Variable item. |
| Delete | Deletes the Variable item |
| Move to Front | Moves this item to the top layer |
| Move to Back | Moves this item to the bottom layer |
| Raise | Moves this item up one layer |
| Lower | Moves this item down one layer |
| New item | Allows a new item to be added to the template |

Note: the Delete and Layer position functions can also be accessed via the buttons at the top of the window.

# Item Configuration:

When an item is selected on the System diagram, all of its configuration options are accessible in the window to the right of the system diagram.

**For Bitmap items:**

| | | |
|---|---|---|
| Meter | Turbine | Bitmap of a Turbine Meter |
| | Ultrasonic | Bitmap of an Ultrasonic Meter |
| | Orifice | Bitmap of an Orifice plate |
| | Venturi | Bitmap of a Venturi nozzle |
| | Annubar | Bitmap of an Annubar flow element cross section |
| Misc. | Gas Chromatograph | Bitmap of a Gas Chromatograph |
| | Flow Computer | Bitmap of a Flow Computer |
| | Prover Ball | Prover Ball |
| | Small Volume Prover | Small Volume Piston Prover |
| | Arrow (Up) | Up Indication arrow |
| | Arrow (Down) | Down Indication arrow |
| | Arrow (Left) | Left Indication arrow |
| | Arrow (Right) | Down Indication arrow |
| | Detector Switch | Prover Detector switches 1 to 4 |
| | Sample | Sample Can |
| | Tank | Storage Tank |
| | Piston | Piston Prover |
| | Generic Status | Status Indicator Circular |
| | Valve | Valve status indicator |
| | Transmitter | Transmitter status indicator |
| Pipes | Thin Horizontal | Thin Horizontal pipe section |
| | Thin Vertical | Thin Vertical pipe section |
| | Thick Horizontal | Thick Horizontal pipe section |
| | Thick Vertical | Thick Vertical pipe section |
| | Vertical join from left | |
| | Horizontal join from top | |
| | Vertical join from right | |
| | Horizontal join from bottom | |
| | Cross | |
| | Corner right down | |
| | Corner up right | |
| | Corner right up | |
| | Prover Curve (Thick) | |
| | Prover Curve (Thin) | |
| | Fade left | |
| | Fade right | |

There are 5 tabs for configuring different elements:

Colour which selects which Colours are to be used in the configuration of

| | | |
|---|---|---|
| | | this item. |
| | Mask | Selects the base or background Colour used for the item. |
| | Normal | Selects the Colour used for the item when its status is OK. |
| | Alarm | Selects the Colour used for a Variable which is in "Alarm" . |
| | Warning | Selects the Colour used for a Variable which is in "Warning" . |
| Alarms | | which selects which Alarm if any is to be used with this item. |
| Warnings | | which selects which Warning if any is to be used with this item. |
| Image | | which allows the image of the Bitmap to be edited or resized using the Bitmap editor which gives access to different size and shape brushes and the available colour palate. Files can be imported into the Bitmap Editor from disk or exported and saved to disk. |
| Operators | | which allows an id of a variable to be selected to be operated upon e.g. an item can be selected to change colour when a variable becomes greater than another variable. Possible operators are:- |
| | | Id 1 is equal to Id 2 or a fixed value |
| | | Id 1 is not equal to Id 2 or a fixed value |
| | | Id 1 is less than Id 2 or a fixed value |
| | | Id 1 is greater than Id 2 or a fixed value |
| | | Id 1 is less than or equal to Id 2 or a fixed value |
| | | Id 1 is greater than or equal to Id 2 or a fixed value |

· The Bitmap editor allows the User to create new or modify existing Bitmaps, using different size and shape brushes and the available colour palate. Files can be imported into the Bitmap Editor from disk or exported and saved to disk. Once the Bitmap is complete, click OK and it will be shown in position in the display.

**For Drawing items:**

| | | |
|---|---|---|
| Pipe | Horizontal | thin Horizontal line section |
| | Vertical | thin Vertical line section |
| Line | Horizontal | thin Horizontal line section |
| | Vertical | thin Vertical line section |
| Misc. | Solid Box | Solid rectangular box |

The configuration window will display the configured colours used by the selected item.

**For an ID** The configuration window consists of 5 tabs:

| | |
|---|---|
| ID | Allows selection of the ID to be displayed from the ID tree |
| Alarms | which selects which Alarm if any is to be used with this ID |
| Warnings | which selects which Warning if any is to be used with this ID |
| Format | which allows the format of the ID to be customised, showing or removing items such as Name, units, status, Value and border. |
| Colour | which selects which Colours are to be used in the configuration of this ID |
| | Foreground: Selects the Colour used for the Text of the ID |
| | Background: Selects the Colour used for the background of the ID box |
| | Alarm: Selects the Colour used for a ID which is in "Alarm" |
| | Warning: Selects the Colour used for a ID which is in "Warning" |

**For a Text item,** The configuration window consists of 2 tabs:

| | |
|---|---|
| Label | which allows the user to enter any text items |
| Colour | which selects which Colours are to be used in the configuration of this item |
| Foreground | Selects the Colour used for the Text |
| Background | Selects the Colour used for the background of the text box |

**For a Button,** The configuration window consists of 4 tabs:-

| | |
|---|---|
| ID | which selects the ID to be displayed from the ID tree. |
| Format | which allows the user to format the position of buttons on the display page, in Horizontal Rows, Vertical Rows or on a Grid of Rows and Columns. |
| Operators | which allows an ID of a variable to be selected to be operated upon and depending upon the result of the operation a particular button can be enabled or disabled when a set of operator circumstances are true or false.<br>Possible operators are:-<br>ID 1 is equal to ID 2 or a fixed value<br>ID 1 is not equal to ID 2 or a fixed value<br>ID 1 is less than ID 2 or a fixed value<br>ID 1 is greater than ID 2 or a fixed value<br>ID 1 is less than or equal to ID 2 or a fixed value<br>ID 1 is greater than or equal to ID 2 or a fixed value |
| Colour | Colour which selects which Colours are to be used in the configuration of this item.<br>Enabled Background: Selects the Colour used for the button background when enabled.<br>Disabled Background: Selects the Colour used for the button background when disabled.<br>Pressed Background: Selects the Colour used for the button background when pressed.<br>Enabled text: Selects the Colour used for the button text when enabled.<br>Disabled text: Selects the Colour used for the button text when disabled.<br>Pressed text: Selects the Colour used for the button text when pressed. |

**For a Custom Bitmap**

| | |
|---|---|
| Custom Bitmap... | Add a custom bitmap to the system diagram. Simply select the image from disk. |

**Extra Items**

In the right click menu, there is also an Extra Items menu option. Under this menu you will find pre-configured controls/groups of controls that can be used on a System diagram and help to quickly configure the page for specific system types.

# Templates

To create a New template, press the New button, and enter a Name for the Template.

Each template can contain up to 20 items.

It is possible to add 5 different item types to the template. These are:

- ID
- VU Meter
- (Horz) Bar Graph
- (Vert) Bar Graph
- Trend

A new item can be added either by selecting the New item button and choosing the selection from the list, or by right clicking on the screen and selecting from the list.

## ID

To Add an ID to the template, select New item then ID. A basic outline will appear on the template.

Left click on this item to select it. Once selected it can then be moved or resized by selecting any of the positional cursors on the outline and holding the mouse button down whilst the move or re-size is effected.

When the ID is selected, the configuration options for the ID are displayed in a window to the right of the Template window.

Right clicking on the item will bring up a menu with the following options:

| | |
|---|---|
| Duplicate | Creates a duplicate of the ID item. |
| Delete | Deletes the ID item. |
| Move to Front | This item has no function in this configuration |
| Move to Back | This item has no function in this configuration |
| Raise | This item has no function in this configuration |
| Lower | This item has no function in this configuration |
| New item | Allows a new item to be added to the template. |

Note: Delete and Layer position functions can also be accessed via the buttons at the top of the window.

## Configure Colours

| | |
|---|---|
| Foreground | Selects the Colour used for the Text of the ID |
| Background | Selects the Colour used for the background of the ID box |
| Ok | Selects the Colour used for a ID which is "OK" and in range |
| Alarm | Selects the colour used for a ID which is in "Alarm" |

## VU Meter

To Add a VU Meter to the template, select New item then VU Meter and a basic outline will appear on the template. Left click on this item to display the items configuration options. It can also be moved or resized by selecting any of the positional cursors on the outline and holding the mouse button down whilst the move or re-size is effected.

Right clicking on the VU Meter, will bring up an additional menu with the following options:-

| | |
|---|---|
| Duplicate | Creates a duplicate of the VU Meter. |
| Delete | Deletes the VU Meter. |
| Move to Front | This item has no function in this configuration |
| Move to Back | This item has no function in this configuration |
| Raise | This item has no function in this configuration |
| Lower | This item has no function in this configuration |
| New item | Allows a new item to be added to the template. |

## Main Config

| | |
|---|---|
| Maximum | Sets the Maximum Value for the meter display |
| Minimum | Sets the Minimum Value for the meter display |
| High | Sets the High limit point on the display |
| Low | Sets the Low limit point on the display |
| Label | You can add a label to the VU Meter, this can be useful when using the Template in the Display Config page to remind you of the configuration for a particular VU Meter. (NOTE: The VU Label will not be displayed on the Flow computer front panel). |
| Quick Config | Select a preset to quickly configure a VU Meter. Presets exist for Pressure, Temperature and Flow Capacity. Just select the preset you want along with the relevant stream, and the maximum/minimum and high/low values will be set based on current values from the config of the relevant stream. |

## Configure Colours

| | |
|---|---|
| Foreground | Selects the Colour used for the Text of the Variable |
| Background | Selects the Colour used for the background of the Variable box |
| Min | Selects the Colour used to indicate when a value is between Min and the low limit. |
| Max | Selects the Colour used to indicate when a value is between Max and the high limit. |
| Top | Selects the Colour used for the Top. |
| Scale | Selects the Colour used for the Meter Scale. |
| ID Background | Selects the Colour used for the background of the id variable. |
| Needle | Selects the Colour used for the Meter Needle. |

## Bar Graph (Horz/Vert)

To add a Bar Graph to the template, select New item then Bar Graph (Horizontal or Vertical) and a basic outline will appear on the template. Left click on this item to display the items

configuration options. It can also be moved or resized by selecting any of the positional cursors on the outline and holding the mouse button down whilst the move or re-size is effected.

Right clicking on the Bar Graph, will bring up an additional menu with the following options:

| | |
|---|---|
| Duplicate | Creates a duplicate of the Bar Graph. |
| Delete | Deletes the Bar Graph. |
| Move to Front | This item has no function in this configuration |
| Move to Back | This item has no function in this configuration |
| Raise | This item has no function in this configuration |
| Lower | This item has no function in this configuration |
| New item | Allows a new item to be added to the template. |

**Configure Limits**

| | |
|---|---|
| Number of IDs | Sets the number of IDs to be displayed on the Bar Graph (Maximum of 12 per control). |
| Maximum | Sets the Maximum Value for the Bar graph display |
| Minimum | Sets the Minimum Value for the Bar graph display |
| High | Sets the High limit point on the Bar graph display |
| Low | Sets the Low limit point on the Bar graph display |

**Configure Colours**

| | |
|---|---|
| Foreground | Selects the Colour used for the Text of the Variable |
| Background | Selects the Colour used for the background of the Variable box |
| Minimum | Selects the Colour used to indicate the low limit. |
| Maximum | Selects the Colour used to indicate the high limit. |
| Bar | Selects the Colour to be used for the actual Bar Graph when in the normal operating range between Min and Max. |
| Id Bg | Selects the Colour to be used for the background of the ID box. |
| #1 Txt Colour | Selects the Colour to be used for each alternate bar. |
| #2 Txt Colour | Selects the Colour to be used for each alternate bar. |
| #1 Bg Colour | Selects the Colour to be used for the background on each alternate bar. |
| #2 Bg Colour | Selects the Colour to be used for the background on each alternate bar. |
| Grid 1 | Selects the Colour to be used for the minor Grid Axis. |
| Grid 2 | Selects the Colour to be used for the major Grid Axis. |

# Trend

To Add a Trend graph to the template, select New item then Trend and a basic outline will appear on the template. Left click on this item to display the items configuration options. It can also be moved or resized by selecting any of the positional cursors on the outline and holding the mouse button down whilst the move or re-size is effected.

Right clicking on the Trend, will bring up an additional menu with the following options:-

| | |
|---|---|
| Duplicate | Creates a duplicate of the Trend graph. |
| Delete | Deletes the Trend graph. |
| Move to Front | This item has no function in this configuration |
| Move to Back | This item has no function in this configuration |
| Raise | This item has no function in this configuration |
| Lower | This item has no function in this configuration |
| New item | Allows a new item to be added to the template. |

**Configure Limits**

| | |
|---|---|
| Num Samples | Sets the number of Samples used to create the Trend graph. |
| Maximum | Sets the Maximum Value for the trend display |
| Minimum | Sets the Minimum Value for the trend display |
| High | Sets the High limit point on the trend display |
| Low | Sets the Low limit point on the trend display |
| Label | You can add a label to the Trend control, this can be useful when using the Template in the Display Config page to remind you of the configuration for a particular Trend control. (NOTE: The Trend Label will not be displayed on the Flow computer front panel). |

**Configure Colours**

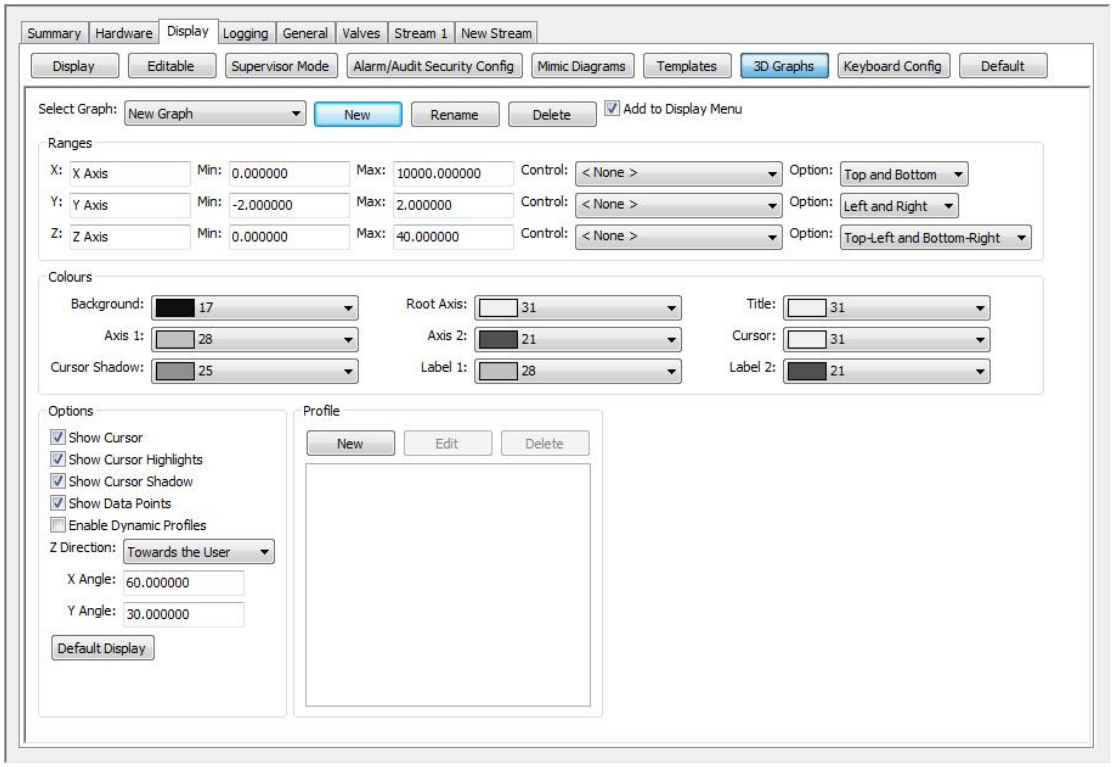
| | |
|---|---|
| Foreground | Selects the Colour used for the Text of the Variable |
| Background | Selects the Colour used for the background of the Variable box |
| Minimum | Selects the Colour used to indicate the low limit. |
| Maximum | Selects the Colour used to indicate the high limit. |
| Plot | Selects the Colour to be used for the trend line |
| Grid 1 | Selects the Colour to be used for the minor graph axis |
| Grid 2 | Selects the Colour to be used for the major graph axis |
| Graph | Selects the Colour to be used for the background of the graph area |
| ID background | Selects the Colour to be used for the background of the id area |

# Page Items

Clicking the Page Items button will display a window containing a list of the individual ctrls that make up that Template. This can be useful for selecting specific controls and also for adjusting the layers of the controls on the Template as necessary.

# 3D Graphs

This display item allows the operator to create 2 dimensional xy or 3 dimension xyz graphs.




To create xy 2 dimensional graphs, max , min and Control Variables should be selected for the x and y axis. The operator can also select on which axis the variable name is shown. Colours can be selected from the palette for background , the axis , titles, cursor and cursor shadow.
Up to 12 curves of the same variables can be shown on the same xy graph by selecting a different profile for each . For example a graph of flow rate (x) can be plotted against error (y) , but multiple graphs of these variables can be plotted for example at different pressures. This is achieved by adding a new profile in the profile window, each additional curve can be plotted using a different colour and can be represented either by a fixed number or by a Preset id from memory.

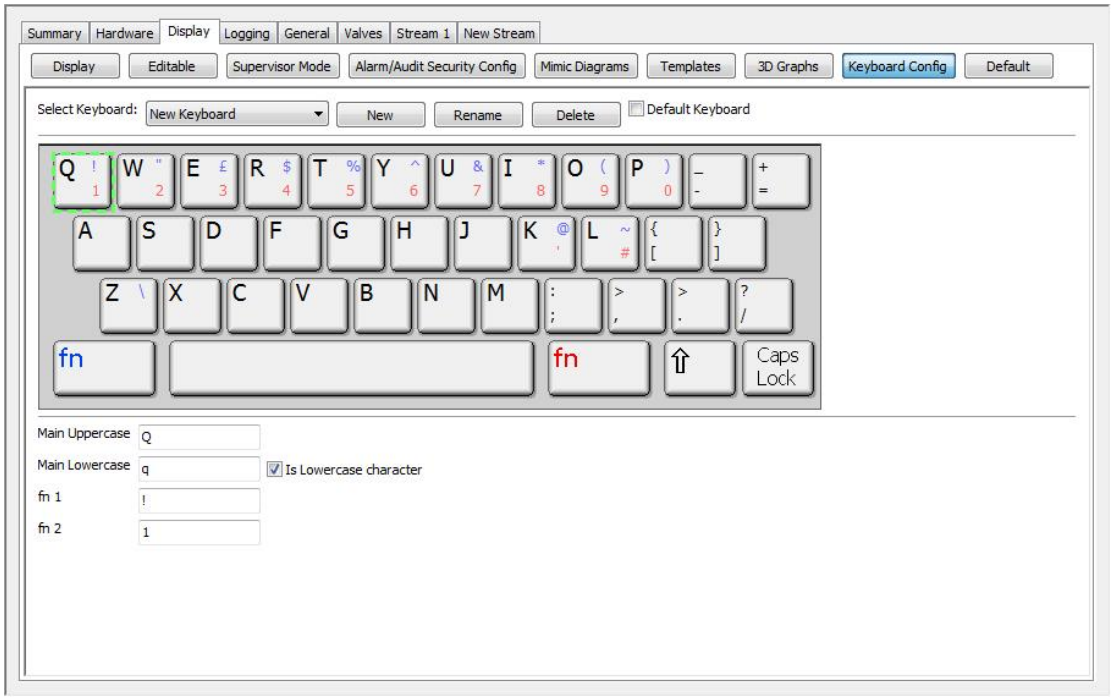
In the above description the result will be a 2 dimensional graph with multiple curves , the same data can be shown , but in the 3 dimensional xyz format , so that all three axis are visible.

Further options allow the presentation angles of the X and Y axis to be altered, as well as the perspective of the Z axis , either toward or away from the user.

The current operating point can be shown by enabling the cursor button and the cursor shadow will enhance the positional information of the cursor. If required the actual available data points which make up the curve can also be selected to be shown.

# Keyboard Config

The Keyboard Config display button allows the operator to create an alternative Keyboard from the standard QWERTY (UK English) type.




The New Key will allow a New Keyboard to be created this can either be a QWERTY type for modification or a BLANK so that all keys can be customised.
The Rename Key allows an existing Keyboard to be re-named.
The Delete Key allows an existing Keyboard to be deleted.
The Default Keyboard tick box allows a particular Keyboard to be selected as the Keyboard to send to the Unit.

When configuring a new Keyboard the button for configuration is selected this will then be highlighted and the four possible characters are entered either direct from the Keyboard or by entering a Unicode number in the appropriate box:-
Main Uppercase
Main Lowercase
Function 1 (blue) Fn1
Function 2 (red) Fn2

The supported character set conforms to MES-2 and comprises most common, Latin, Greek and Cyrillic extensions (1013 characters)

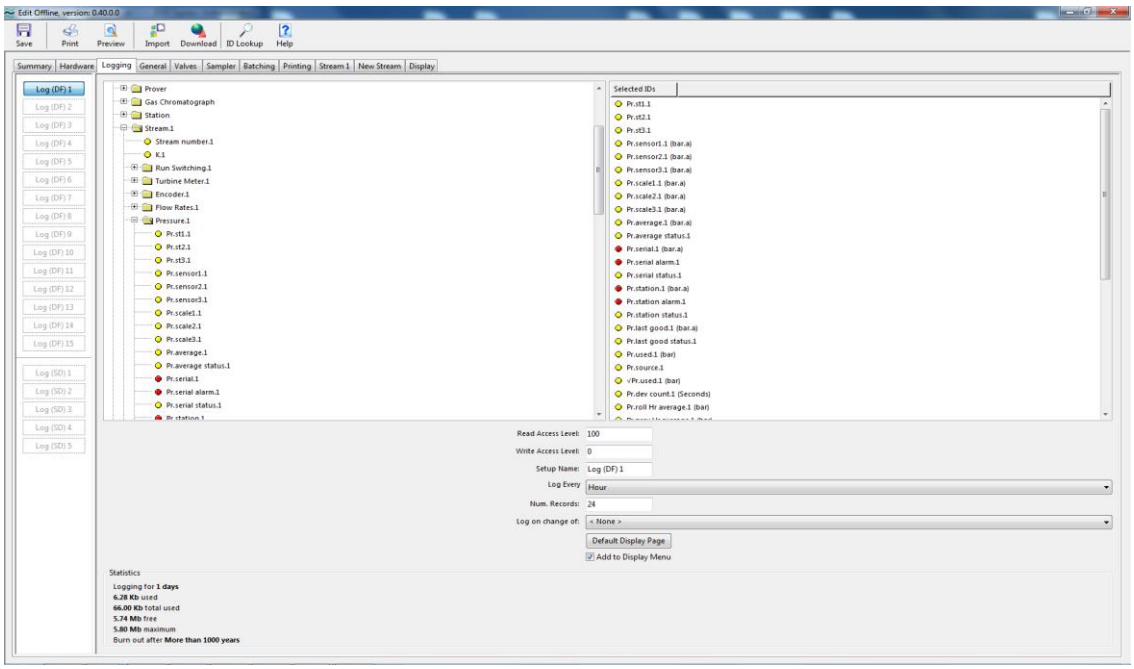
# Default

The Default display button allows the operator to select a particular page to be the default or return page if no activity is recorded on the touch screen or rotary control after a preset period of time.

Any page that is shown on the main menu can be selected to be the default page, this is either selected from the pull down list when the Default button is operated. If the page is not shown in the available list it can be added by operating the Default button on the set up page for that display or by right clicking on the set up page for that display and selecting Set as Default.

This operation will add the display page to the default list, all that is then required is to select a time out period in minutes, after which the display will revert to the selected page. If the function is not required then disable should be selected from the pull down list of pages.

# 11. Logging



- Up to 15 different logging tables can be set in the DF (Data Flash) Internal memory and up to 5 additional logging tables can be set in the SD (Optional, removable) memory.
- The Read and Write Access Level is only used when data is access using the SOAP protocol.
- Each logging table can be set to log up to 50 different data items
    - The log can occur at time intervals selected between every 5 mins to once a year.
    - And or on an event (change of parameter) such as when a prove completes

NOTE this function is intended to be used when a particular parameter, changes state, however, care should be taken when selecting the id as a log will be generated on each change

- The Internal (DF) memory has a capacity of approximately 6 M bytes which approximates to 300,000 data records, with time and date for each.
- The SD Card available memory will vary depending upon the size of the card and the % of SD card to use set for this log record.
- Items to log are selected from the Data tree and dragged and dropped into the selected ids window.
- The statistics of memory use is indicated on this page, in terms of time and amount of memory used.

# 13. General

Pages for setting up general items of data, data that will apply to the overall machine rather than specifically to each stream. The data is divided into groups, which are selected by individual icons.

## Unit Identification

Sets the Unit name or Tag number of the Flow Computer

## Date / Time

### Date/Time

Sets the Time and Date, Time and Date Format

### Contract Time

Sets the Contract Hour.

## Translation

Sets up the translation of Display text into languages other than English. English is the default language and if any item in the new language is not entered then English will be used. Up to 10 alternative languages can be set. A filter list option allows the text list to be shown to be reduced down to a list that only contain the letter or letter combinations entered into the filter list.

In order to add a new translation, the following steps must be taken:

1. Export the default language (giving a file, say trans.csv.
2. Edit trans.csv, replacing the English terms with those of the desired language, but leaving the TXT_XXX identifiers untouched.
3. Save trans.csv, making sure to use the UCS-16 character set (Big-Endian and Little-Endian are both fine).
4. Import the modified trans.csv file.

Following that, the new language also needs to be selected on the Flow Computer. This is done under the "Main Menu / Settings / Display Settings".

## Audit Log

Sets, which Alarm types are to be included in the Audit log and, which additional data is to be recorded for each Audit. A maximum of 10 additional data items can be recorded with each Audit Record. The internal memory of the flow computer has a capacity of approximately 200 k bytes which approximates to a minimum of 1000 audits. If recording of additional audits is required then a % of SD card to use can be set, in which case a percentage of the SD card will be set for Audit recording. The maximum number of Audits to be recorded will depend upon the size of the card and the percentage allocated.

## Settings

General machine settings, includes, machine cycle time and Total rollover value.

# Custom Alarms

The Custom Alarms page allows for the configuration of custom alarms

**Alarm Creation**
Before an alarm can be configured it must first be created. This can be done in two ways
New Button - Clicking on the New Button will create a new blank custom alarm

Drag and Drop - A new custom alarm can also be created by dragging an ID into the custom alarm configuration table. The ID used in the drag and drop process will then populate the column in which it is dropped for the new custom alarm (e.g. if the ID is dropped in the Check ID column of the table then the new alarms Check ID value will be that of the ID that was dropped).

**Alarm Configuration**
Once the alarm is created it can be configured. The ID fields in the table may only be populated by dragging and dropping the relevant ID's from the ID tree on the left side of the page. The other fields are configured using either number input or drop box selection. The fields and their purpose are shown below.

Check ID - The Check ID is the main ID used to set up the custom alarm. This field is configured using the ID tree's drag and drop functionality.

Operator - The Operator field is used to state the way in which the check is done (e.g. greater than or equal to). This field is configured using the relevant alarms operator drop down.

Check Method - The Check Method option states the whether an alarm will compare the Check ID against another ID or against a numeric value. This field is configured using the relevant alarms Check Method drop down.

Alarm Value - The Alarm Value field takes a numeric input which can be compared to the Check ID if the Value option is selected in the Check Method field.

Compare ID - The Compare ID field will be checked against the Check ID if the ID option is selected in the Check Method field. This field is configured using the ID tree's drag and drop functionality.

Alarm ID - The Alarm ID is the alarm that will be raised if the comparison succeeds. This field is configured using the ID tree's drag and drop functionality.
*NOTE* It is important that the alarm ID selected is one of the designated alarm ID's which can be found in the relevant area of the ID tree as not using an alarm ID could result in some very undesirable consequences.

Alarm Bit - The Alarm Bit field takes a numeric input which is used to state the bit of the Alarm ID which will be used to switch the alarm. The alarm bits are indexed (start) from zero

**Validation**
The alarms and their configurations are automatically saved when moving away from the page, however this is only possible if the alarm has been configured to a certain degree. If this is not the case then you will be prompted by the software to fill out the required fields.

**Alarm Deletion**
If the alarm/s are no longer required then they can be deleted as necessary using the Delete button. Simply select the alarm you wish to delete and click the delete button.

The Custom Alarm table also supports multiple selection and deletion. Holding down Shift or Ctrl and clicking alarms will select multiples and then clicking the Delete button will remove them. You will be asked to confirm the deletion.

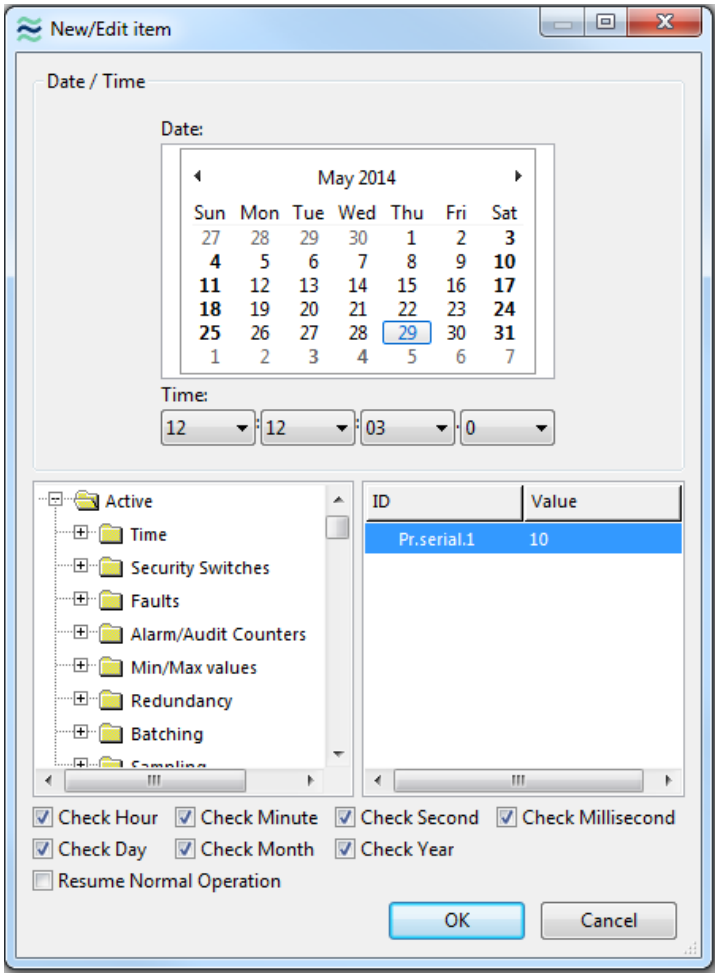
# FAT check

The FAT check allows the flow computer to run through a predefined sequence of values to verify that it is performing correctly. This is performed by adding one or more events to the list, each with an individual time, and at this time the configured changes are applied.
FAT Check Mode is entered by setting the controlling ID (Local -> Station -> General -> FAT Simulation) to On.

**New Button.**
This adds new events to the sequence.
**Edit Button.**
This allows existing events to be modified.

**Delete Button.**
This removes events from the sequence.

When creating New events or Editing existing events a dialog box is displayed to configure the event.




Select the value or values that you wish to change from the data tree on the left, and drag it to the list box on the right. Upon releasing the mouse you will be prompted to enter the

value that you wish to change the value to. If you wish to change the value of any of the ID's listed in the table just double click them.

Once you have configured the values that will change, the next step is to configure when they change. Changes can be configured to occur at a single time and date, or also to occur multiple times at regular intervals.

To configure an event to occur once only, set the date from the calendar, and also the time from the dropdown selection boxes.

To configure an event that occurs many times use the tick boxes. For example if you want the event to occur every minute, uncheck all boxes except the 'Check Second. This means that at X seconds (Configured in the dropdown box) past every minute the event will trigger. To automatically exit FAT Check Mode, configure an event to trigger and check the 'Resume Normal Operation' option. Alternatively the FAT Simulation ID can be set to Off.

# Config Security

Sets the Security of each data item that can be configured under the setup menu, either Editable i.e. item can be altered, Read only i.e. item can be viewed but not altered, or Hidden i.e. item cannot be seen. These settings are only used when the security level of the flow computer is set to partially secure by means of the rear panel mode switches (see operating instruction manual for details of these settings).

# ID Report

Sets up Data Reports of active or Preset data. Any item of Data can be selected from the tree and dragged and dropped into the selected ids window, these items will then be complied into a Data report, with current values, units etc. and can be viewed, stored or Printed by using the Read Data Report button on the Connection menu Page.

# Maintenance

Configures the various options when the flow computer is set to operate in Maintenance mode. Normally Maintenance mode is used for routine configuration or validation procedures and any changes or any flow recorded, will not form part of the normal measurement records.

The following options for maintenance mode configuration are available:-

| | |
|---|---|
| Use Station Maintenance Mode | Yes or No |
| Maintenance requires Loq condition | Yes or No |
| Use maintenance flow | Yes or No |
| Use maintenance Totals | Yes or No |
| Inhibit maintenance accountable alarms | Yes or No |
| Inhibit maintenance non accountable alarms | Yes or No |
| Maintenance restore data | Yes or No |
| Maintenance mode requires an open valve before operation | Not Controlled of Select Valve n (1-18) |
| Maintenance mode requires a closed valve before operation | Not Controlled of Select Valve n (1-18) |
| Use Maintenance 4-20mA output | Yes , set to minimum or set to maximum |

# Formatting

Configures the formatting of all ids used , which basically allows the number of significant figures and the number of decimal places to be set for each parameter. This will affect the formatting of the number on the display, printing and logging.
Individual ids can be selected from the Parameter tree and dragged and dropped into the formatting window. In this way each id can be given if required a separate format, any items not included in the list will use default formatting.
An option exists to copy the formatting across from stream 1 to the same parameter or group of parameters on stream 2 etc. by enabling the Affect all indexes tick box.

# Custom Strings

Allows up to 20 Custom String variable ids to be created, these variables can contain up 40 numerical or letter characters. They appear in all tree lists for the display and printer outputs. The function of the string variable is to allow the operator place lines of custom text on any display page, System diagram or on any printer output.

# Min/Max ids

This function allows minimum and maximum values for up to 20 selected ids to be recorded and used on display pages, in printer records or as parameters in serial communication outputs.
The Parameter to be recorded is selected from the id tree and dragged and dropped into a vacant Min/Max ID position. This item can be cleared by operating the adjacent Clear button and a new parameter selected if required.
In the Parameter tree on the Display , set up page, Printer set up page or Modbus communication set up page a list of available Min/Max parameters will be shown
For each Min/Max id 1-20 the following values will be recorded

| | |
|---|---|
| Min ch ID.1 | current hour |
| Min cd ID.1 | current day |
| Min cm ID.1 | current month |
| Min ph ID.1 | previous hour |
| Min pd ID.1 | previous day |
| Min pm ID.1 | previous month |
| Max ch ID.1 | current hour |
| Max cd ID.1 | current day |
| Max cm ID.1 | current month |
| Max ph ID.1 | previous hour |
| Max pd ID.1 | previous day |
| Max pm ID.1 | previous month |

# Custom Deviation

The deviation check allows two different ID's to be compared against each other. The check ID and compare ID should be selected from the tree and dragged to the required check or compare position.
The comparison can be made using the actual difference of the two values or as a percentage difference, or both. If you wish to disable either check then right click on the limit and set it to invalid.
The time setting specifies how long the deviation must be above the set limit before it is indicated. Setting this value to 0 will cause an instant indication of a deviation.
The configuration information can be found in the tree, Preset →Deviation Check →Check X.
The current information can be found in the tree, Active →Deviation Check →Check X. The

deviation time counter will count down to 0, and when 0 is reached the deviation will be indicated in the Alarm Active register as a value of 1.

# Redundancy

This function allows a system redundancy function to be enabled, it will also assign whether the machine is duty or standby and assumes that a system consists of a duty and a standby machine that are in communication with each other.
A fully healthy machine is assigned a redundancy score of 100% and each individual redundancy item can also be given a score, this score is then taken away from the healthy total as and when each redundancy item occurs.
Once the nominated Duty machine score is lower than the Standby machine score by more than the preset Switch over value in % for more than the Switch over time in seconds the Duty and Standby nominations will switch over.
The Clash alarm time sets a period of time to allow the switch of Duty and Standby nomination before any alarm is raised.

# Watchdog

This function allows a system watchdog to be enabled which will perform a complete system reset after a preset watchdog time out period has elapsed, the time out period can be set from 5, 10, 15, 20 or 30 seconds or 1 minute.

# Run Switching

Configuration options are detailed in the stream section of this document.

# SOAP Users

SOAP Users can be added, edited and removed here. Each user has 3 characteristics, a username, a password and an access level. For each user the username and password must be unique. This information is used to log on and off of the SOAP interface. A user will automatically be logged out after 5 minutes after the last Keep Alive message is received.

The access level is used to control what users have access to specific information, where a higher number allows most access.

# CTE

Note: Familiarity with Serial Communication and the CTE Protocol is assumed on the part of the operator.

**Settings**
The Settings Page enables or configures all communication settings associated with this output.

| | |
|---|---|
| Baud Rate | Set between 300 and 38400 |
| Parity | None, odd, even, mark or space |
| Stop Bits | 1 or 2 stop bits |
| Mode | RS232 or RS485 |
| Word size | 7 bits or 8 bits |
| Master | When Master if enabled, if a password request is received the password request is echoed. When Master is disabled, password request is ignored. |
| Level code1 | Must match Level code1 of request, packet ignored otherwise |
| Level code2 | Must match Level code2 of request, packet ignored otherwise |

| | |
|---|---|
| Level code3 | Must match Level code3 of request, packet ignored otherwise |
| Session Timeout | Currently unused. |

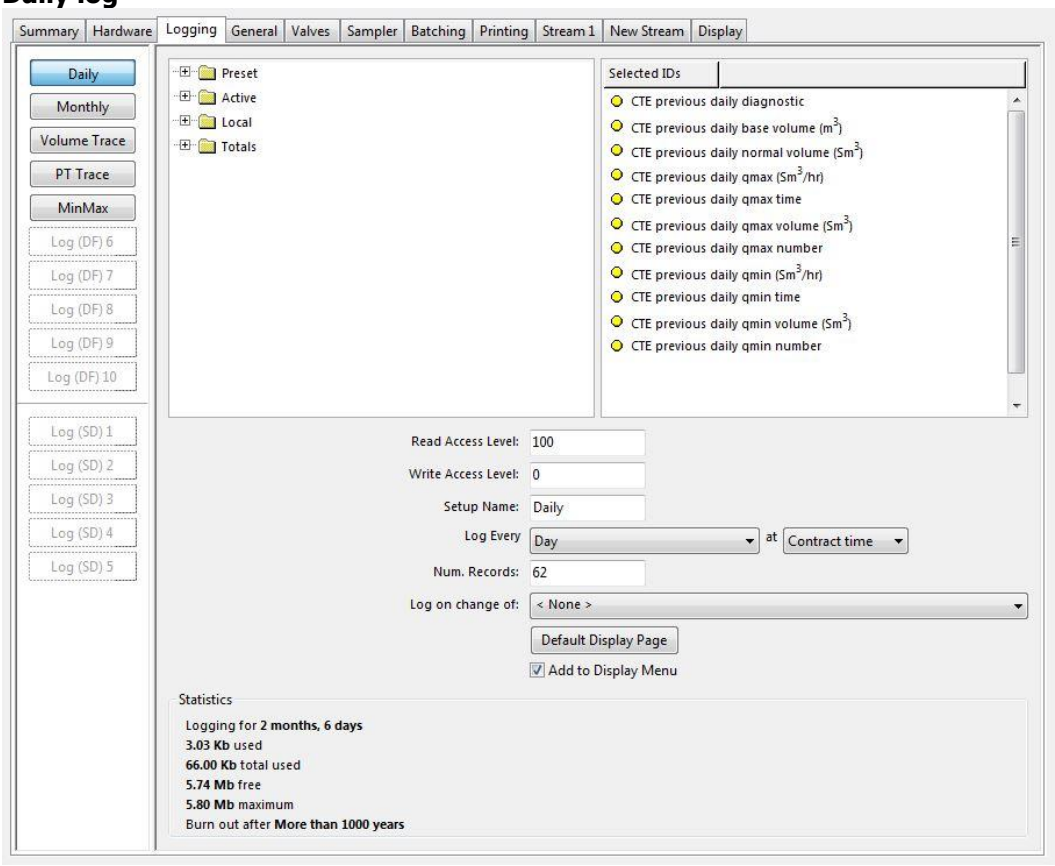
Note: Only Stream 1 is currently used for CTE.

**General Setup/ CTE Logdata**

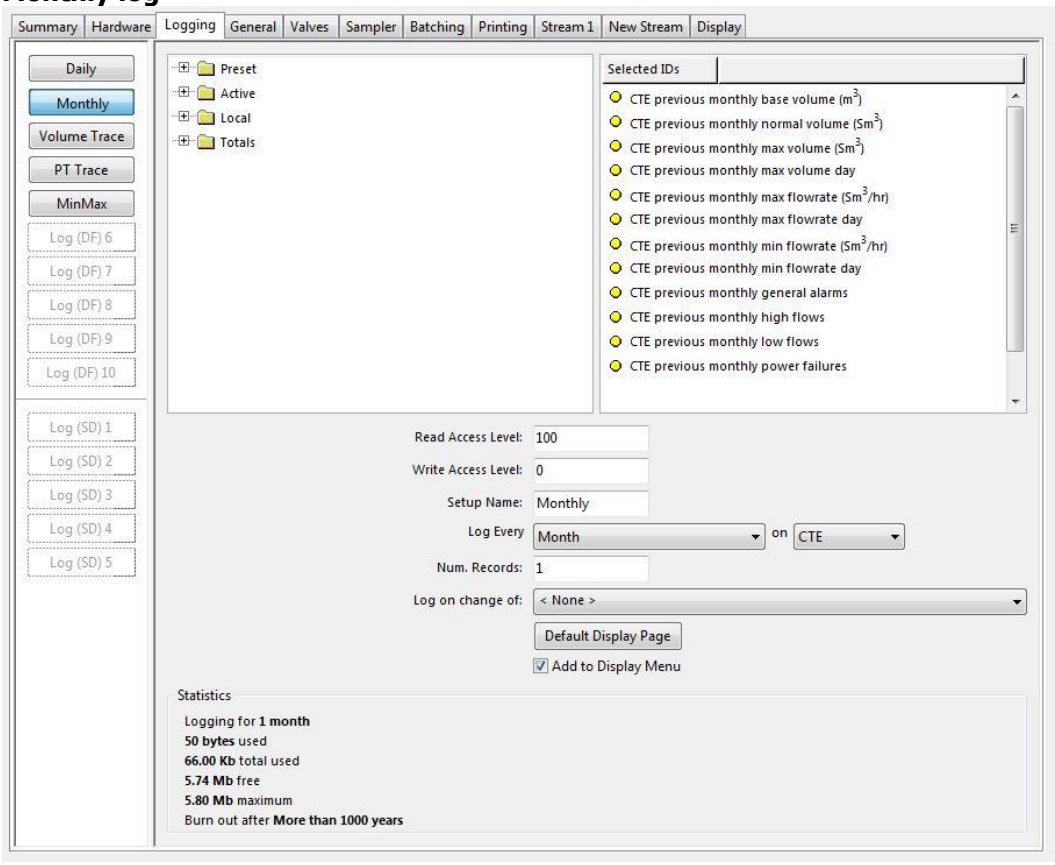
The CTE protocol is dependent on the logs being set correctly, and the general setup.
There are 5 logs which need to be configured (order is not important)
Daily (Daily interval)
Monthly (Monthly interval)
Volume Trace (15 Minute interval)
Pressure and Temperature Trace (15 Minute interval)
Min/Max of Pressure/Temperature Pressure (Daily interval)

CTE IDs can be found in active\station\CTE\previous_period. The order of IDs in each folder is set to match the protocol.
The logs are setup as follows:

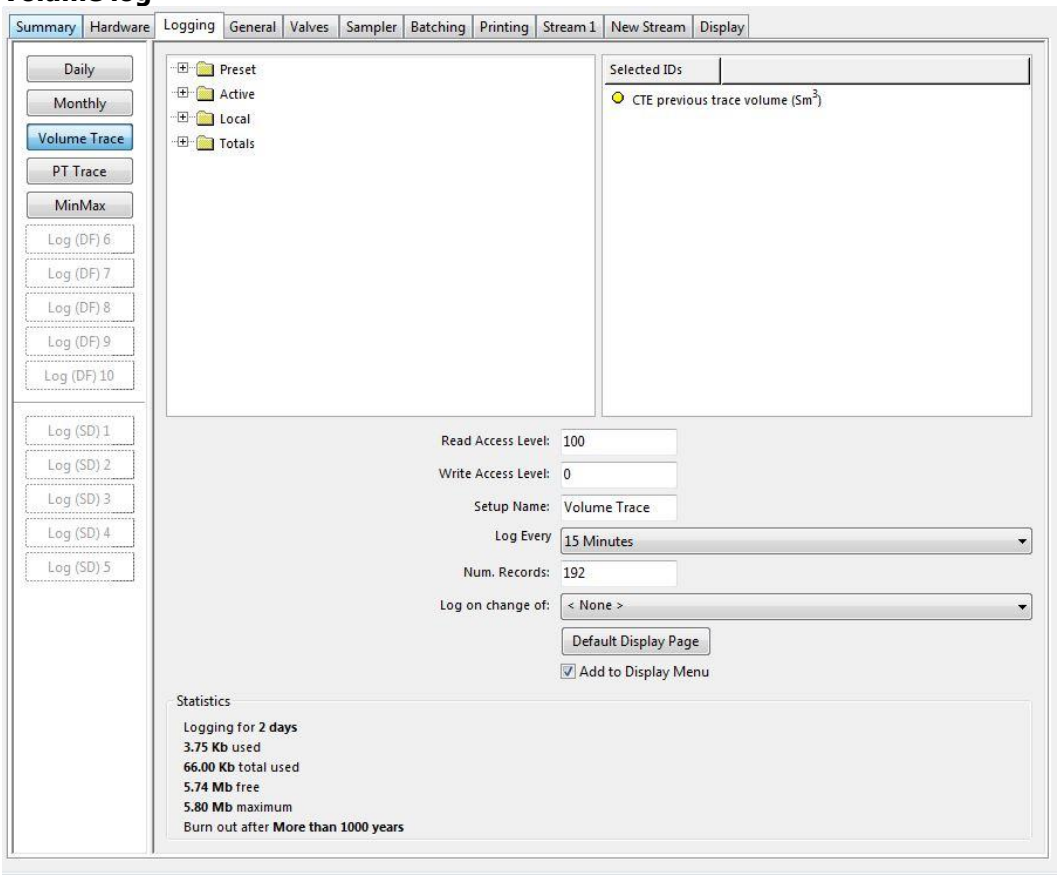
## Daily log



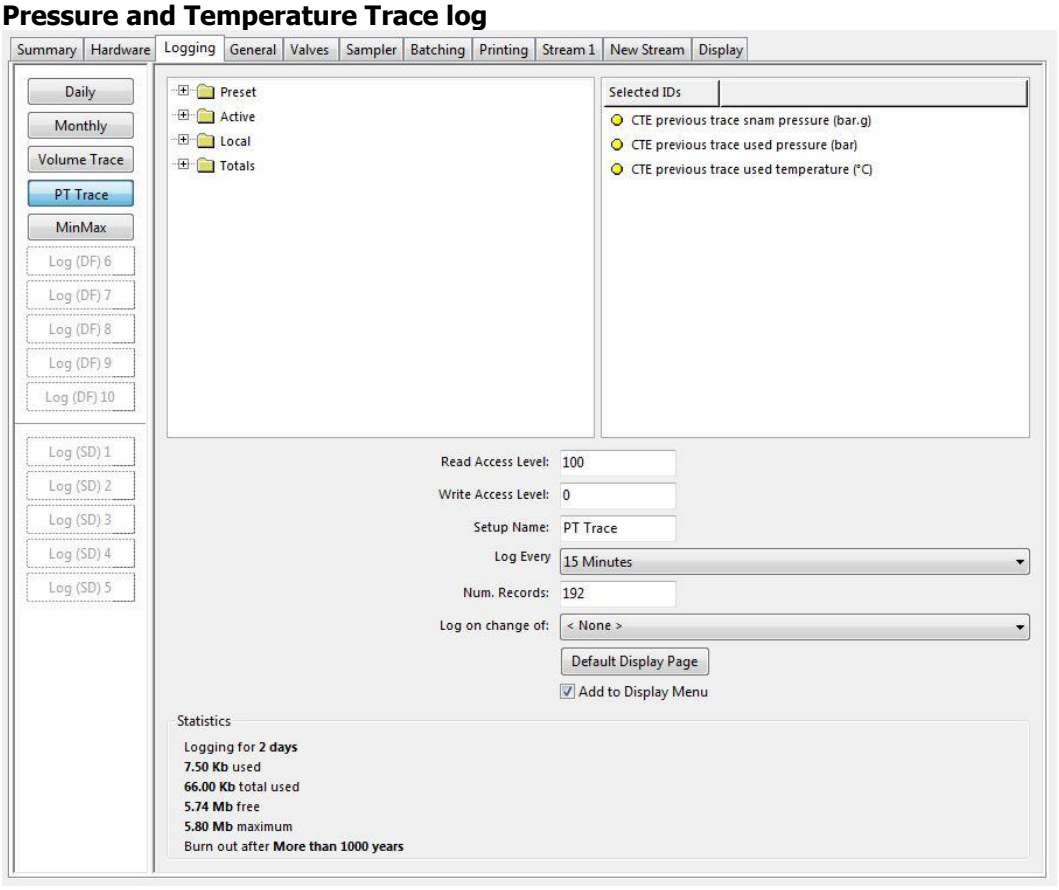

## Monthly log



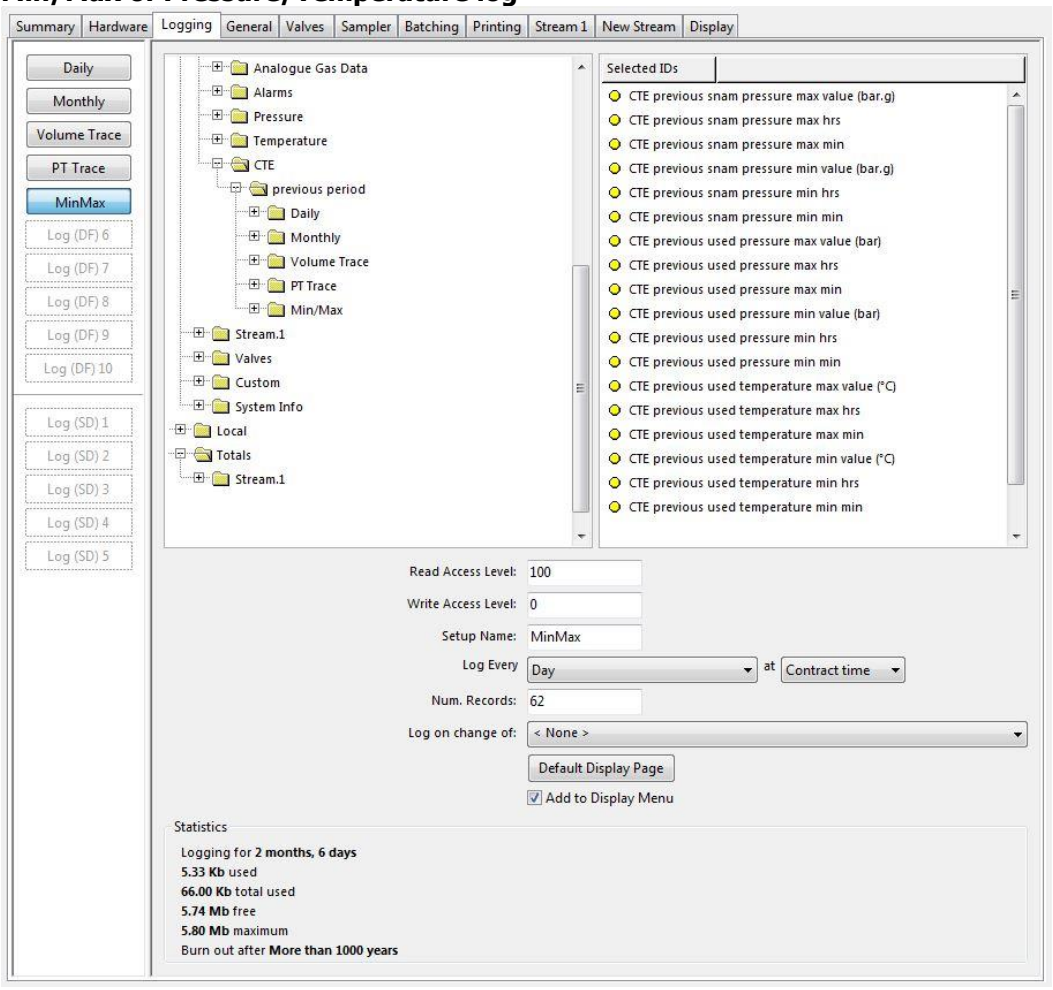
## Volume log




## Pressure and Temperature Trace log



## Min/Max of Pressure/Temperature log




### General Setup

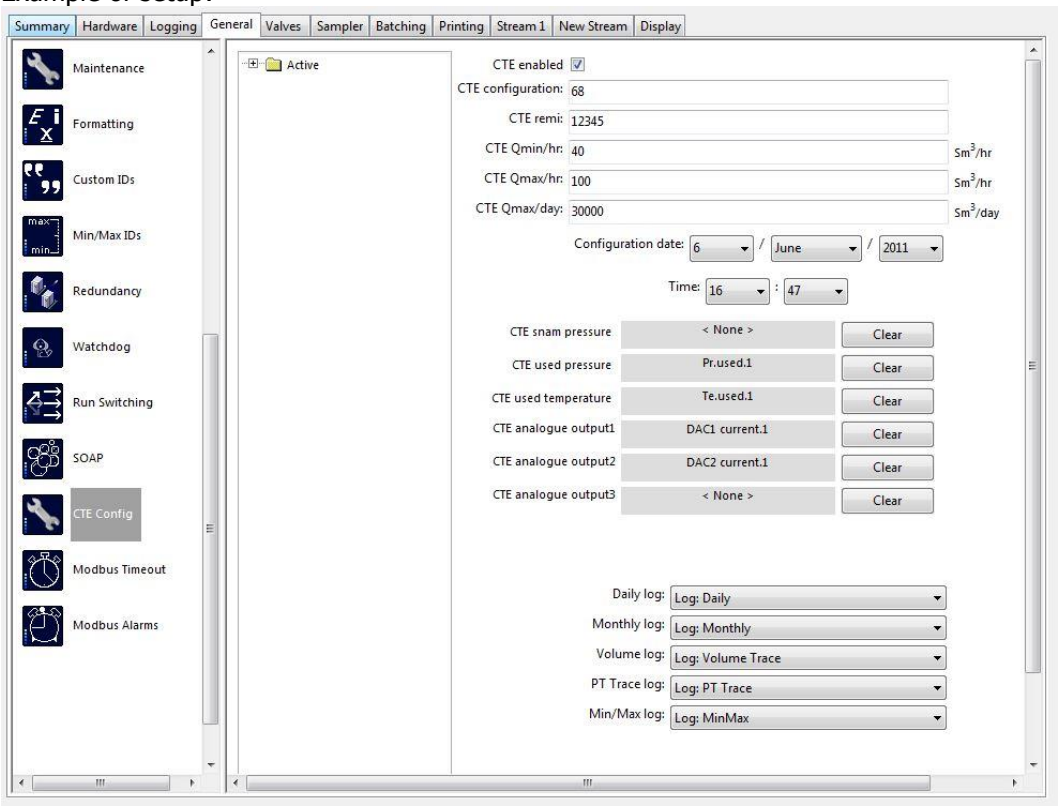
| | |
|---|---|
| CTE enabled | When enabled, turns on the calculation of CTE values. |
| CTE configuration | Configuration number used in protocol header |
| CTE remi | Serial number used in protocol header |
| CTE Qmin/hr | Minimum hourly flow |
| CTE Qmax/hr | Maximum hourly flow |
| CTE Qmax/day | Maximum daily flow |
| Configuration date | Data returned when accessing programmed data. |
| CTE snam pressure | if required, assign ID from active folder. |
| CTE used pressure | if required, assign ID from active folder |
| CTE used temperature | if required, assign ID from active folder |
| CTE analogue output1 | if required, assign ID from active\board_information\slot.n\Analogue_Outputn\DACn.current |
| CTE analogue output2 | if required, assign ID from active\board_information\slot.n\Analogue_Outputn\DACn.current |
| CTE analogue output3 | if required, assign ID from active\board_information\slot.n\Analogue_Outputn\DACn.current |

Note: The analogue outputs are used whilst accessing the instantaneous data. The corresponding analogue output must be setup accordingly.

| | |
|---|---|
| Daily log | If used, assign log for Daily Log |
| Monthly log | If used, assign log for Monthly Log |
| Volume log | If used, assign log for Volume Log |
| PT Trace log | If used, assign log for PT Trace Log |
| Min/Max log | If used, assign log for Min/Max Log |

If no log is assigned to any of the above, any protocol requests requiring access to log data will be ignored.

Example of setup:




# MODBUS Timeout

The modbus timeout function is designed to be used to identify when essential modbus communications are lost. This function also requires the "Use modbus timeout alarm" mode switch to be enabled on the relevant streams, and also the "Use modbus timeout" option to be enabled on at least one modbus slave communications port.

Enter the maximum time the flow computer should not be without communications. This time will decrement every second and upon reaching 0 seconds an accountable alarm will be raised on every stream that is using the timeout alarm, and any modbus received gas data will be flagged as in error. To disable the timer set its value to be invalid.

The timer is reset upon receipt of a valid modbus packet on a modbus slave port that has the use modbus timeout option selected.

# MODBUS Alarms

This is used to associate unit alarms with Modbus values, and is used to generate events within an Event Log. The Event log can be accessed by Modbus to extract alarms/events. The Event log typically contains the Modbus Log Event bitmap, which details which alarms/events have occurred.

When a modbus setup has been created, the IDs within the setup are presented in the left window (Available IDs). To add the ID to the Alarmed IDs list, double click the ID or select and press Enter. To remove an ID from the Alarmed IDs list, select and then delete it.

To associate an alarm with an ID, select the ID. Then for each of "Minimum Alarms", "Lo Alarms", "Hi Alarms", "Maximum Alarms", select the alarms from the list. Multiple Alarms can be selected for each alarm type if required.

Once a cycle, the Modbus Alarms are checked, and if the alarm has changed from last cycle, and entry is made in the relevant Event Log.

The alarms set the following bits within the Modbus Log Event bitmap register, and the following Alarms/Events are supported:

Bit 0, Fixed Value
Bit 1, unassigned (0)
Bit 2, unassigned (0)
Bit 3, unassigned (0)
Bit 4, unassigned (0)
Bit 5, unassigned (0)
Bit 6, unassigned (0)
Bit 7, unassigned (0)
Bit 8, unassigned (0)
Bit 9, Operator change event identified bit (0= Alarm change, 1=Operator change)
Bit 10, LoLo Limit (Set when Min alarm value exceeded)
Bit 11, Lo Limit (Set when Lo alarm value exceeded)
Bit 12, Hi Limit (Set when Hi alarm value exceeded)
Bit 13, HiHi limit (Set when Max value exceeded)
Bit 14, unassigned (0)
Bit 15, Set/Reset Alarm (1=set, 0=reset)

Events are a result of a preset value change, and are generated by examining values in the modbus setup. These IDs do not necessarily have to be present in the Alarmed IDs list.

# ID Arithmetic

The ID Arithmetic page allows for the configuration of arithmetic operations on ID's. Before an arithmetic operation can be configured it must first be created. This can be done by clicking on the New Button. Once the operation is created it can be configured. The ID fields in the table may only be populated by dragging and dropping the relevant ID's from the ID tree on the left side of the page. The other fields are configured using either number input or drop box selection.
The alarms and their configurations are automatically saved when moving away from the page, however this is only possible if the alarm has been configured to a certain degree. If this is not the case then you will be prompted by the software to fill out the required fields.
If the operations are no longer required then they can be deleted as necessary using the Delete button. Simply select the operation you wish to delete and click the delete button. The Arithmetic Operations table also supports multiple selection and deletion. Holding down Shift or Ctrl and clicking operations will select multiples and then clicking the Delete button will remove them. You will be asked to confirm the deletion.

# Input Assignment

The Input Assignment page allows for the configuration of ID assignments. Before an assignment can be configured it must first be created using the New button or by dragging and dropping an ID in the respective table columns. Once the assignment is created it can be configured. Both ID fields in the table may only be populated by dragging and dropping the relevant ID's from the ID tree on the left side of the page.

The assignments are automatically saved when moving away from the page, however this is only possible if the assignment has been configured to a certain degree. If this is not the case then you will be prompted by the software to fill out the required fields.
If the assignment/s are no longer required then they can be deleted as necessary using the Delete button. Simply select the assignment you wish to delete and click the delete button.
The assignment table also supports multiple selection and deletion. Holding down Shift or Ctrl and clicking assignments will select multiples and then clicking the Delete button will remove them. You will be asked to confirm the deletion.

# 14. Valves

Sets the functionality of up to 18  Valves from the following valve types:-

| | |
|---|---|
| Inactive | Not operating |
| Analogue | Analogue 4-20mA set to a preset value and hence position. |
| Digital | Timed Digital Output with no feedback. |
| PID | Analogue 4-20mA Output used as a PID control output |
| Feedback | Digital Switch Output , with Open, close and Transition time control coupled with digital status input to feedback valve position. |
| 4 Way | 4 Position Valve Control used in a Liquid Prover system. |

NOTE each of the above Valve types will require the actual Outputs used , 4-20mA Analogue Output, Digital switch Outputs and possibly Digital switch Inputs to be correctly configured in the hardware set-up of the flow computer. This is done on the Hardware set up page corresponding for each board type.

The flow computer has 5 different types of valve available.

# Analogue

Used to control an analogue output either remotely or via the front panel of the flow computer.

Keypad value.
Value used if no set point has been received.
Minimum value.
Minimum scaling value.
Maximum value.
Maximum scaling value.

Note: Maximum and minimum values can be configured to prevent the output either fully opening or fully closing by setting the limits within the band set when configuring the output.

## Inputs Required

Local > Valves > Valve.X > Analogue

Valve analogue set point.
Used to provide the desired set point.

## Outputs Required

Active > Valves > Valve.X > Analogue

Analogue Output
Used to indicate the percentage open that the valve should be.

# Digital

Used to control a digital output either remotely or via the front panel of the flow computer.

Keypad value.
Value used at power-on.
Duration.
Duration for the pulse to remain on.

## Inputs required

Local > Valves > Valve.X > Digital

Duration
Open status received from the valve.
Set point Closed status received from the valve.
1 = Output constantly off.
2 = Output constantly on.
3 = Output on for the programmable duration.

## Outputs required

Active > Valves > Valve.X > Digital

Digital Output
Signal from the flow computer to open the valve.

# PID

Used for controlling an analogue output to achieve a given setpoint. Can be run in Primary Control Mode or alternatively Primary and Secondary Control Mode. The functionality is selectable using the cascade function switch as well as the change up/down logic.

The P, I and D actions control the rate at which the valve moves.

The PV Maximum and PV Minimum represent the limits used for process values. If a setpoint received is outside these limits then an alarm will be raised. The SP Maximum and SP Minimum represent the limits used for control values.

The change down logic allows configuration of the condition to swap from PID 1 to PID 2.

The change up logic allows configuration of the condition to swap from PID 2 to PID 1.

The PID Mode selects if the PID Valve is running in Manual or Automatic mode. In manual mode the PID valve will regulate to the PV Setpoint, whilst in Manual mode the valve will remain static at the last received CV Setpoint. The transition from Automatic to Manual mode will be performed seamlessly, so the valve will continue to use the same % output until told otherwise. The transition back to Automatic mode will see the valve begin to regulate to the last known setpoint.

### Inputs Required

Control Value - Percentage to manually set the valve to.

Set point - Required set point to regulate to.

Process Value - Value to regulate.

**Outputs Required**

Percentage the valve is open, Percentage

Used for controlling an analogue output to achieve a given set point.

- The process variable selects what is trying to be regulated.
- The keypad set point selects the default position for the valve if there is no set point present.
- The P, I and D actions control the rate at which the valve moves.
- The maximum and minimum output levels are the limits at which the valve can operate.

## Inputs Required

Local > Stream.X > Run Switching > Flow Control Valve

Set point
: Required set point to regulate to.

## Outputs Required

Active > Stream.X > Run Switching > Flow Control Valve

Run Flow Percentage.
: Indicates the current percentage open level of the flow control valve.

# Feedback

Used to control and monitor digital valves.

Control.
: Selects if this valve should be controlled or not.

Alarm.
: Selects if the valve alarms should be used or ignored for this valve.

Open & Close durations.
: The length of time the corresponding command is sent.

Transition duration.
: The maximum amount of time it should take for the valve to move. If this time is exceeded then an alarm will occur.

If a valve is in alarm then to clear the alarm the Action tag must be set to reset.

### Inputs required

Local > Valves > Valve.X > Feedback

Open Feedback
: Open status received from the valve.

Close Feedback
: Closed status received from the valve.

Failure Feedback
: Failure indication received from the valve.

Automatic Feedback
: Mode selection received from the valve.

Local > Valves > Valve.X > Feedback

Action
: Command to either reset or move the valve.

### Outputs required

Active > Valves > Valve.X > Feedback

Open Output
: Signal from the flow computer to open the valve.

Close Output
: Signal from the flow computer to close the valve.

## Four Way

Four Way valve control used in prover systems.

| | |
|---|---|
| Leak sensor. | Selects what type of sensor is used to detect leaks. |
| Leak detect. | Selects when to detect for leaks. |
| Open & Close durations. | The length of time the corresponding command is sent. |
| Transition duration. | The maximum amount of time it should take for the valve to move. If this time is exceeded then an alarm will occur. |

## Inputs required

Local > Valves > Valve.X > Feedback

| | |
|---|---|
| Open Feedback | Open status received from the valve. |
| Close Feedback | Closed status received from the valve. |
| Failure Feedback | Failure indication received from the valve |
| Automatic Feedback | Mode selection received from the valve. |

Local > Valves > Valve.X > Feedback

Action
: Command to either reset or move the valve.

## Outputs required

Active > Valves > Valve.X > Feedback

Open Output
: Signal from the flow computer to open the valve.

Close Output
: Signal from the flow computer to close the valve.

# 15. Sampler

The sampler can be configured to be active in 4 different modes:-

- Fixed Time. When running in fixed time mode the sampler will automatically become active between the on and off times.
- Duration. In this mode the sampler will be active for a fixed time period and then automatically stop.
- Batch. Batch mode allows the sampler to operate until a the amount of product configured in 'parcel size' has been measured.
- Continuous. The sampler will run continuously.

If the sampler is active in either 'Fixed Time', 'Duration' or 'Continuous' modes it can be configured to sample in any of the following 3 ways:-

- Time based: The sampler will take a sample after the time period configured in the sampler interval expires.
- Flow based: The sampler will take a sample after the flow configured in both the sample counter and sample interval has been measured.
- Manual: The sampler will only take a sample when a manual sample request is received.

The sampler may be automatically stopped if the flow goes above or below configurable limit. These limits are configured in the flow limits section of the sampler setup.

The sample deviation alarms allow both accountable and non-accountable alarms to be configured if the deviation between the calculated can level and measured can levels are greater than expected.

The sample can may only be reset when sampling status is either "Full", "Paused" or "Complete". Any reset requests received when the sampler is in another state will be ignored.

The entire sample mechanism may also be reset when the sampling status is either "Full", "Paused" or "Complete". Any reset requests received when the sampler is in another state will be ignored. It is recommended that this reset is used when any preset data relating to the sampler is changed. Resetting this also resets the sample can information.

## Inputs Required

**Local > Sampling > Sampler.X**

Sampler Can Full.
: Input from sample can indicating it is full. (Optional)

## Outputs Required

**Active > Sampling > Sampler.X**

Can full
: Digital indication that the calculations estimate the can is full.

Grab output
: Output to the sampler to grab.

# Alarms

**Accountable Alarms**

| | |
|---|---|
| Sampler deviation | Generated when the calculated and measured can levels are outside limits. |
| Sampler can maximum | Generated when the calculated can level is above max level. |
| Sampler stopped because hi flow condition | Sample flowrate is above sample hi flow limit. |
| Sampler stopped because lo flow condition | Sample flowrate is below sample lo flow limit. |
| Sampler full | Generated when sample can full input is received. |
| Sampler input | Generated when there is a problem with the measured can level. |
| Sampler over-run | Generated when a sample request is made whilst the previous request is still active |

**Non-Accountable Alarms**

| | |
|---|---|
| Sampler deviation | Generated when the calculated and measured can levels are outside limits. |
| Sampler can hi | Generated when the calculated can level is above hi level. |

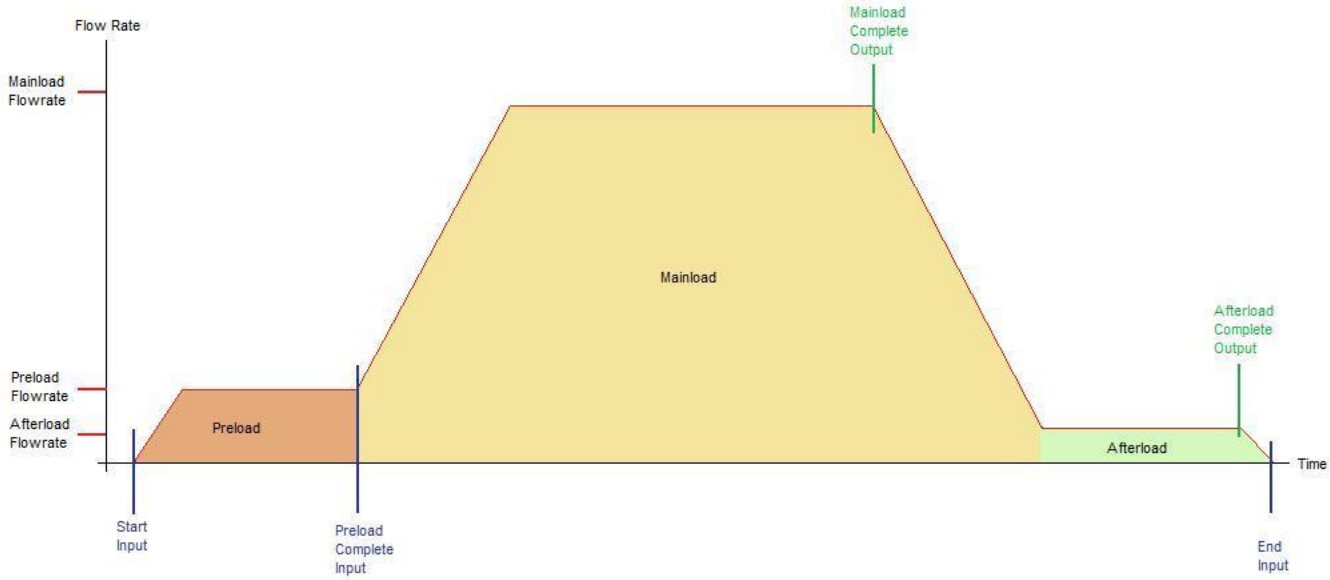
# 16. Batching

The Batching in the flow computer is split into 4 sets of data. Preset, Current, Waiting and Complete.
Preset batch data is how the batch is configured.
Once the begin batch flag has been set, the current batch data holds data relating to the currently active batch. This data is constantly updating and is stored in non-volatile memory.
Once the batch end flag has been set the batch report is moved into the batch waiting area, and the active batch data is cleared. If the batch waiting area is full, then the batch status will be moving, but will remain in the current batch data until the batch end flag is set, and there is sufficient room in the batch waiting area.
The batch waiting area can hold up to a maximum of 10 batches and is stored in non-volatile memory.
When in the waiting area the batches can be recalculated any number of times on a stream basis by using the Active → Waiting Batches → Batch X → Report Update tag. Once the recalculation has been concluded the batch can be completed by using the Active → Waiting Batches → Batch X → Report Complete tag. Once the report has been completed it is moved from the waiting area to the complete data.
The complete batch data only holds 1 report, but can be used to log all completed batch reports by setting the data to be logged on change of Active? Complete Batch ? Complete Batch Number ID.
The flow computer has two methods of batching available, but for all methods of batching the following options require configuration.
General Options:

- Density Units. Allows the selection of the density units.
- Pressure Units. Allows the selection of the pressure units.
- Temperature Units. Allows the selection of the temperature units.
- Energy Input Scale. Allows the selection of the heating value scale.
- Energy Input Type. Allows the selection of the heating value units.
- Stream Selection allows the streams that the batch is based on to be configured.
- Text is the text specific to each batch.
- The scaling tab allows the units of the batch totals to be customised. NOTE: the units of all streams in the batch, and the batch totals must match.
- The recalculation tab allows the configuration of the values that are used when the reports are recalculated.

# Fixed Batching

Fixed batching requires a trigger to start the batch, and a trigger to end the batch. This method of batching also allows optional triggers to indicate the end of the test phase, and also a pause in the batching.




Options:
Batch Measurement. Selects the counter to base the batching on.

- Use Flow Control Valves. Selects if set-points should be provided to any connected flow control valves.
- Preload Flow Rate. Flow rate to use at the beginning of the batch. (Optional).
- Mainload Flow Rate. Flow rate to use for the majority of the batch. (Optional).
- Afterload Flow Rate. Flow rate to use at the end of the batch. (Optional).
- Batch Size. Required amount of product.
- Afterload Duration. Time required to remain at afterload flowrate. This timer starts once the active flowrate is within 10% of the Afterload flowrate. When the timer expires the digital output Afterload Complete is switched on.
- End of Mainload Percentage. Percentage that Mainload should end. Once the total batch production has reached this percentage the digital output Mainload Complete is switched on.

Inputs Required

- Local → Batching → Batching X →
  - Batch Begin. Indicates the beginning of a batch.
  - Batch Preload Complete. Indicates the completion of the preload phase. (Optional).
  - Batch Pause. Indicates a pause in the batching. (Optional). This input clears any flow rate set points.
  - Batch End. Indicates the end of a batch.

Outputs Required

- Active → Current Batches → Batch X → Active Data
  - Mainload Complete
  - Afterload Complete

# Continuous Batching

Continuous batching uses a single trigger to simultaneously end the current and start a new batch.
Inputs Required

- Local → Batching → Batching X →
    - Batch Begin / End Indicates the end of the current batch, and seamless beginning of the next batch.

# 17. Network Printing

## Print Jobs

The Print Jobs page defines the method as to how and when the Print Data is printed.

Print Jobs can be added and removed using the "Add" and "Remove" buttons.

Print Jobs can be configured to activate on any single or combination of the following actions.

| | |
|---|---|
| **Events** | To configure the Print Job to activate on an event, such as an alarm, choose the relevant alarm from the Event tree. |
| **Change of value** | To configure the Print Job to activate on a change of ID, select the required ID from the 'Print on change of' selection box. |
| **Regular Interval** | To configure the Print Job to activate at a regular time interval select the required interval from the 'Print every' selection box. |
| **Manual** | To add the Print Job to the display to be manually triggered, select the 'Show on print menu' option. |

The destination printer for the report is selected by adjusting the 'Printer' selection box.

The 'Use Print Data' Selection box allows one of the pre-configured 'Print Data' reports to be selected.

The 'Archive Type' controls how the Print Data interacts with any configured logged data. This setting is useful for configuring report based on different billing periods, and has five settings:

| | |
|---|---|
| **None** | There is no archiving required, so any logged data will refer to either the most recent or oldest data in the log. |
| **Row Based** | This allows several items of data to be printed from the same log record. Particularly useful for printing Proving, Validation or Batch reports. |
| **Daily Report** | This allows data to be printed from a specified day, between contract times. |
| **Weekly Report** | This allows data to be printed from a specified week. Starting from Sunday and ending on Saturday. |
| **Monthly Report** | This allows data to be printed from a specific calendar month. |

If an Archive Type is selected then the 'Archive Index' becomes enabled. This allows a specific time period to be selected and will vary based on the Archive type.

For Row Based Archives the Archive Index will be a selection of the Log Table required to access the data on the print report.

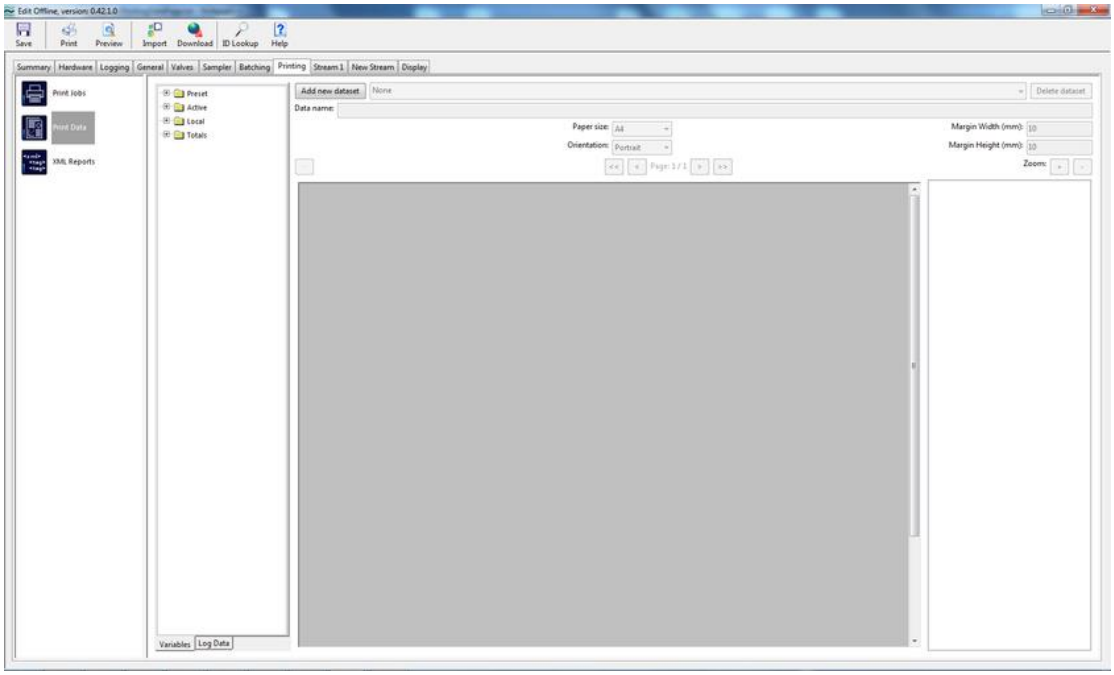
For Daily Reports the Archive Index will be a selection of days, starting from the current day stretching back to any specific day for 1 month.

For Weekly Reports the Archive Index will be a selection of weeks, starting from the current week stretching back a maximum of 4 weeks.

For Monthly Reports the Archive Index will be a selection of months, starting from the current month stretching back to any specific month for the last year.

# Print Data

The "Print Data" page controls all the information about the data to be printed, including page setup and how the page is laid out. Items are added by right clicking on the page diagram and selecting, as appropriate, from the right click menu or by dragging and dropping from the trees on the left of the page. Once added, items can be dragged with the mouse or (for fine positioning) using the arrow keys. There are also various alignment and spacing options which can be implemented to improve report aesthetics as well as copy paste options. Holding the "Alt" key increases the amount by which arrows keys move items. Holding "Ctrl" will allow for the selection/deselection of multiple Ids and for the use of copy/paste/select all hot keys.




Datasets can be added and removed using the "Add new dataset" and "Remove dataset" buttons.

The "Paper Size" option allows the destination medium to be selected.

The Width and Height margins define the margins around the page.

The Orientation option allows the page to be printed in either portrait or landscape.

It is possible to zoom in and out from the page using the Zoom +/- buttons.

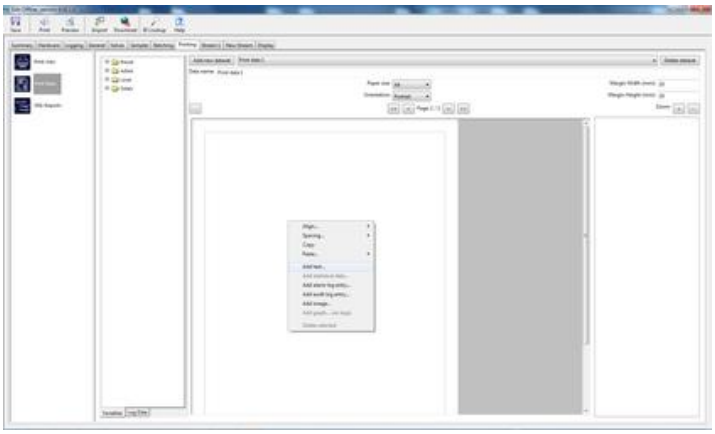
New individual pages can be added/inserted/deleted using the . button.

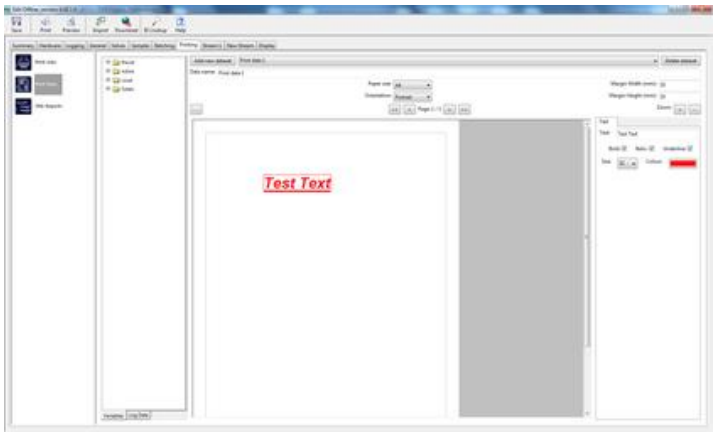
Data item formatting is implemented using the formatting option window displayed to right of the data page. When changing formatting options the changes will be applied to all selected data item that support that formatting option.

The individual data items that can be added to the print report are as follows.

## Text

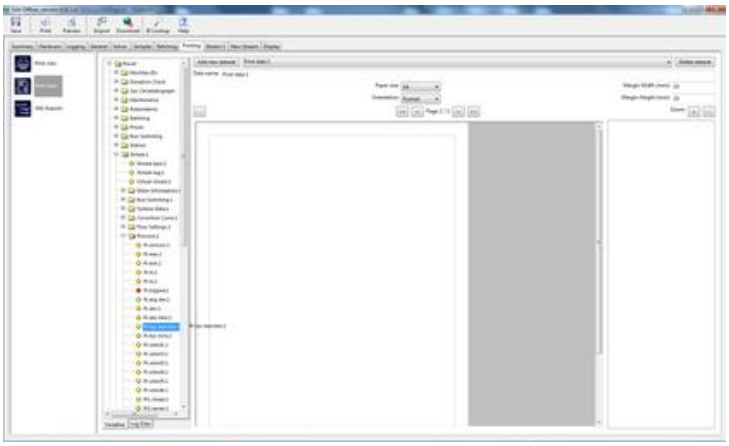
Allows a fixed text string to be added to the report. Text can be changed and formatted, in the option windows in the right, to be any combination of Bold, Italic or Underlined. The font size and colour can also be selected.

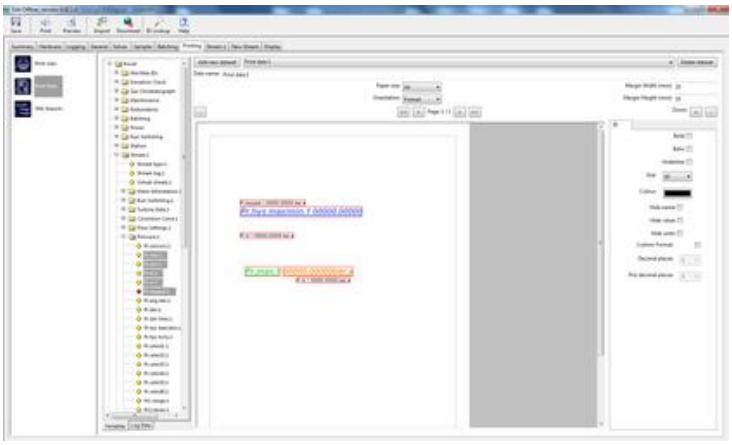





## ID's

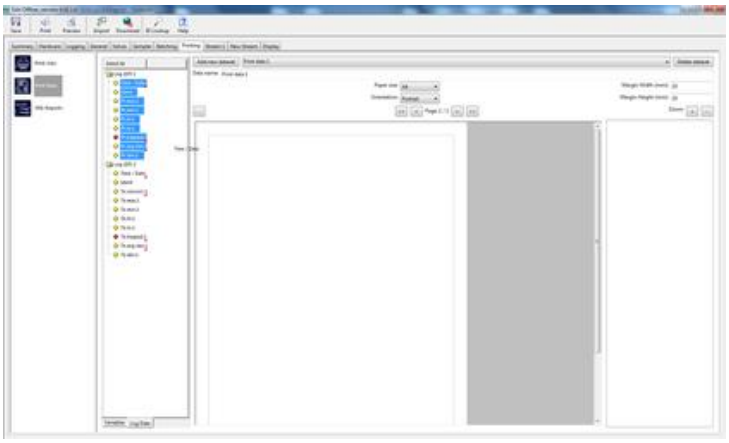
IDs can be added to the data report by dragging and dropping them onto the page from the tree on the left, and then a range of formatting options, show in the window to the right, to show or hide the name, value or units. If required the default formatting for the value can be overwritten. The ID can be formatted to be any combination of Bold, Italic or Underlined. The font size and colour can also be changed using the options panel to the right.

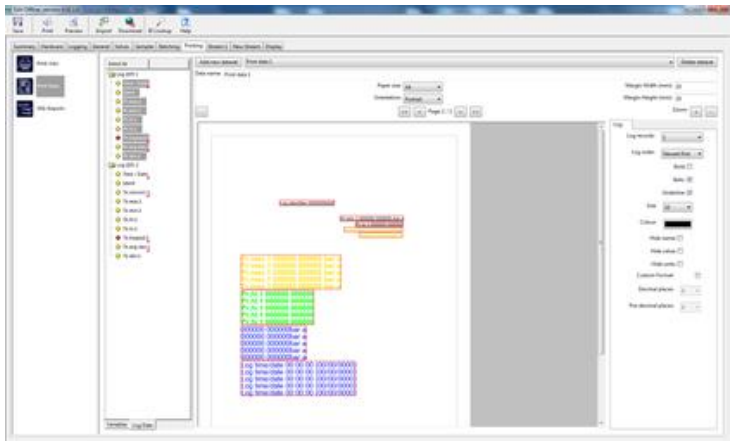




## Logged Data

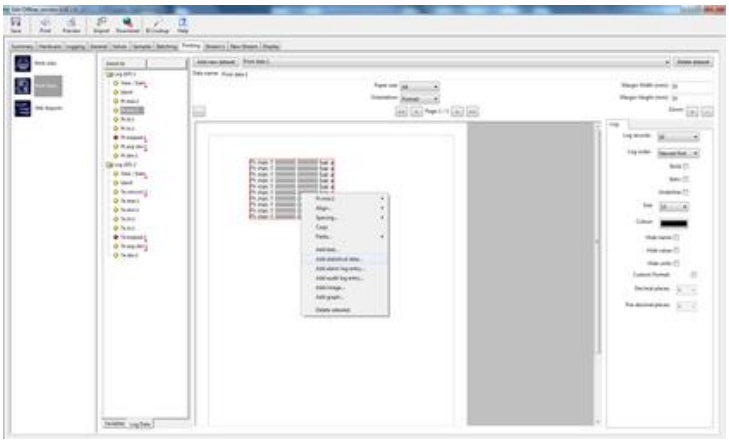
Allows logged data to be added to the report. The required Logged ID's are chosen from the Log tree on the left of the window by dragging and dropping on the page. This can then be ordered to show either the Oldest or Most Recent entry first by changing the value of the Log order selection box. The number of log records can be selected. For Row Based reports this should be left at 1, but for other reports this can be changed to fit your data requirements. As with the ID formatting a range of formatting options are available to show or hide the name, value or units. If required the default formatting for the value can be overwritten. The ID can be formatted to be any combination of Bold, Italic or Underlined.

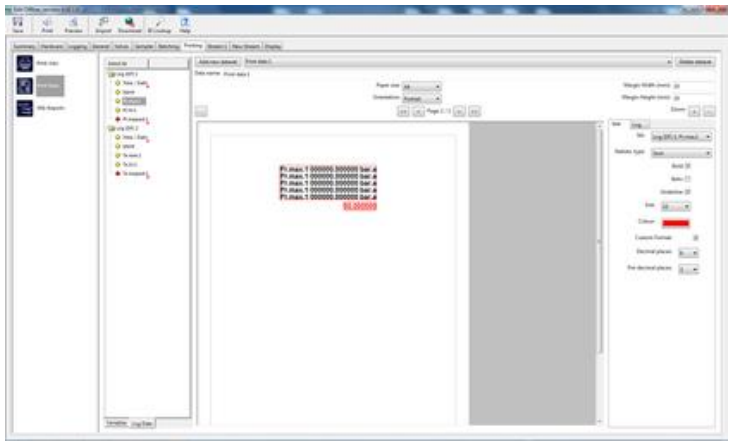




## Statistical data

Allows statistics, created from logged data, to be added to the report. In the ID selection box the Log IDs available for the application of statistical analysis are listed. Only one statistics item may be assigned per log item. If the report contains no log data items then it will not be possible to create a statistics item. Also if a log item already has a statistics item assigned to it that item will not appear in the ID dropdown. The statistic type is selected using the type selection box from either the Sum, Average, Minimum or Maximum. Holding "Ctrl" and left clicking a statistics item, while no other items are selected, will also select the log item on the page that it is assigned to. If a log item has a statistic item associated with it then the statistic item will have to be deleted before the log can be deleted. Statistical items can be formatted to be any combination of Bold, Italic or Underlined etc.



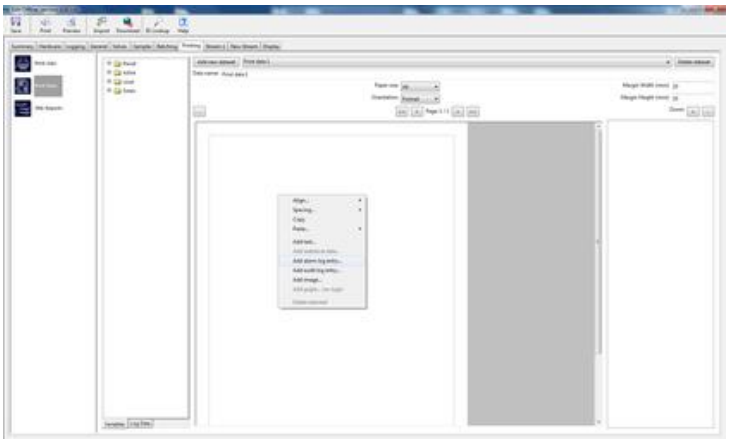


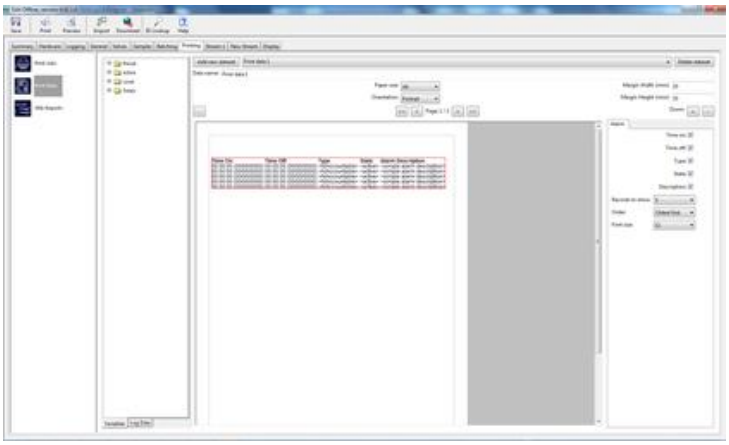
## Alarm Log Data

Allows data from the alarm history to be added to the report. The required fields can be selected from:

| | |
|---|---|
| **Time On** | The time the alarm occurred. |
| **Time Off** | The time the alarm expired (if applicable). |
| **Type** | The alarm type. Either Accountable, Non-Accountable, Warning or Fault. |
| **State** | The current alarm state. Either Active or Expired. |
| **Description** | The alarm description. |

Other selections include the number of records to show, the order of the records and the font size.



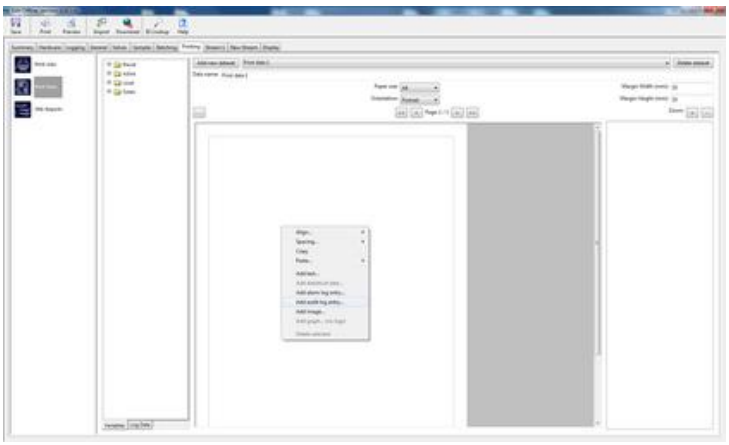


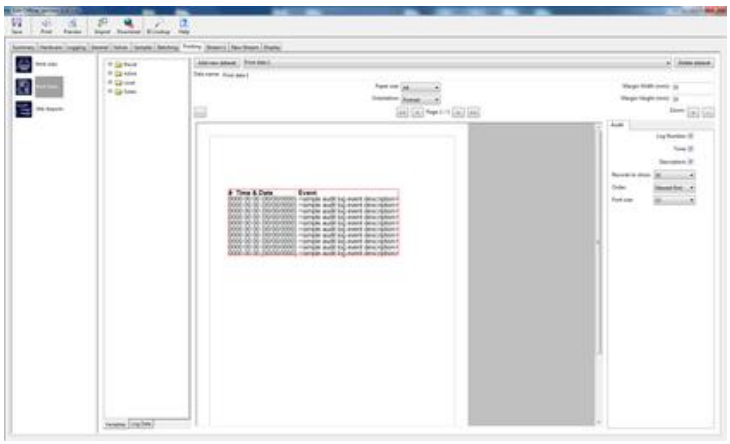
## Audit Log Data

Allows data from the audit history to be added to the report. The required fields can be selected from:

| | |
|---|---|
| **Time** | Time of the event. |
| **Description** | Description of the event. |

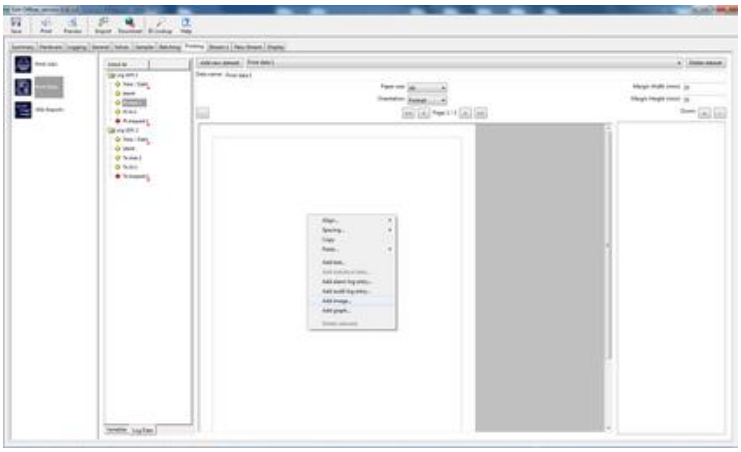
Other selections include the number of records to show, the order of the records and the font size.

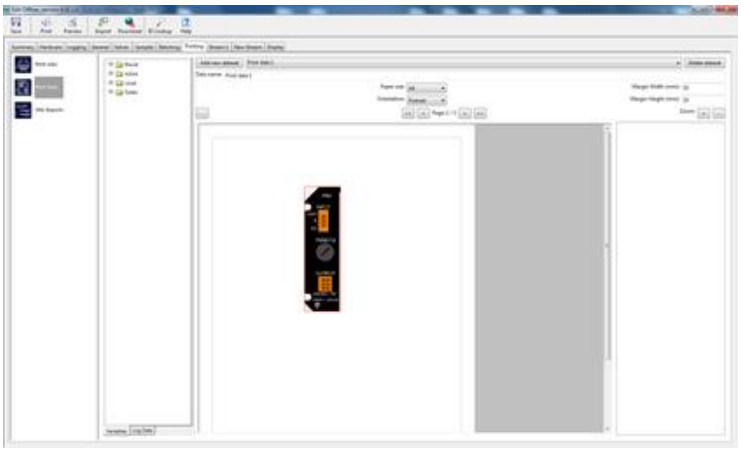




## Images

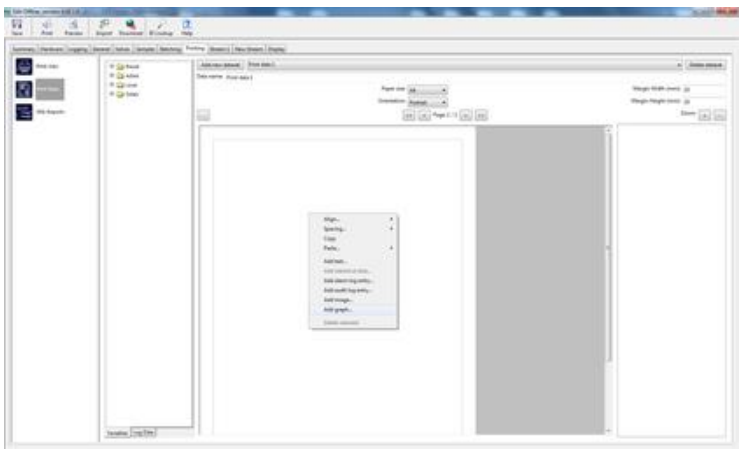
Allows images to be added to the report. These can be either .png, .bmp, .jpg or .gif files. Any resizing of the loaded images must be done prior to the image being loaded. There no formatting options available for an image item.

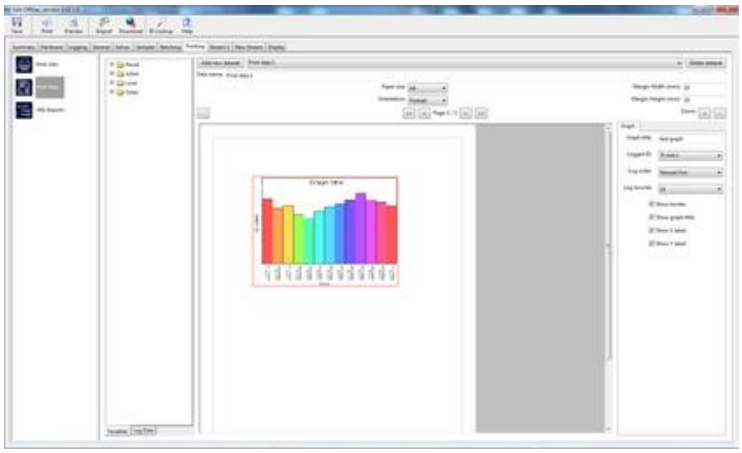




## Graphs

Allows graphs based on logged data to be added to the report. The graph can be customised to allow the Border, Title, X Axis Label or Y Axis Label to be either shown or hidden. A title can be added and the ID to graph is selected from the Logged ID selection box. Other selections include the number of records to show and the order of the records.





# XML Reports

This page controls all the information about the data to be included in a report in XML format, these reports are produced by attaching them to a print job. Reports are built by dragging items from the tree on the left hand side of the page over to the right hand side. On dragging an item into the report its configuration dialog appears.

The data name is used to identify the XML report when attaching it to a print job. The filename of the generated report starts with the contents of the "Code name" field, followed by the contents of the "File name" field, and finishes with the date and time that the report was printed, in the form CCCCMMDDHHMMSS (Century, Month, Day, Hours, Minutes, Seconds).

It should be noted that in order for the report to be valid XML the entire report must be enclosed within a single tag. For instance:

```
<section>
        ...
</section>
<new_section>
        ...
</new_section>
```

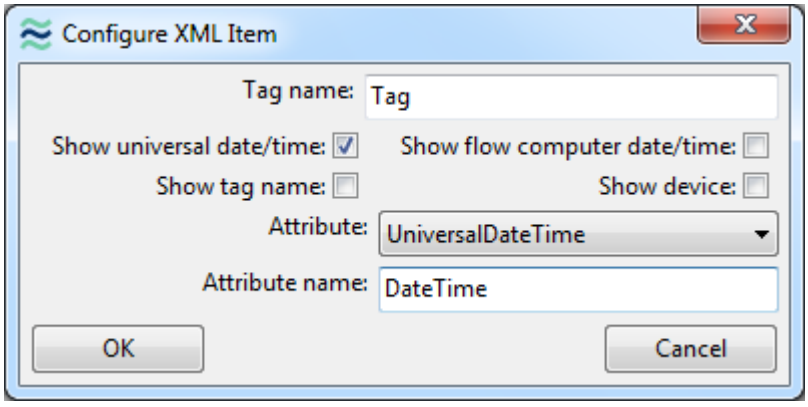
would not produce a valid XML document, whereas:

```
<report>
        <section>
                ...
        </section>
        <new_section>
                ...
        </new_section>
</report>
```

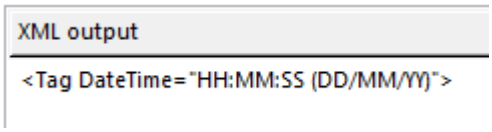
would produce a valid report.

## Begin Tags

These are found in the "XML Tags" tab of the tree and are generally used to mark out a distinct section (or subsection) of a report. Their name is configurable and they can have various attributes added. The configuration dialog for opening XML tags is shown below.



The tag in the XML report is shown below.

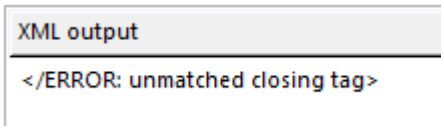



The tag name and any attributes may not be empty or contain spaces. The number of begin tags must be exactly matched by the number of end tags.

## End Tags

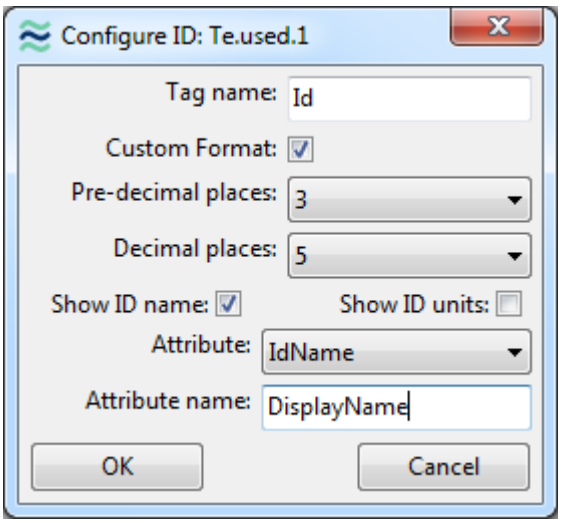
Closing tags are found in the "XML Tags" tab of the tree have no options associated with them; they simply close the most recently opened XML tag and as such they have no configuration dialog.

There must be exactly the same number of begin tags as end tags, and their order must be appropriate (i.e. no end tags at the start of a report and begin tags at the end). An end tag in an error state is shown below.



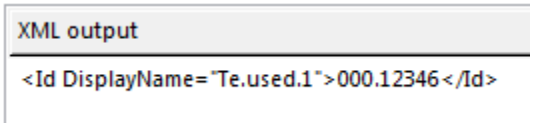

## IDs

IDs are found in the "Variables" tree tab. The exact format of the id can be specified if desired, along with attributes listing its name and units. Since it can be difficult to remember what ids are shown there, it is recommended to add the ID name attribute for clarity. The configuration dialog is shown below.

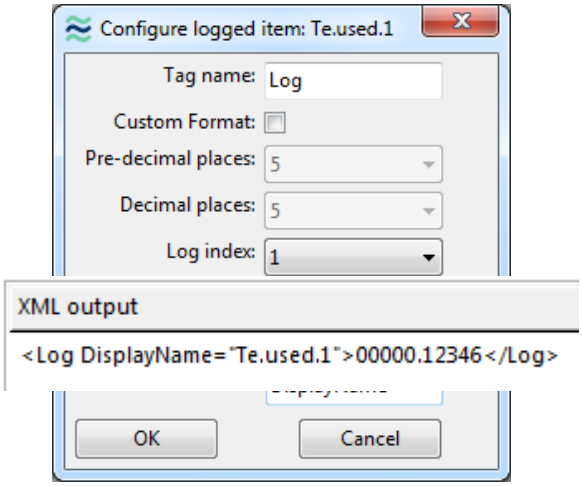


The id as shown in the report is below.

## Log Data

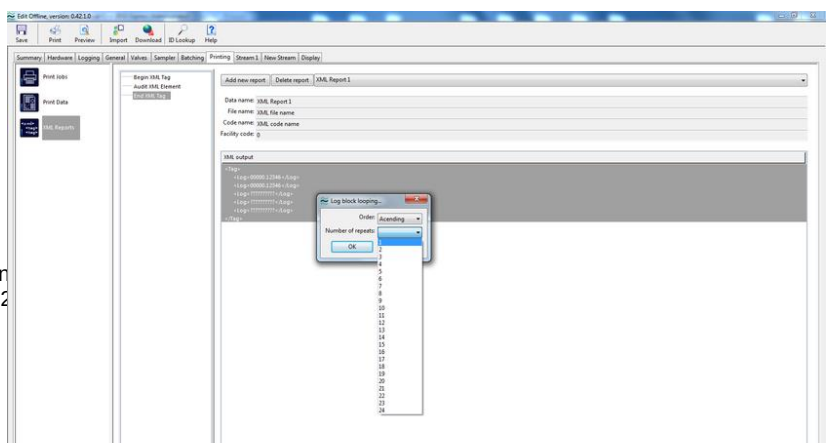



Found in the "Log Data" section. The same notes apply here as to the ID tags, but now the log index must be specified. The configuration dialog and the corresponding XML entry are shown below.



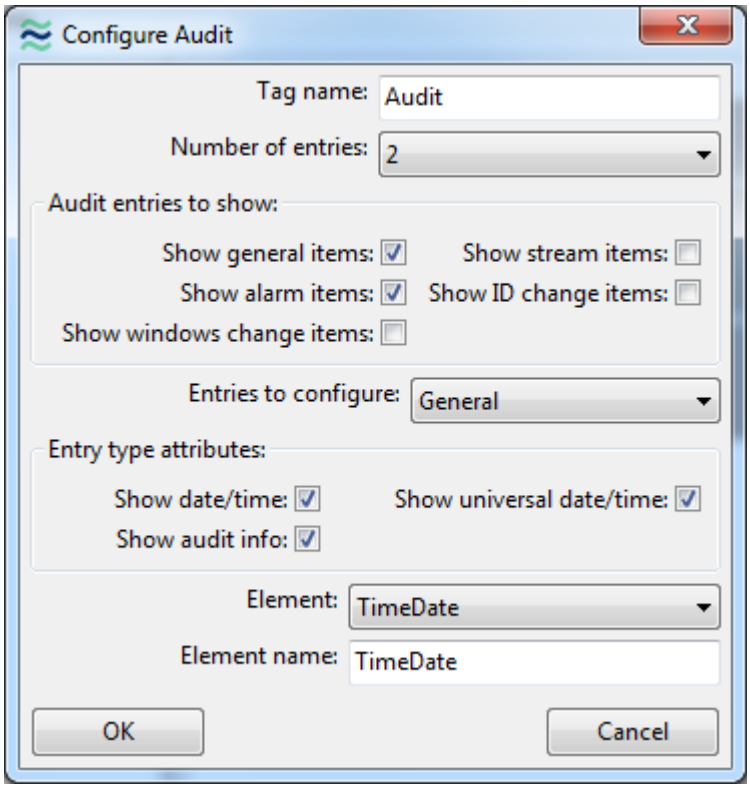

## Repeat Log Block

If required, it is possible to repeat a block of log entries in the item list, incrementing the index each time. The entries being repeated in the report must be encapsulated by a begin and end tag and must all be log items from the same log. To apply the repeat functionality, first select the items in the list which are to be repeated, including the blocks begin and end tags, then right click the block and select the Apply Log Looping option from the menu. A settings box will appear allowing you to set both the order and the number of times the block will repeat. Once the repeat block is created no items can be added to it.



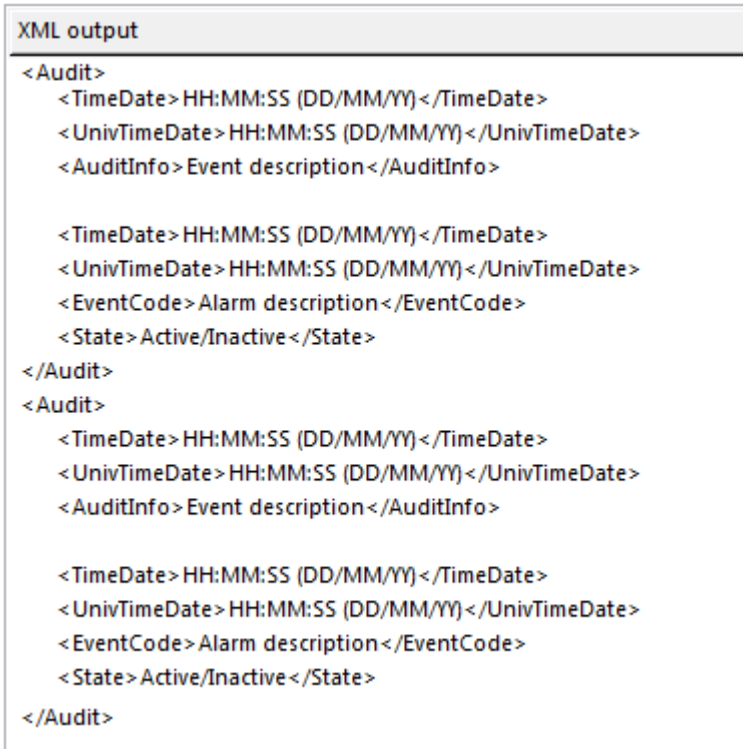
# Audit Log Data

Audit items are found in the "XML Tags" tab and allow items from the audit log to be show. The configuration of audit items is a little more complex than other items. The dialog is shown below.




It is possible to filter the types of entries displayed by using the tick boxes in the "Audit entries to show" box. If there are entries of that type in the audit log they will be added to the report.

Showing an entry type adds it to the "Entries to configure" drop down list. By selecting an entry type from this drop down list the "Entry type attributes" box changes so that the presence of attributes for that type can be configured. The audit item as displayed in the XML output is shown below.

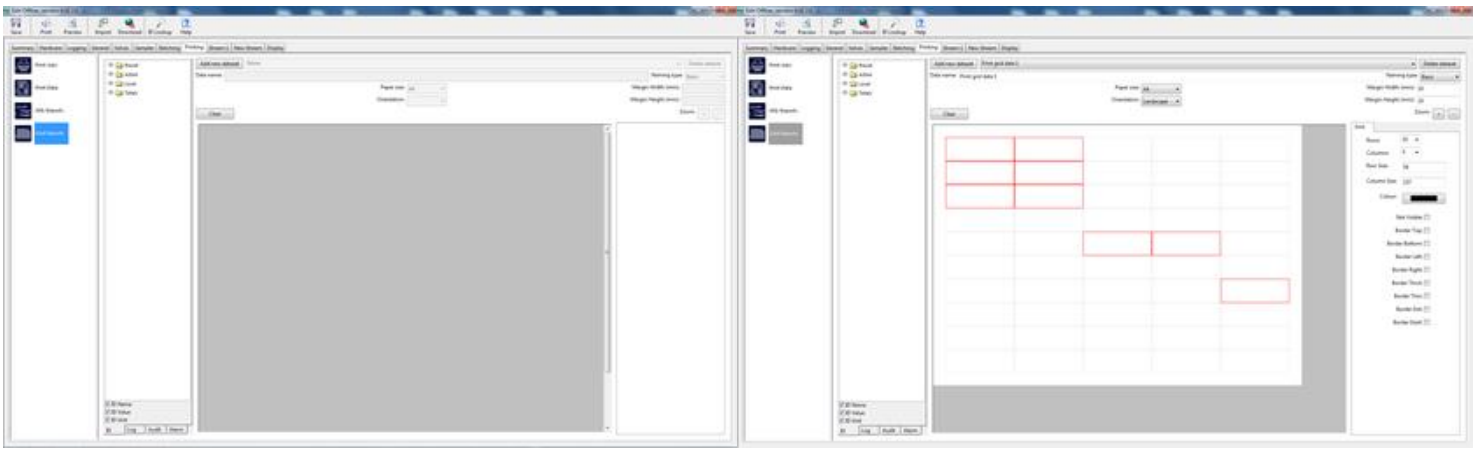



Note that if multiple entry types are selected they will all appear in the XML diagram on the right-hand side (separated by a blank line), but since each audit log entry is of only one type, only one of the types will appear. For instance, in the example below, in each <Audit> element, either the block of the first three items will appear, or the block of the last four items.

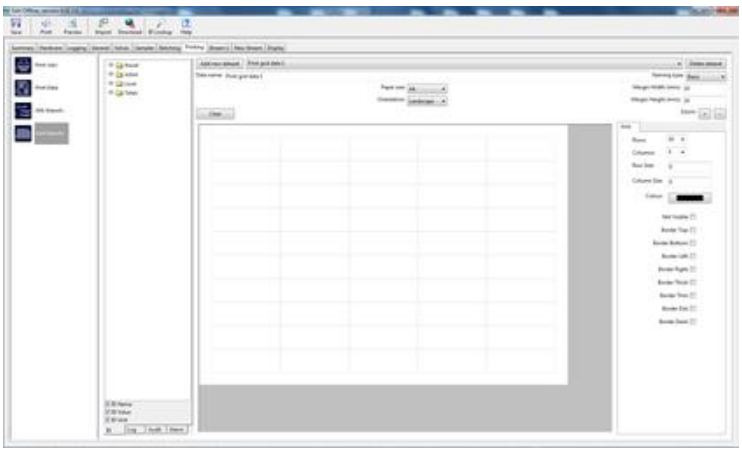
# Print Grid Data

## Print Data

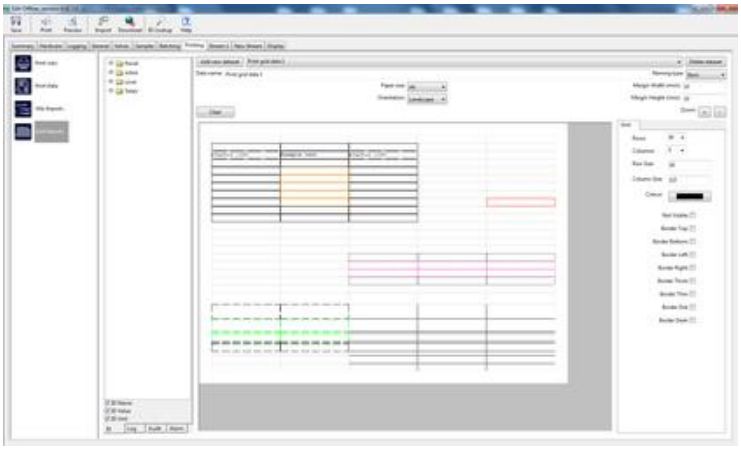
The "Print Data Grid" page controls all the information about the grid data to be printed, including page setup and how the page is laid out. Items are added by right clicking on the page diagram and selecting, as appropriate, from the right click menu or by dragging and dropping from the trees on the left of the page. Cells within the grid can be selected by left clicking or by drag selecting. Holding "Shift" when clicking will select vertical or horizontal line of cells whereas holding "Ctrl" and clicking will allow for the selection of multiple cells across the whole grid. Pressing the arrow keys will move the selected cell in the direction of the arrow pressed.



Once a cell is selected the grids layout and configuration options become available in the formatting tab displayed in the right side of the page. The number of rows and the number of columns are selectable from their drop down boxes, to a maximum of 50x50. The size of the rows and columns, in pixels, is also changeable using the row size and column size input boxes. Only the rows and/or columns selected will be affected by any changes to the row/column size options. The row and column sizes are also changeable by dragging the boarders as required.



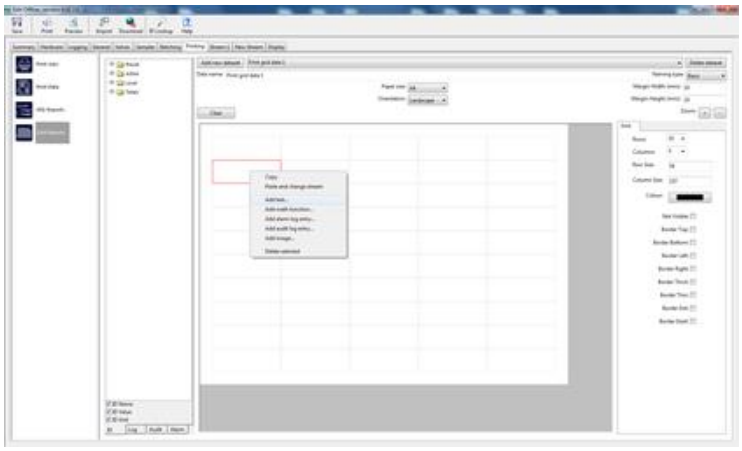
Each cells visibility can be changed as required using the visible check box, when a cell is not visible it will be displayed in the report with cross hatching through its contents. For each cell in the grid there are also configuration options pertaining to the boarder of the cells which are shown in the formatting tab on the right side of the page. The drawing of all four boarders of the cell can be turned on or off using the respective check boxes. The boarder colour change be selected using the colour picker. The boarder can also be set as either thick, thin, dots or dashes using the respective thick/thin/dots/dashes check boxes

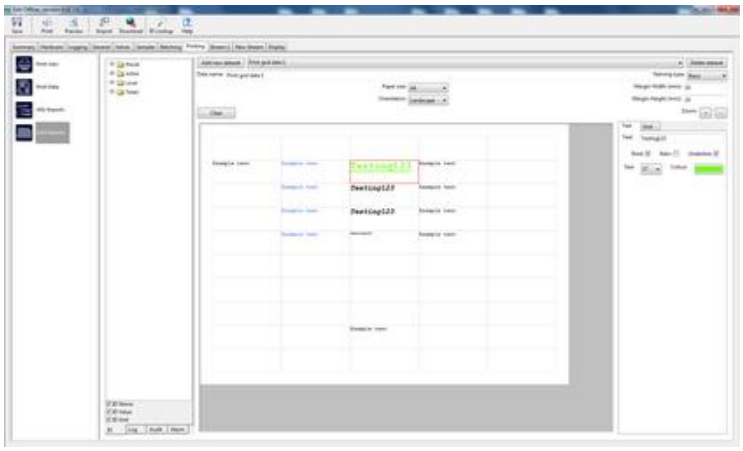


Datasets can be added and removed using the "Add new dataset" and "Remove dataset" buttons. The "Paper Size" option allows the destination medium to be selected. The Width and Height margins define the margins around the page. The Orientation option allows the page to be printed in either portrait or landscape. It is possible to zoom in and out from the page using the Zoom +/- buttons. Data item formatting is implemented using the formatting option window displayed to right of the data page. When changing formatting options the changes will be applied to all selected data items of that type. The individual data items that can be added to the print report are as follows.

## Text

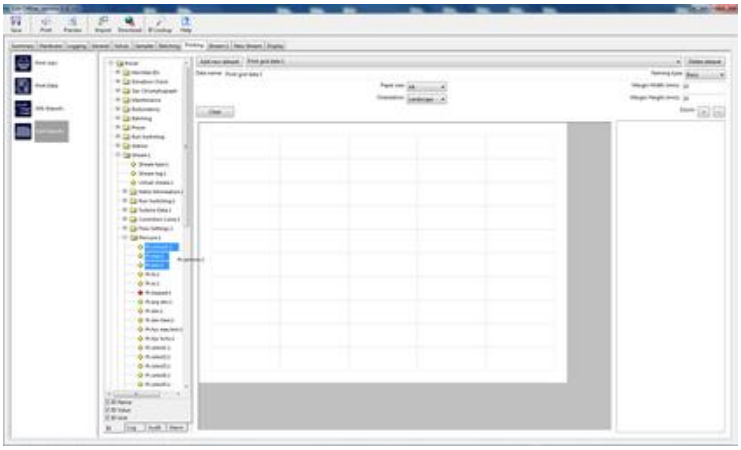
Allows a fixed text string to be added to the report in the selected cell/s. Text can be changed and formatted, in the option windows in the right, to be any combination of Bold, Italic or Underlined. The font size and colour can also be selected.

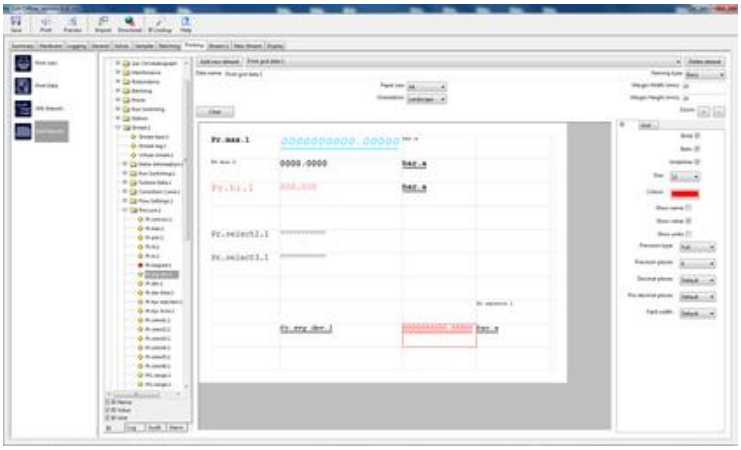




## IDs

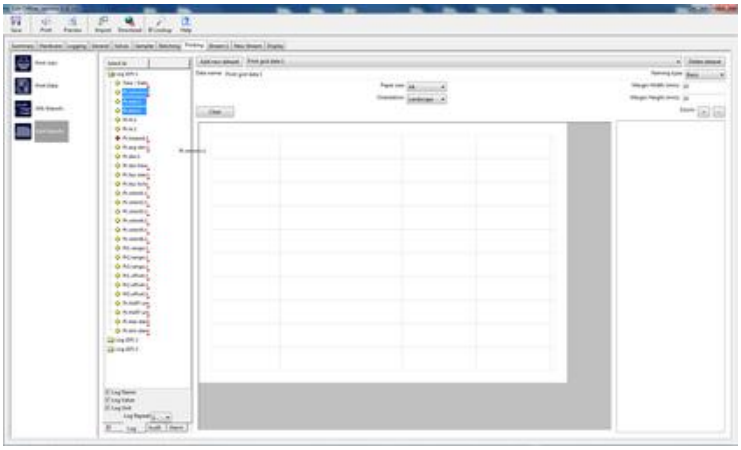
IDs can be added to the report by dragging and dropping them onto the page from the tree on the left. While dragging the ID's destination cells will be highlighted in red. Below the ID tree are three check boxes which are used to indicate which parts of the ID will be dropped on the grid. A range of formatting options, show in the window to the right, can then be changed to show or hide the name, value or units. If required the default value formatting, e.g decimal/predecimal/field width/precision, can be overwritten using the various drop downs. The ID can be formatted to be any combination of Bold, Italic or Underlined. The font size and colour can also be changed using the options panel to the right.

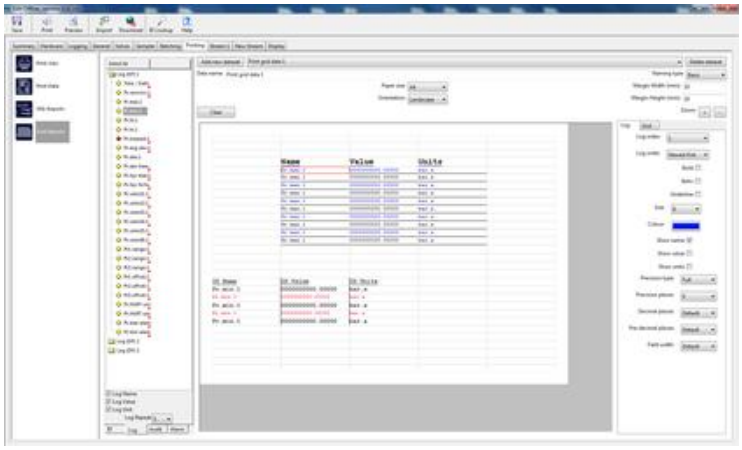




## Logged Data

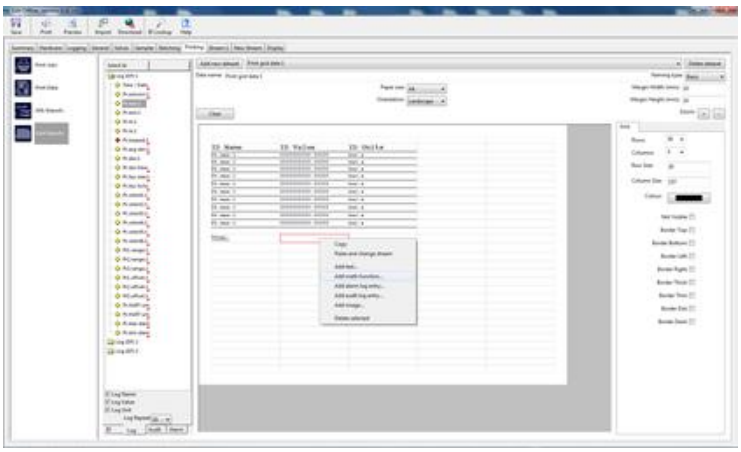
Allows logged data to be added to the report. The required Logged ID's are chosen from the Log tree on the left of the window by dragging and dropping on the page. Like the ID's, the elements of the log data to be included, e.g. name, value or units, are selectable using the check boxes shown below the log tree with the addition of a repeat value. This indicates how many times a piece of log data can be duplicated when dropped. If only one log ID is being dragged then each dropped piece of log data will have its log index value incremented accordingly. Log order can also be ordered to show either the Oldest or Most Recent entry first by changing the value of the Log order selection box. These options are also changeable for the log data once it has been dropped using the log data formatting tab on the right side of the page. If required the default value formatting, e.g. decimal/predecimal/field width/precision, can be overwritten using the various drop downs. The ID can be formatted to be any combination of Bold, Italic or Underlined. The font size and colour can also be changed using the options panel to the right.



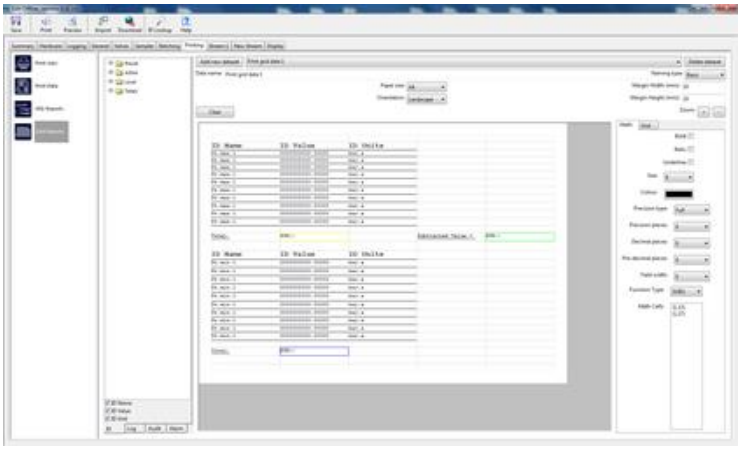


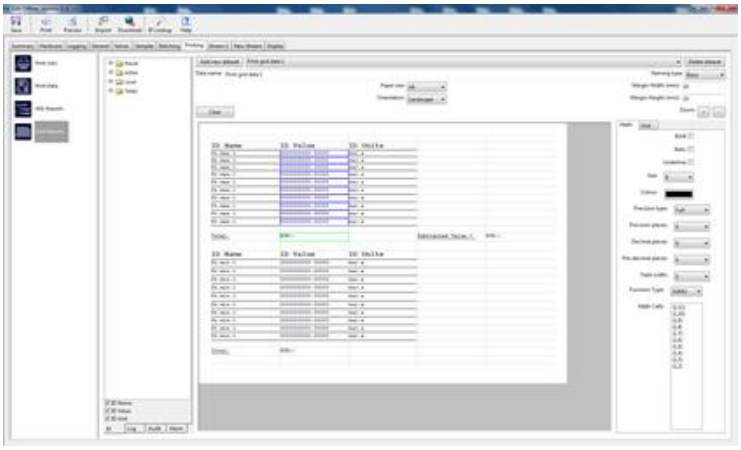
## Mathematical data

A mathematical cell is added to the report using the right click options menu and are highlighted on the grid in green when selected. Once the cell is added it is possible to 'assign' calculation cells to that math cell by holding "Ctrl" and left clicking the cells you would like to assign. A cell can be unassigned by clicking it when already assigned. Once a cell is assigned its co-ordinates will be displayed in the math cells list shown in the math formatting tab on the right of the page and will be highlighted on the grid in blue when its 'parent' math cell is selected. It is possible to select which type of calculation should be applied using the function type dropdown.



The available types are sum, average and subtract. When using the subtract type the cell which will be subtracted from is the first cell listed in the math cells list, show on the formatting tab to the right, and is highlighted in the grid in yellow. If required the default value formatting, e.g. decimal/predecimal/field width/precision, can be overwritten using the various drop downs. The ID can be formatted to be any combination of Bold, Italic or Underlined. The font size and colour can also be changed using the options panel to the right.



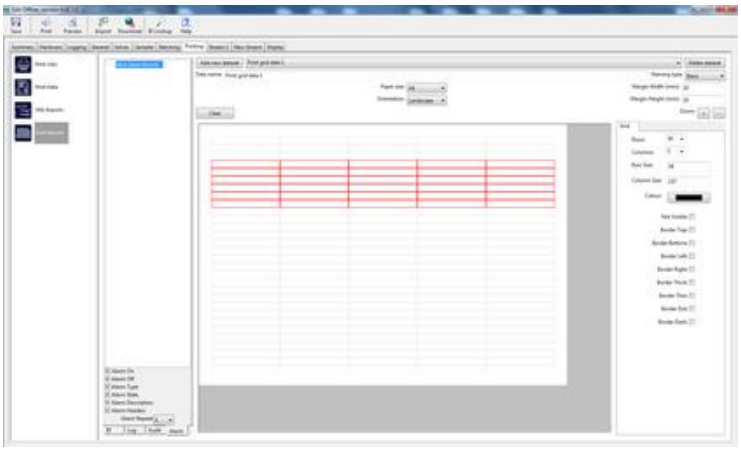


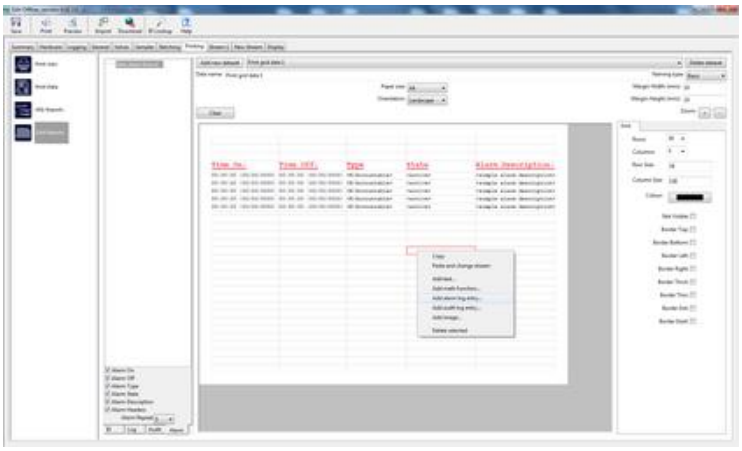
## Alarm Log Data

Allows data from the alarm history to be added to the report. This can be done in two ways, the first is to use the right click menu to add alarm data to all the selected cells. The second is to drag and drop the alarm data from the tree shown on the left of the window. When dragging from the tree it is possible to configure which elements of the record will be dropped on the grid using the check boxes and repeat value combo box shown below the alarm tree. The required fields can be selected from:

**Time On** - The time the alarm occurred.
**Time Off** - The time the alarm expired (if applicable).
**Type** - The alarm type. Either Accountable, Non-Accountable, Warning or Fault.
**State** - The current alarm state. Either Active or Expired.
**Description** - The alarm description.
**Headers** - The header of each column.

Once the data is dropped on the grid these options are modifiable in the formatting tab displayed to the right of the window. Other selections include the order of the records and the font size.



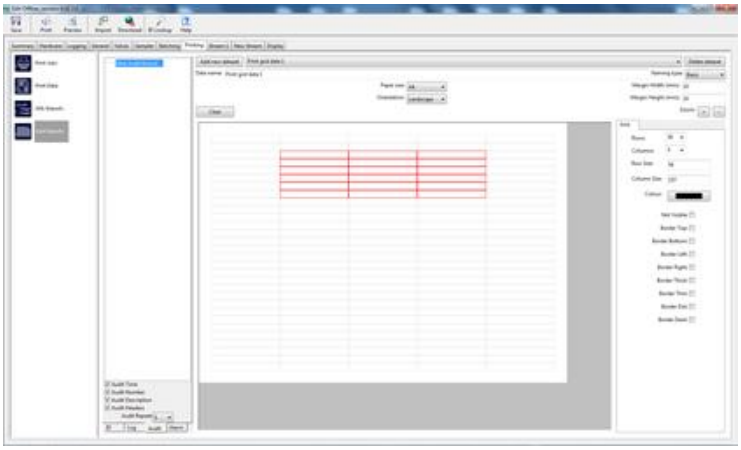


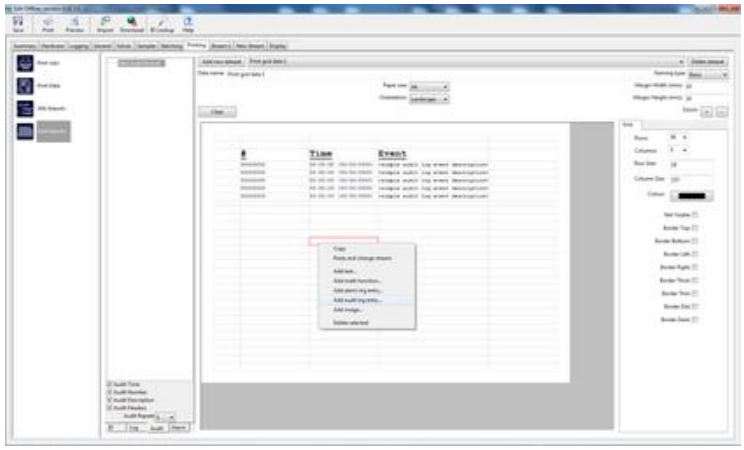
## Audit Log Data

Allows data from the audit history to be added to the report. This can be done in two ways, the first is to use the right click menu to add audit data to all the selected cells. The second is to drag and drop the audit data from the tree shown on the left of the window. When ragging from the tree it is possible to configure which elements of the record will be dropped on the grid using the check boxes and repeat value combo box shown below the audit tree. The required fields can be selected from:

**Number** - Number of the event.
**Time** - Time of the event.
**Description** - Description of the event.
**Headers** - The header for each column.

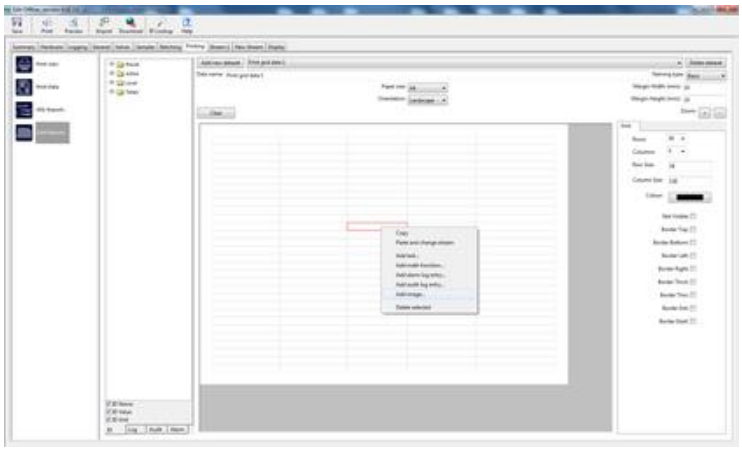
Once the data is dropped on the grid these options are modifiable in the formatting tab displayed to the right of the window. Other selections include the index of the records, the order of the records and the font size.

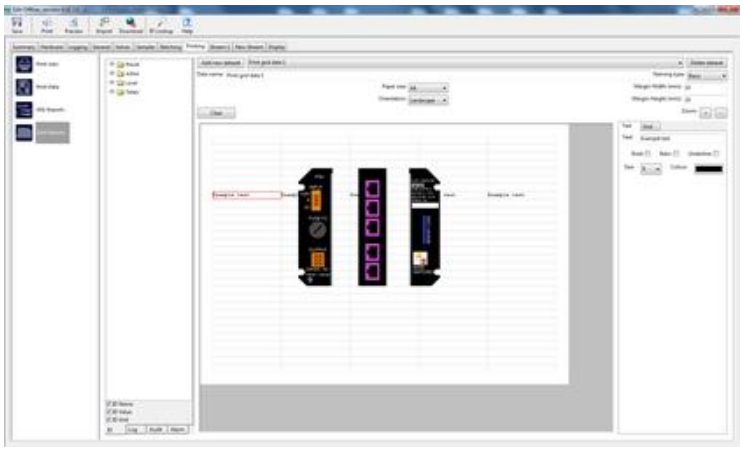




## Images

Allows images to be added to the report. The images are not assigned to any cells and can be moved freely around the report by dragging them as required.The images can be either .png, .bmp, .jpg or .gif files. Any resizing of the loaded images must be done prior to the image being loaded. There are no formatting options available for an image item.





# 18. Station

## Station Totals

Sets the summation criteria and scaling factors to be used, when the flow computer is used in a multistream configuration with requirements to create Station totals. Two different regimes can be separately configured Station A and Station B.

## Station Units

Sets the Global Station Units to be used Imperial or Metric and the scaling factors for each of the station flow rate types.

## Preset Counters (A)

Allows the Station Totalisers A to be configured to a starting value.

## Preset Counters (B)

Allows the Station Totalisers B to be configured to a starting value.

# 19. Stream

Pages for setting up items of flow computer data, data that will apply a single stream of the machine. The data is divided into groups, which are selected by individual icons.

## Units

### General

Sets the Global Units to be used for stream, Imperial or Metric, together with the stream units for density, pressure, temperature. Additionally Pressure measurement in Absolute or Gauge and the Value for Pressure Atmospheric if Gauge is selected. Water Content units can be independently set to Metric or Imperial.

### Metric

Sets the scaling or multiplier units for each of the following categories of data:-

| | |
|---|---|
| Volume Units | m3, km3, Mm3, Gm3, Tm3 |
| Std Volume Units | Sm3, kSm3, MSm3, GSm3, TSm3 |
| Energy Units | Std, Kilo, Mega, Giga, Tera for Units of Joules, Watts or Calories |
| CO2 | g CO2, Kg CO2, tonnes CO2, K tonnes CO2, M tonnes CO2 |
| Mass Units | g, Kg, tonnes, K tonnes, M tonnes |

### Imperial

Sets the scaling or multiplier units for each of the following categories of data:-

| | |
|---|---|
| Volume Units | Std, Kilo, Mega, Giga, Tera for Units of ft3, bbl, US Gallons |
| Std Volume Units | Std, Kilo, Mega, Giga, Tera for Units of Sft3, Sbbl, US S Gallons |
| Energy Units | Std, Kilo, Mega, Giga, Tera for Units of BTU |
| CO2 | oz CO2, lbs CO2, tons CO2, K tons CO2, M tons CO2 |
| Mass Units | oz, lbs, tons, K tons, M tons |

## Turbine

### Gas

Sets parameters associated with the main Meter Input for the stream. Turbine refers to pulse counting inputs and can be used for other pulse output type meters. Meter input can be configured for 1 or 2 pulse outputs from the meter.

For one input set the Blade Ratio to 0 , for two inputs set the blade ratio to 1 or whatever value is appropriate for the ratio between the two inputs.

A separate scaling K factor can be entered for both inputs in pulses per volume.

In addition a frequency minimum cut off point below which no frequency can be entered in Hz and a Frequency offset also in Hz for calibration or simulation can be entered normal default value for this is 0.

## Liquid

Sets parameters associated with the main Meter Input for the stream. Turbine refers to pulse counting inputs and can be used for other pulse output type meters. Meter input can be configured for 1 or 2 pulse outputs from the meter.

API standard 5.5 levels B to E will require input parameters as follows:-

For one input set the Blade Ratio to 0 , for two inputs set the blade ratio to 1 or whatever value is appropriate for the ratio between the two inputs.

A separate scaling K factor can be entered for both inputs in pulses per volume.

In addition a frequency minimum cut off point below which no frequency can be entered in Hz and a Frequency offset also in Hz for calibration or simulation can be entered normal default value for this is 0.

API standard 5.5 levels A will require input parameters as follows:-

Turbine Frequency Deviation in Hz

Turbine pulse limit in pulses

Turbine pulse interval in seconds

Turbine Failure limit in pulses

Turbine Direction change in pulses

In addition a frequency minimum cut off point below which no frequency can be entered in Hz and a Frequency offset also in Hz for calibration or simulation can be entered normal default value for this is 0.

# Ultrasonic

There are 3 tabs on this page both Gas and Liquid types are very similar

Meter Input Tab, sets Meter type or manufacturer number of measurement paths, Metric or imperial units and any meter specific parameters associated with the main Meter Input for the stream. It is important to consult the Meter manufacturers operating instructions for further guidance.

On the Pulse Input Tab, Primary Flow data from the meter can be read serially using the communication method for the meter selected by Primary measurement menu **USM Direct** or as a pulse input from Primary measurement menu **Frequency Input**. A flow comparison system can be set up if required between the two measurement inputs with deviation and time alarm settings.

The Meter Correction tab allows the selection of any Pressure or Temperature expansion correction to be selected from

None

Correction for Flanged configuration

Correction for Welded configuration

Correction in accordance with ISO 17089

# Differential Pressure

## General

Sets the general parameters associated with Differential Pressure measurement. Such parameters are (see calculations manual for more details):

- What pressure measurement range transmitters will be used (High, Mid, Low) and if more than one such transmitters is selected, at which percentage of their max value to switch between them.
- Type of DP meter that is being used. The various types supported are described below (Orifice, Venturi etc. not all are available for Liquid streams).
- Pipe expansion correction equations to be used. Currently supported methods are:
    - Standard
    - GOST 8586: 2005
- Pipe and flow element constants such as important dimensions and calibration values.
- For Liquid streams the Isentropic Exponent can also be setup here.

## Orifice Plate

This page sets Equations and options specifically related to Orifice Plate meter type. It is available for both Gas and Liquid streams.

## Classical Venturi

This page sets equations and options specifically related to Classical Venturi meter type. It is available for both Gas and Liquid streams.

## Venturi Nozzle

This page sets equations and options specifically related to Venturi Nozzle meter type.

## ISA 1932 Nozzle

This page sets equations and options specifically related to the ISA 1932 Nozzle meter type.

## Long Radius Nozzle

This page sets equations and options specifically related to the Long radius Nozzle meter type.

## Cone

This page sets equations and options specifically related to the Cone meter type.

## Annubar

This page sets equations and options specifically related to the Annubar meter type. It is available for both Gas and Liquid streams.

# CoD Table

If on the Differential Pressure page, Classical Venturi tab a Use Table is selected for CoD calculation, this page is used to set the values of CoD to be used in that table. Any table of size from 1 to 10 values of Pressure and Temperature can be entered here. Linear interpolation is carried out between table values.

# CoD Reynolds Table

If on the Differential Pressure page, Classical Venturi tab a Use Table is selected for Reynolds calculation, this page is used to set the values of CoD Reynolds to be used in that table. Linear interpolation is carried out between table values.

# Liquid Coriolis

Sets Meter type or manufacturer and parameters associated with the main Liquid Coriolis Meter Input for the stream.

Primary Flow data from the meter can be read serially **Meter direct** or using a pulse output from the meter **Frequency Input** on the Pulse Input Tab. The meter scaling factor is also set on this page.

The Density Deviation tab, allows a comparison to be made between calculated or measured density and the density indicated by the Coriolis Meter. This comparison can be used to set an Accountable or Non accountable alarm if the difference between densities exceeds a preset percentage for a given period of time.

# Flow Rates and Totals

Sets, Qmax and Hi and low flow alarm limits and scaling factors for all totalisers (both Imperial and Metric).

For Gas Meter Linearisation correction can be entered as a table of data points of flow rate and corresponding error. The size of the table can be selected from 2 to 20 points. The correction type is linear where the correction is applied through the operating range and MID where the correction is limited under Low and high flow conditions as required by the MID approval See Instruction manual paragraph 3.6.1
A Calculate button allows the user to simply check the correction that would be applied at any flow rate entered.

For Liquid Meter correction an individual Meter Factor can be entered or K Factor Curve of points can be entered for up to 5 different liquid products A, B, C, D, or E. If Meter Factor is selected then a Meter Factor, Shrinkage Factor and Preset K Factor in pulses / volume are entered. If K factor is selected then additionally up to 20 flow rates with a corresponding K factor can be entered.

# Tariff

Up to 4 separate tariff bands can be set up, this allows separate pulse outputs to be enabled for the same parameter depending upon which tariff band the actual flow rate of that parameter is actually in.

The flow rate parameter to be used to determine the tariff bands is selected from the pull down id tree Tariff flow rate.

A flow rate value in the same units as the actual parameter can then be entered for each of the available bands Level 1, 2 or 3 Maximum.

When setting up the Pulse outputs (See Section 12 Digital Outputs) Select the pulse output parameter from the Tariff Folder.

The Level 1 output will apply when the flow rate is between 0 and Level 1 Max Value

The Level 2 Output will apply when the flow rate is between Level 1 Max Value and Level 2 Max Value.

The Level 3 Output will apply when the flow rate is between Level 2 Max Value and Level 3 Max Value.

The Level 4 Output will apply when the flow rate is above Level 3 Max Value.

# Pressure

Sets all parameters associated with the stream pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# Temperature

Sets all parameters associated with the stream temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# DP High

Sets all parameters associated with the stream differential pressure high range measurement. Number of measurement sensors 0, 1, 2 or 3, dp ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set.

# DP Mid

Sets all parameters associated with the stream differential pressure mid range measurement. Number of measurement sensors 0, 1, 2 or 3, dp ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set.

# DP Low

Sets all parameters associated with stream 1 differential pressure low range measurement. Number of measurement sensors 0, 1, 2 or 3, dp ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set.

# Gas Measurement

# Line Density

## General

Sets up to 6 levels of source of density measurement, alarm and keypad values for density measurement and the Calculation constants for Ratio of Specific Heats.

## Measured

If the source of Density is set to measured, e.g. direct from a Corriolis meter this page sets the parameters associated with Pressure and Temperature measurement.

## Z Equation

If the source of Density is selected to be calculated using a Z factor calculation, then the standard of Calculation and other associated values are selected and entered here.

# Density Sensor 1 / 2

If on the previous page a direct measurement of Density is selected, then a page associated, with the type of sensor will appear. All certification and Calibration parameters for the Sensor type can be entered here, together with optional corrections for VOS, and Correction for Pressure and temperature of the Density sensor.

# Z Table

If on the Line Density page, Z Equation tab a Table Z Factor is selected, this page is used to set the values of Z Factor to be used in that table. Any table of size from 1 to 10 values of Pressure and Temperature can be entered here. Linear interpolation is carried out between table values.

# Base Density

Sets up to 3 levels of base density measurement, alarm and keypad values for density measurement and the Zn calculation standard to be used if the option of Zn calculation is chosen.

# Relative Density

Sets up to 3 levels of source of measurement of Relative Density, alarm and keypad values and parameters associated, with direct relative density measurement sensors.

# Heating Value

Sets up to 3 levels of source of Heating Value measurement, together with alarm and keypad values for both Superior and Inferior Heating Values.

# Gas Data

## Selection

Sets up to 4 levels of source of measurement of Gas Data From:

Keypad
Chromatograph A
Chromatograph B
Modbus data written in
Analogue Input
Last Good Value received
Last Hour Average
Last Day Average
Calculated H2O value

The Gas Average source can be selected to come from:
Chromatograph A
Chromatograph B
Modbus data written in
Analogue Input

When a Gas component is in an Error or Alarm state selection can be made to use all other received gas data or to not use it.

Normalisation of Gas Data received can be selected from
None
Normalise all components to 100%
Normalise Raw GC Data

## Normal

Sets Keypad and Alarm values for 22 Normal Gas components used within ISO6976 and AGA 8 Calculations.

## Extended

Sets Keypad and Alarm values for 34 Extended gas components that are listed within ISO 6976.

# GPA 2145

## Normal

Allows user entry of GPA 2145 parameter values for 22 Normal Gas components used within GPA 2145 and or AGA 8 Calculations. Parameters are

Mr Molar Mass

Gid Molar Mass Ratio

Hmid Ideal Gross heating Value Mass

Hvid Ideal Gross heating value Volume

hmid Ideal net heating value Mass

hvid Ideal net heating value Volume

bi Summation factor

For complete information of these parameters and the values that should be used reference to the standards GPA 215 and GPA 2172 should be sought. These standards are revised on a regular basis and as such care should be chosen to make sure the year of issue is appropriate to the desired use.

## Extended

Mr Molar Mass

Gid Molar Mass Ratio

Hmid Ideal Gross heating Value Mass

Hvid Ideal Gross heating value Volume

hmid Ideal net heating value Mass

hvid Ideal net heating value Volume

bi Summation factor

For complete information of these parameters and the values that should be used reference to the standards GPA 215 and GPA 2172 should be sought. These standards are revised on a regular basis and as such care should be chosen to make sure the year of issue is appropriate to the desired use.

## Select Standard

Select the Year of the Standard GPA 2145 to Use from 1989 or 2003.

# General Calculations

Selection and Set up parameters associated with the calculation of Base Density of Air, Molecular Weight and CO2 Emissions Factor.

# Constants

Values of universal Constants used in the Calculation process, Tb, Pb, Molar Mass of Air, Z of air and g.

# Options

List of Mode Switch options.:-

| | |
|---|---|
| MS Inc nV in Acc | Increment Normal Totals when in Accountable Alarm |
| MS Inc eV in Acc | Increment Error Totals when in Accountable Alarm |
| MS count pulses during LoQ | Totals continue when in Low Flow condition |
| MS zero flow during LoQ | Flow rate set to zero when in Low Flow condition |
| MS use Nacc LED for LoQ | Indicate Low Flow Condition with Non Accountable LED |
| MS use digital +ve counter | Use Digital switch Input to enable +ve flow total |
| MS use digital -ve counter | Use Digital switch input to enable –ve flow total |
| MS use digital invert flow | Use Digital switch input to indicate flow direction |
| MS Indicate Acc alarms during loQ | Selects if Accountable alarms should be indicated during low flow conditions. |
| MS Indicate Nacc alarms during loQ | Selects if Non-Accountable alarms should be indicated during low flow conditions. |
| MS Use modbus timeout alarm | Selects if the modbus timeout alarm should be used for this stream. |
| MS Use PGC 9000 | Selects if this stream expects gas from a PGC 9000, and also the stream number that corresponds to the GC. |

# Preset Counters

Allows the Stream Totalisers to be configured to a starting value.

# Run Switching

The Run Switching in the flow computer will only become active when a Station Set point is received in the register "Local > Run Switching > Station Set point" To instantly disable Run Switching an invalid number should be written to this register.

A run can individually be made available or unavailable by using the switch "Local > Stream.X > Run Switching ... Stream". If a run has been made offline due to an error it will not automatically become online until, an operator must manually change the status to available.

The General Settings determine the following:

- The run priority selection allows the control of the order in which the streams are opened and then closed. No two streams should have the same priority.
- The maximum and minimum capacity values refer to the percentage of QMax that is found on the "Flow Rates and Totals" page. Once a stream set point above the maximum % of QMax is required a new stream will be opened if this is one available. And likewise if the calculated stream set point is below the minimum % of QMax then the lowest priority stream will be closed.

The Inlet and Outlet Valve Settings configure how the corresponding valves are controlled:

- The control option selects if this valve should be controlled or not.
- The alarm option selects if the valve alarms should be used or ignored for this valve.

- The open and close durations refer to the length of time the corresponding command is sent.
- The transition duration is the maximum amount of time it should take for the valve to move. If this time is exceeded then an alarm will occur.

## Inputs required

**Local > Stream.X > Run Switching > Inlet / Outlet Valve**

| | |
|---|---|
| Run Inlet Open Feedback | Open status received from the valve. |
| Run Inlet Close Feedback | Closed status received from the valve. |
| Run Inlet Failure Feedback | Failure indication received from the valve |
| Run Inlet Automatic Feedback | Mode selection received from the valve. |

## Outputs required

**Active > Stream.X > Run Switching > Inlet / Outlet Valve**

| | |
|---|---|
| Run Inlet Open Output | Signal from the flow computer to open the valve. |
| Run Inlet Close Output | Signal from the flow computer to close the valve. |

The Flow Control Valve Settings control the flow based on the flow rate Qbc.

- The control option selects if this valve should be controlled or not.
- The keypad set point selects the default position for the valve if there is no set point present.
- The P, I and D actions control the rate at which the valve moves.
- The maximum and minimum output levels are the limits at which the valve can operate.

## Inputs Required

None.

## Outputs Required

**Active > Stream.X > Run Switching > Flow Control Valve**

Run Flow Percentage.

Indicates the current percentage open level of the flow control valve.

## Alarms

The Inlet and Outlet valves will use the same alarms as described in the valve configuration.

## Accountable Alarms

Run switching maximum capacity A set point has been received, but the flow rate is not achievable.

# Liquid Measurement

## $\rho_{tp}$

### Measured

If the source of Density is set to measured, e.g. direct from a Corriolis meter this page sets the parameters associated with Pressure and Temperature measurement.

### Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

### Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

### Serial

If the source of Density is selected to be written in serially this page sets the parameters associated with Pressure and Temperature measurement.

### Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

### Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Table

If the source of Density is selected to be a table this tab sets the parameters associated with Pressure and Temperature measurement.

## Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Solartron or Sarasota

If the source of Density is selected to be a Solartron or Sarasota Transducer a separate page ρtp 1/2 will appear where all parameters associated with the Density Transducer are configured together with the Temperature and Pressure measurements for the Transducer.

# $\rho_{tp}$1/2

If on the previous page a direct measurement of Density is selected, then a page associated with the type of sensor will appear. All certification and Calibration parameters for the Sensor type can be entered here, together with optional corrections for VOS, and Correction for Pressure and temperature of the Density sensor.

## Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# $\rho_{tp}$TABLE

If on the ρtp page, a Table Density is selected, this page is used to set the values of density to be used in that table. Any table of size from 1 to 10 values of Pressure and Temperature can be entered here.

## $\rho_m$

Sets the options and parameters for the Calculations for CTSm, CPSm, CTLm, CPLm and βm

## $\rho_S$

Sets the options and parameters for the Calculations for CTLρ, CPLρ and βρ

## $\alpha t$

Sets the options and parameters for the Calculations for αt

# Basic Sediment and Water correction

Sets the options and parameters for the Calculations for the basic sediment and water correction in accordance with API Ch 12.2.1

# Steam Measurement

## $\rho_{stm}$

### General

This page sets the following,

Up to 4 levels of order of selection can be set None, Keypad, IAPWS IF97, Sensor, Modbus or Table. Alarm limits for the value, Max, Min, Hi and Lo together with the Keypad value can also be entered here.

Under the Viscosity tab the source of Viscosity is entered as either Keypad or IAPWS IF97 together with the actual keypad value if required.

### Measured

If the source of Steam Density is set to measured by a HART transmitter this page allows the transmitter alarms and indicated Units to be ignored.

# Steam Density Table

If on the ρstm page, a Table Density is selected, this page is used to set the values of density to be used in that table. Any table of size from 1 to 10 values of Pressure and Temperature can be entered here.

# Enthalpy

This page sets the following,

Up to 3 levels of order of selection can be set  None, Keypad, Modbus, Analogue, IAPWS IF97, Last Good Value, Last Hr Average or Last Day Average. The Source of the Average Enthalpy is also selected here Used, Analogue, Modbus or IAPWS IF97. Alarm limits for the value, Max, Min, Hi and Lo together with the Keypad value can also be entered here.

# 20. Proving

## Liquid Prover

Pages for setting up items of flow computer data, data that will apply when the machine is configured as a prover. The data is divided into groups, which are selected by individual icons.

## Constants

Values of universal Constants used in the Prover Calculation process, Tb and Pb

## Pressure

Prover Pressure settings are divided into 3 tabs:-

General

Sets the units of Pressure to be used, gauge , absolute measurement  value of Atmospheric pressure and other parameters associated with all prover pressure measurement.

It is assumed that the pressure measurement in the Prover system , can consist of measurement on the Inlet side of the prover, or on the outlet side or both in which case the average is used, separate configuration tabs apply to Inlet and Outlet.

Inlet and Outlet

For both Inlet and Outlet the following parameters are associated with the pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

Prover Temperature settings are divided into 3 tabs:-

General

Sets the units of Temperature to be used and other parameters associated with all prover temperature measurement.

It is assumed that the temperature measurement in the Prover system , can consist of measurement on the Inlet side of the prover, or on the outlet side or both in which case the average is used, separate configuration tabs apply to Inlet and Outlet.

Inlet and Outlet

For both Inlet and Outlet the following parameters are associated with the temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# Alarm Setting

Sets the alarm conditions for a Re-Prove Alarm to be generated or for the conditions during approve to be monitored:-

## Re-prove :-

Prover , Pressure, Temperature, Density and Corrected Flow can be monitored and the deviation of these items from previous values used to determine if a new prove is required.

A Deviation value in % and a Deviation time in Seconds is set for each parameter. A Deviation Value in per cent for each parameter is calculated from the Equation:-

$$\text{Deviation} = \frac{\text{Currentcondition} - \text{ReferenceCondition}}{\text{ReferenceCondition}} \times 100$$

If the value of the item is greater or less than the Deviation limit for the preset time period, then a Re-prove alarm will be raised.

A decision on Re-prove must then be made by the operator and Proving started manually by his command.

## Start of prove :-

Prover , Pressure, Temperature, Density and Corrected Flow can be monitored during the prove cycle and the values of these items used to determine if the current prove run should be stopped.

A Deviation value in % and a Deviation time in Seconds is set for each parameter. A Deviation Value in per cent for each parameter is calculated from the Equation:-

$$\text{Deviation} = \frac{\text{Currentcondition} - \text{ReferenceCondition}}{\text{ReferenceCondition}} \times 100$$

If the value of the item is greater or less than the Deviation limit for the preset time period, then current prove cycle will be stopped, a report generated and the system will return to idle state.

A decision on the next action must then be made by the operator.

# Prover Options

List of Prover set up options:

Configuration of a Prover is considered an advanced operation and it is assumed that the configurator and operator is familiar with prover operation in general and the specific prover that is being used in the system that is being configured.

The Option Page consists of 2 tabs:-

## General

Allows the operator to Configure:-

The Prover type, Bi-directional Ball Prover type or Small Volume Piston prover or Master Meter prover or Uni-directional prover.
The Number of Streams to be proved from 1-5
The Number of points to prove 1 to 20
Maximum number of Runs that can make up a prove before the prove is stopped.
Maximum number of runs allowed to fail in a prove, before the prove is stopped.
Update K Factor or Meter Factor
Release the PID flow Control Valve between runs Yes or No

Replace Valves to starting position on Prove failure Yes or No

For Bi-direction Ball Prover two maximum times can be set
Maximum allowable loop time in Seconds
Maximum allowable chamber time in Seconds

For Small Volume Prover additional parameters can be set
Maximum forward time in Seconds - maximum allowable piston forward move time
Maximum reverse time in Seconds – maximum allowable piston reverse move time
Use Home detection switch Yes or No
Plenum Deviation in %
Plenum Deviation time in seconds
Plenum constant R
Plenum constant pressure

For Master Meter Prover additional parameters can be set
Master Meter Correction using Meter factor or K Factor curve
Master Meter Preset MF
Master Meter Preset K Factor in pulses /m3

For Uni-direction Ball Prover four times can be set
Ball release time in seconds
Maximum allowable loop time in Seconds
Maximum allowable chamber time in Seconds
Pump check delay time in seconds

# Stability

The Prover can be configured to check the Stability of any or all of the parameters, Pressure, Temperature and Flow before the prove sequence is initiated. Once the proving sequence has been initiated the prover will wait for the Minimum stability duration setting, time in seconds before adjusting the prover loop outlet valve and it will wait up to a user selectable maximum stability duration time, in seconds for the flow, pressure or temperature to stabilise. If the required stabilisation level is not met then the prove will be aborted. The stabilisation is checked by calculating the standard deviation of the selected parameter over the last x seconds (where x is the Minimum stability duration time) by using the equation shown below.

$$\sigma = \sqrt{\frac{\sum_{x}^{1}\left(qM - \overline{qM}\right)^2}{x - 1}}$$

Once stabilisation has been achieved the prover computer will continue with the prove sequence.

# Calculation

Calculation set up for K-Factor and for the Liquid Corrections

## K-Factor

Allows the operator to Configure:-

The Prover Units Metric or Imperial.
The Number of Detector switches to be used 2 3 or 4
If 3 or 4 switches are selected the combination of switches to be used for the prove
Average All
1 + 3
2 + 4
1 + 4
2 + 3
The Prover Volume for those switch combinations
The K-Factor Calculation method is selected from Traditional repeatability, Statistical repeatability or from an Uncertainty Calculations as below:-
This input basically sets the limit at which the Prove is deemed to be complete in each case the result will be of the form of a confidence level which is then compared to a preset Confidence Level and once this value has been exceeded then the prove is complete and the results calculated etc. Provided the number of Required runs has been exceeded.

Selection of method of calculating the repeatability and uncertainty of K Factor.

| ***Prover, K-Factor, K-Factor Calculation*** |
|---|
| Statistical Repeatability |
| Traditional Repeatability |
| Uncertainty |

**Statistical Repeatability**
An estimator for the Mean K-factor ,$\mu$, is given by Equation 1. Assuming that all K factors ,**X**, follow a normal distribution with standard deviation ,**s**, and average ,**/X**, the estimator for the Mean K factor ,$\mu$, will follow a Student-t distribution with ,**(n-1)**, degree of freedom.

$$1) \qquad P\left(\bar{X} - t_{\frac{\alpha}{2},n-1}\frac{s}{\sqrt{n}} < \mu < X + t_{\frac{\alpha}{2},n-1}\frac{s}{\sqrt{n}}\right) = 1-\alpha$$

The uncertainty band ,$\delta$, (confidence level) at 95% confidence level ($\alpha$=5%) for the estimator for the Mean K-factor ,$\mu$,. is given by Equation 2

$$2) \qquad \delta = 200 \times t_{\frac{\alpha}{2},n-1}\frac{s}{\bar{X}\times\sqrt{n}} \quad \%$$

Equation 2 gives an uncertainty band for the average of the proving results and shall be less or equal to the NPD repeatability of 0.050% band for an acceptable prove cycle.

**Traditional Repeatability**

$$3) \qquad \text{Rangeof Repeatability} = \frac{\text{MaxValue} - \text{MinValue}}{\text{MinValue}} \times 100 \quad \%$$

Where:
Max and Min values are taken from the last x runs where x is the number of required runs.

**Uncertainty**

Taken from the Uncertainty calculation from API Chp 4 Appendix A
Pulse Interpolation can be selected from None or Dual Chronometry, where none is selected then a Minimum number of pulses over which the measurement is made must be entered. Dual Chronometry does require any additional data to be entered.

## Liquid Correction

The configuration for the various liquid corrections are entered here:-

Sets the options and parameters for the Calculations for CTSp, CPSp, CTLp, CPLp, αp and βp

# Density Options

## General

There are 3 options for the Prover Density measurement.

| | |
|---|---|
| None | No Prover Density measurement is done. |
| Full | Density measurement is undertaken using a separate density prover input from a Transducer or alternative method of density input. Key pad values and alarm level values are entered on this page. Up to 4 levels of source of density measurement can be set. |
| P & T | In this option Density Measurement is not undertaken in the Prover but is measured in the individual flow computers. Density Input Pressure and Temperature measurement is however configured on separate pages , which will appear when this option is selected. |

## Measured

If the source of Density is set to measured, e.g. direct from a Corriolis meter this page sets the parameters associated with Pressure and Temperature measurement.

## Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Serial

If the source of Density is selected to be written in serially this page sets the parameters associated with Pressure and Temperature measurement.

## Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Table

If the source of Density is selected to be a table this tab sets the parameters associated with Pressure and Temperature measurement.

## Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Solartron or Sarasota

If the source of Density is selected to be a Solartron or Sarasota Transducer a separate page $\rho$tp 1/2 will appear where all parameters associated with the Density Transducer are configured together with the Temperature and Pressure measurements for the Transducer.

# $\rho_{tp}$1/2

If on the previous page a direct measurement of Density is selected, then a page associated with the type of sensor will appear. All certification and Calibration parameters for the Sensor type can be entered here, together with optional corrections for VOS, and Correction for Pressure and temperature of the Density sensor.

## Pressure

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

## Temperature

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 4 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# $\rho_{tp}$TABLE

If on the Density setup page, a Table Density is selected, this page is used to set the values of density to be used in that table. Any table of size from 1 to 10 values of Pressure and Temperature can be entered here.

# $\rho_s$

Sets the options and parameters for the Calculations for CTL$\rho$, CPL$\rho$ and $\beta\rho$

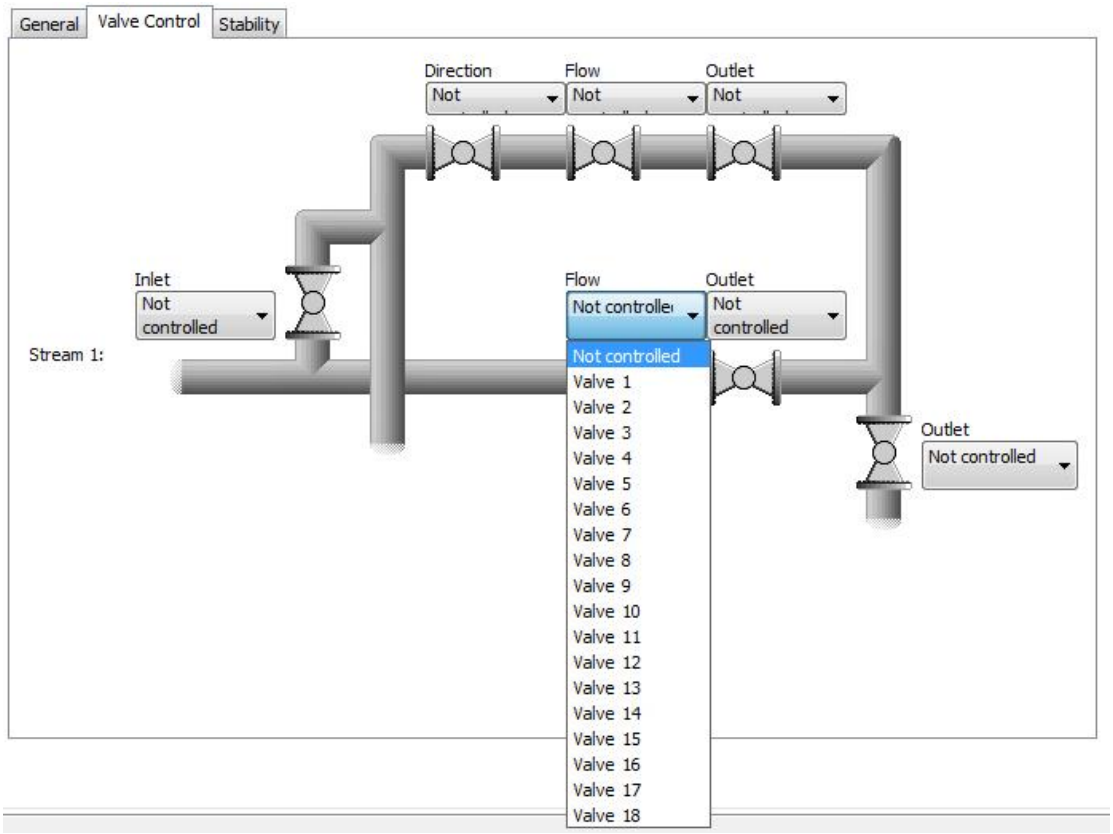
# Density Pressure 1/2

The following parameters are associated with the density input pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# Density Temperature 1/2

The following parameters are associated with the density input temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# Liquid Prover Valve Control




The Liquid Prover Valve Control page allows the operator to assign the control of each valve in the system to the particular Digital or Analogue output from the Unit that is being used for the Valve control purpose. In earlier versions a Diagram (as above) shows a system of interconnected Inlet, Outlet, Flow and Direction Control Valves. It is not envisaged that all of these Valves will be present in any one system, but this diagram , allows the operator to select the Valve types that are present in his system and configure the method of Control.

NOTE in later versions of the operating software the diagram has been replaced with a simple list of the available valves , in the case of the prover:-

General

Prover four way valve

Prover flow control valve

Prover outlet valve

Prover Stream n

Prover stream n inlet valve

See Valve, Digital and Analogue Output configuration pages for details of individual configuration of Valves and Outputs

# Gas Prover

Pages for setting up items of flow computer data, data that will apply when the machine is configured as a prover. The data is divided into groups, which are selected by individual icons.

# Constants

Values of universal Constants used in the Prover Calculation process, Tb and Pb

# Pressure

Prover Pressure settings are divided into 3 tabs:-

General

Sets the units of Pressure to be used, gauge , absolute measurement  value of Atmospheric pressure and other parameters associated with all prover pressure measurement.

It is assumed that the pressure measurement in the Prover system , can consist of measurement on the Inlet side of the prover, or on the Outlet side or both in which case the average is used, separate configuration tabs apply to Inlet and Outlet.

Inlet and Outlet

For both Inlet and Outlet the following parameters are associated with the pressure measurement. Number of measurement sensors 0, 1, 2 or 3, pressure ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# Temperature

Prover Temperature settings are divided into 3 tabs:-

General

Sets the units of Temperature to be used and other parameters associated with all prover temperature measurement.

It is assumed that the temperature measurement in the Prover system , can consist of measurement on the Inlet side of the prover, or on the outlet side or both in which case the average is used, separate configuration tabs apply to Inlet and Outlet.

Inlet and Outlet

For both Inlet and Outlet the following parameters are associated with the temperature measurement. Number of measurement sensors 0, 1, 2 or 3, temperature ranges, alarm values, keypad values etc. Up to 6 levels of order of selection can be set, including Sensor 1, 2, 3, average, serial written value, keypad value or none. Under the Advanced tab items, such as alarm hysteresis, deviation from average and alarm usage can be set. Under the Calibration Constants tab, a linear range and offset correction can be applied to the sensor value.

# Alarm Setting

Sets the alarm conditions for a Re-Prove Alarm to be generated or for the conditions during approve to be monitored:-

## Re-prove :-

Prover , Pressure, Temperature, Density and Corrected Flow can be monitored and the deviation of these items from previous values used to determine if a new prove is required.

A Deviation value in % and a Deviation time in Seconds is set for each parameter. A Deviation Value in per cent for each parameter is calculated from the Equation:-

$$\text{Deviation} = \frac{\text{Currentcondition} - \text{ReferenceCondition}}{\text{ReferenceCondition}} \times 100$$

If the value of the item is greater or less than the Deviation limit for the preset time period, then a Re-prove alarm will be raised.

A decision on Re-prove must then be made by the operator and Proving started manually by his command.

## Start of prove :-

Prover , Pressure, Temperature, Density and Corrected Flow can be monitored during the prove cycle and the values of these items used to determine if the current prove run should be stopped.

A Deviation value in % and a Deviation time in Seconds is set for each parameter. A Deviation Value in per cent for each parameter is calculated from the Equation:-

$$\text{Deviation} = \frac{\text{Currentcondition} - \text{ReferenceCondition}}{\text{ReferenceCondition}} \times 100$$

If the value of the item is greater or less than the Deviation limit for the preset time period, then current prove cycle will be stopped, a report generated and the system will return to idle state.

A decision on the next action must then be made by the operator.

# Options

List of Prover set up options:

Configuration of a Prover is considered an advanced operation and it is assumed that the configurator and operator is familiar with prover operation in general and the specific prover that is being used in the system that is being configured.

The Option Page consists of 2 tabs:-

## General

Allows the operator to Configure:-

The Prover type Master Meter prover only
The Number of Streams to be proved from 1-5
The Number of points to prove 1 to 20
Maximum number of Runs that can make up a prove before the prove is stopped.
Maximum number of runs allowed to fail in a prove, before the prove is stopped.
Release the PID flow Control Valve between runs Yes or No
Replace Valves to starting position on Prove failure Yes or No

For Master Meter Prover additional parameters can be set
Prove length Selection in pulses or time
Prove Length in Seconds or number of pulses
Master Meter Correction using Meter factor or K Factor curve
Master Meter Preset MF
Master Meter Preset K Factor in pulses /m3

## Stability

The Prover can be configured to check the Stability of any or all of the parameters, Pressure, Temperature and Flow before the prove sequence is initiated. Once the proving sequence has been initiated the prover will wait for the Minimum stability duration setting, time in seconds before adjusting the prover loop outlet valve and it will wait up to a user selectable maximum stability duration time, in seconds for the flow, pressure or temperature to stabilise. If the required stabilisation level is not met then the prove will be aborted. The stabilisation is checked by calculating the standard deviation of the selected parameter over the last x seconds (where x is the Minimum stability duration time) by using the equation shown below.

$$\sigma = \sqrt{\frac{\sum_{x}^{1}\left(qM - \overline{qM}\right)^2}{x-1}}$$

Once stabilisation has been achieved the prover computer will continue with the prove sequence.

# Calculation

Calculation set up for K-Factor

## K-Factor

Allows the operator to Configure:-

The Prover Units Metric or Imperial.
The Number of Detector switches to be used, fixed at 2
The Prover Volume for those switch combinations
The K-Factor Calculation method is selected from Traditional repeatability, Statistical repeatability or from an Uncertainty Calculations as below:-
This input basically sets the limit at which the Prove is deemed to be complete in each case the result will be of the form of a confidence level which is then compared to a preset Confidence Level and once this value has been exceeded then the prove is complete and the results calculated etc. Provided the number of Required runs has been exceeded.

Selection of method of calculating the repeatability and uncertainty of K Factor.

| ***Prover, K-Factor, K-Factor Calculation*** |
|---|
| Statistical Repeatability |
| Traditional Repeatability |
| Uncertainty |

**Statistical Repeatability**
An estimator for the Mean K-factor ,$\mu$, is given by Equation 1. Assuming that all K factors ,**X**, follow a normal distribution with standard deviation ,**s**, and average ,**/X**, the estimator for the Mean K factor ,$\mu$, will follow a Student-t distribution with ,**(n-1)**, degree of freedom.

1) $$P\left(\bar{X} - t_{\frac{\alpha}{2},n-1}\frac{s}{\sqrt{n}} < \mu < X + t_{\frac{\alpha}{2},n-1}\frac{s}{\sqrt{n}}\right) = 1-\alpha$$

The uncertainty band ,$\delta$, (confidence level) at 95% confidence level ($\alpha$=5%) for the estimator for the Mean K-factor ,$\mu$,. is given by Equation 2

2) $$\delta = 200 \times t_{\frac{\alpha}{2},n-1}\frac{s}{\bar{X}\times\sqrt{n}} \quad \%$$

Equation 2 gives an uncertainty band for the average of the proving results and shall be less or equal to the NPD repeatability of 0.050% band for an acceptable prove cycle.

**Traditional Repeatability**

3) $$\text{Rangeof Repeatability} = \frac{\text{MaxValue} - \text{MinValue}}{\text{MinValue}} \times 100 \quad \%$$

Where:
Max and Min values are taken from the last x runs where x is the number of required runs.

**Uncertainty**
Taken from the Uncertainty calculation from API Chp 4 Appendix A
Pulse Interpolation can be selected from None or Dual Chronometry, where none is selected then a Minimum number of pulses over which the measurement is made must be entered. Dual Chronometry does require any additional data to be entered.

# Line Density

## General

Sets up to 6 levels of source of density measurement, alarm and keypad values for density measurement and the Calculation constants for Ratio of Specific Heats.

## Measured

If the source of Density is set to measured, e.g. direct from a Corriolis meter this page sets the parameters associated with Pressure and Temperature measurement.

## Z Equation

If the source of Density is selected to be calculated using a Z factor calculation, then the standard of Calculation and other associated values are selected and entered here.

# Density Sensor 1 / 2

If on the previous page a direct measurement of Density is selected, then a page associated, with the type of sensor will appear. All certification and Calibration parameters for the Sensor type can be entered here, together with optional corrections for VOS, and Correction for Pressure and temperature of the Density sensor.

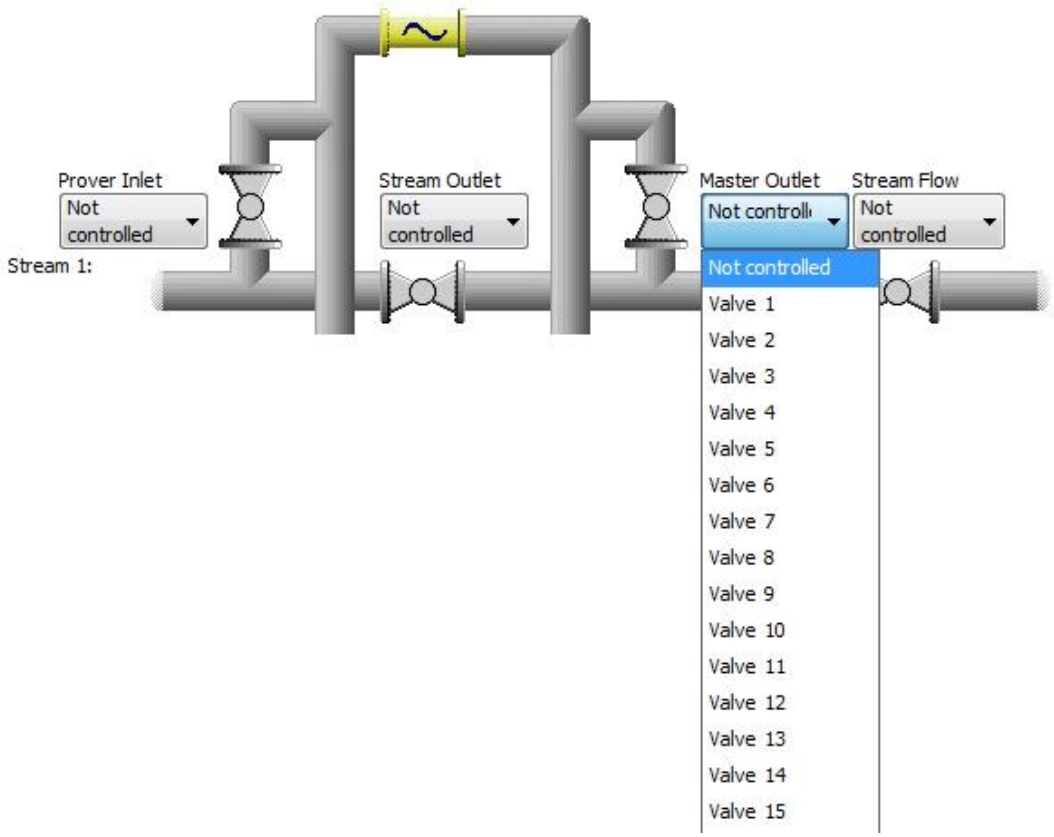
# Z Table

If on the Line Density page, Z Equation tab a Table Z Factor is selected, this page is used to set the values of Z Factor to be used in that table. Any table of size from 1 to 10 values of Pressure and Temperature can be entered here. Linear interpolation is carried out between table values.

# Base Density

Sets up to 3 levels of base density measurement, alarm and keypad values for density measurement and the Zn calculation standard to be used if the option of Zn calculation is chosen.

# Gas Prover Valve Control




The Gas Prover Valve Control page allows the operator to assign the control of each valve in the system to the particular Digital or Analogue output from the Unit that is being used for the Valve control purpose. In earlier versions a Diagram (as above) shows a system of interconnected Inlet, Outlet, Flow and Master Outlet Control Valves. It is not envisaged that all of these Valves will be present in any one system, but this diagram, allows the operator to select the Valve types that are present in his system and configure the method of Control.

NOTE in later versions of the operating software the diagram has been replaced with a simple list of the available valves , in the case of the prover:-

General

Prover flow control valve

Prover outlet valve

Prover Stream n

Prover stream n inlet valve

Prover stream n Master outlet valve

See Valve, Digital and Analogue Output configuration pages for details of individual configuration of Valves and Outputs

# 21. New Stream

Prompts the user to select a new edit offline page for stream 2, 3 etc. by selecting the stream type for that stream, or creating a duplicate of an existing stream.

# 22. Read Setup

Reads the current setup from the connected machine, displays the setup as a separate Setup tab on the Main page.

# 23. Read Alarms

Reads the current alarms from the connected machine, displays the alarms as a separate Alarms tab on the main page.

This display uses the standard convention for displaying alarms:

| # | On Time / Date | Off Time / Date | Type | Group | Alarm |
|---|---|---|---|---|---|
| 2 | 11:59:50.000 (31/07/08) | --:--:--.--- (--/--/--) | Accountable | Gas Differential pressure Acc Alm.1 | GC.B C7 |
| 1 | 11:59:50.000 (31/07/08) | --:--:--.--- (--/--/--) | Non-Accountable | Chromatograph B Nacc Alm.1 | Heating |
| 3 | 11:59:50.000 (31/07/08) | --:--:--.--- (--/--/--) | Accountable | Pressure Acc Alm.1 | Pressur |

Each alarm is displayed with Alarm Number, on time and date, off time and date, where applicable, alarm type, alarm group and specific alarm description.

Alarms are colour coded:

| | |
|---|---|
| Blue | Non Accountable |
| Red | Accountable |
| Orange | Warning |
| Bold Text | Active Alarm |
| Light Text | Cleared Alarm |

# 24. Read Log Data

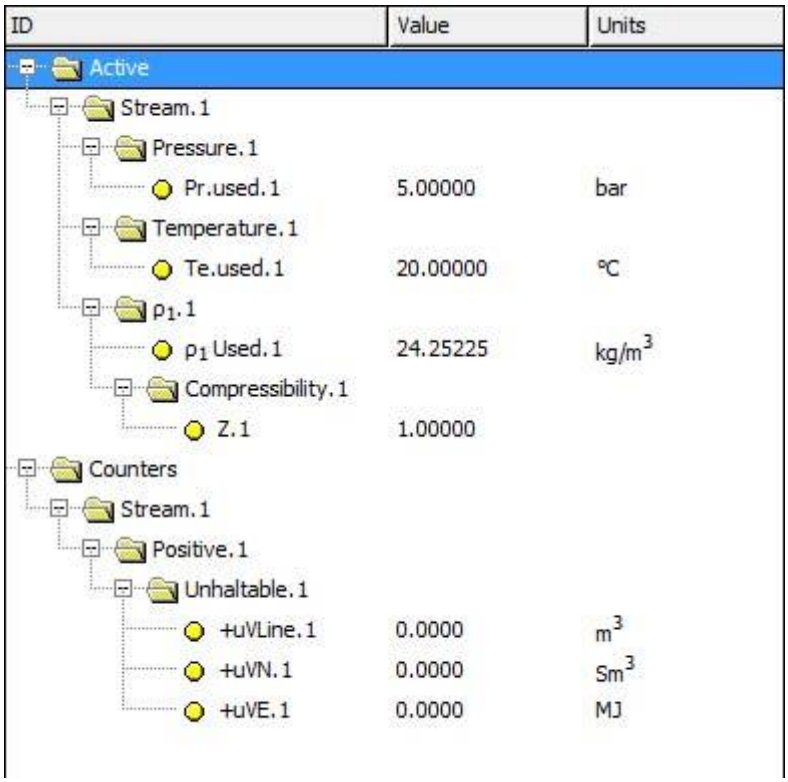
Reads the current logged Data from the connected machine, displays the log Data as a separate Log Data tab on the main page. If more than one Log record type is set up the operator, will be prompted to select which Log Record to display.

| Log No. | Time / Date | Pr.used.1 (bar) | Te.used.1 (°C) | $\rho_1$ Used.1 (kg/m$^3$) |
|---|---|---|---|---|
| 1 | 14:41:00.000 (03/09/08) | 5.00000 | 20.00000 | 24.25225 |
| 2 | 14:42:00.000 (03/09/08) | 5.00000 | 20.00000 | 24.25225 |
| 3 | 14:43:00.000 (03/09/08) | 5.00000 | 20.00000 | 24.25225 |
| 4 | 14:44:00.000 (03/09/08) | 5.00000 | 20.00000 | 24.25225 |

The selected Log Data, will be displayed in Vertical columns in descending time and date order together with the Log record number, time and data of the record and the data logs.

# 25. Read Data Reports

Reads any available Data Reports that have been set up on the connected machine, displays the Data Report as a separate Read Data Reports tab on the main page. If more than one Data Report has been set up the operator will be prompted to select which Data Report to display.



# 26. Read Audit Log

Reads the current audit log Data from the connected machine, displays the audit log Data as a separate Read Audit Log tab on the main page. The operator will be prompted to display the Audit log from internal memory Data Flash, or from the optional memory card SD Card.

| | |
|---|---|
| 15:52:40.000 (21/08/08)<br>**Change:** Edit mode exited<br>**User:** User 1 | Edit mode exited |
| 15:12:56.000 (21/08/08) | Edit mode entered |
| 12:21:50.000 (30/07/08) | General: Alarm Log Cleared |
| 10:39:05.000 (30/07/08) | Display configuration changed. |
| 10:38:35.000 (30/07/08) | Hardware configuration changed. |
| 10:36:43.000 (30/07/08) | General: Powerup |
| 10:32:53.000 (30/07/08) | Ethernet slot 6 configuration changed. |
| 10:32:53.000 (30/07/08) | Hardware configuration changed. |
| 09:59:14.000 (30/07/08) | Date / Time changed. |

The selected Audit Log Data, will be displayed in Vertical columns in descending time and date order.

Each Record can be expanded, where such data exists, to display additional data from each audit, For Example, if data was changed the from and to value, how the data was changed and by whom, and any additional data that is to be recorded for each audit item.

# 27. Clear Data

Allows the user to clear any stored, Audit, Alarm or Logged Data. The user is prompted to select the logged data item to be cleared, from a list of possible items. Once the item has been cleared, this is confirmed by a message window.

# 28. Calibrate Inputs and Outputs

Allows the operator to Calibrate any available Input or Outputs. The Operator will be prompted to Select which I/O Stream or Analogue card is to be calibrated.

The Calibration status of the selected Card will be read and a Calibration window will appear.

The following types of different Inputs and Outputs can be Calibrated, and are selected by the individual tabs on the main Calibration page.

## PRT Input Calibration

Main Controls:
Start Calibrate, starts the calibration process
Write, write the new calibration data to the connected flow computer
Discard, discards any calibration changes made.
Default, reverts to default factory calibration.
Stop Calibrate, stops the calibration process.


### PRT Calibration Procedure

1. Apply the Lower Calibration input to the unit (e.g. set the PRT input to 0°C )
2. Type in 0 to the Wanted box for Point 1 above.
3. Press the Set button for Point 1
4. Wait for stabilization.
5. Apply the Upper Calibration input to the unit (e.g. set the PRT input to 100°C)
6. Type in 100 to the Wanted box for Point 2 above.
7. Press the Set button for Point 2.
8. Wait for Stabilization.

Note: other calibration points can be used the above is an example.

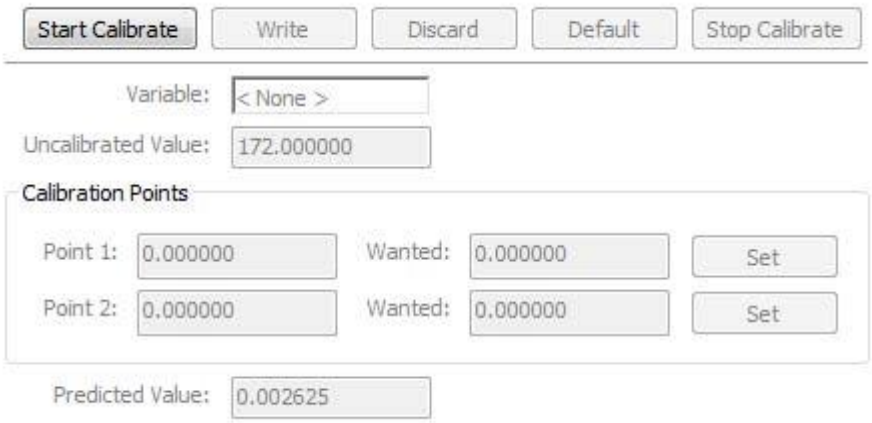
It will be necessary to repeat the above steps a number of time until the predicted value is stable and correct for both the lower and upper calibration points.

Once the Calibration is correct and stable for both points press the Write button to commit the calibration to memory.

Press the Close button to leave the PRT Calibration menu.

# Analogue Input Calibration

Main Controls:
Start Calibrate, starts the calibration process
Write, write the new calibration data to the connected flow computer
Discard, discards any calibration changes made.
Default, reverts to default factory calibration.
Stop Calibrate, stops the calibration process.




## Analogue Input Calibration Procedure

1. Apply the Lower Calibration input to the unit (e.g. set the 4-20mA Input to 4.8mA i.e. 5% i.e. 5 BARA)
2. Type in 5.0 to the Wanted box for Point 1 above.
3. Press the Set button for Point 1
4. Wait for stabilization.
5. Apply the Upper Calibration input to the unit (e.g. set the 4-20mA Input to 19.2 mA i.e. 95% i.e. 95BARA)
6. Type in 95.0 to the Wanted box for Point 2 above.
7. Press the Set button for Point 2.
8. Wait for Stabilization.

Note: other calibration points can be used the above is an example.

It will be necessary to repeat the above steps a number of time until the predicted value is stable and correct for both the lower and upper calibration points.

Once the Calibration is correct and stable for both points press the Write button to commit the calibration to memory.

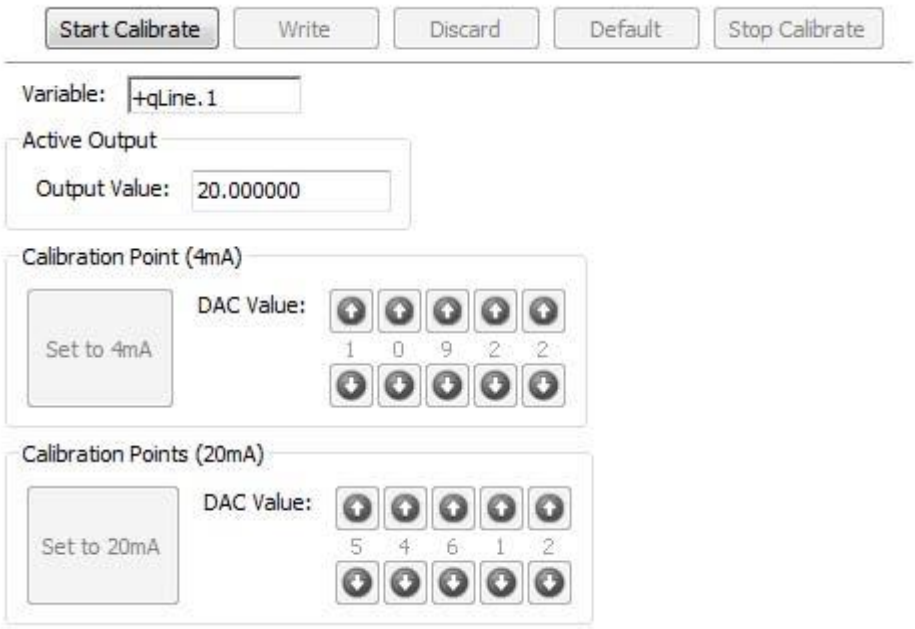
Press the Close button to leave the Analogue Input Calibration menu.

# Hart Input Calibration


Calibration of the Hart Transmitter Inputs is performed using a Digital Handheld of other similar Calibration device supplied by the Transmitter manufacturer. In the flow computer it is necessary to suspend Hart Communication to the Hart transmitters whilst they are being calibrated. Communication on any one connection loop can be suspended to all transmitters, or individually. The Start Communication and Stop Communication buttons are used for this purpose. All transmitter communication will automatically be re-started irrespective of the button status, when the Close button is pressed.

# Analogue Output Calibration

Main Controls:
Start Calibrate, starts the calibration process
Write, write the new calibration data to the connected flow computer
Discard, discards any calibration changes made.
Default, reverts to default factory calibration.
Stop Calibrate, stops the calibration process.




## Analogue Output Calibration Procedure

1. Connect a standard 100 ohm resistance across the Analogue Output to be calibrated.
2. Connect a DVM capable of reading 0-2 V across the 100ohm resistance
3. Press the Set to 4mA button on the Calibrate page.
4. Use the up and down arrow buttons to raise and lower the output until 0.400V is indicated on the DVM.
5. Press the Set to 20mA button on the calibrate page.
6. Use the up and down arrow buttons to raise and lower the output until 2.000V is indicated on the DVM.

It may be necessary to repeat this process a number of times, until the indicated values are correct in both positions.

Once the Calibration is correct and stable for both points press the Write button to commit the calibration to memory.

Press the Close button to leave the Analogue Output Calibration menu.

# 29. Battery Status

Indicates the operational Status of the Internal clock and Memory back up Battery. The status will be shown in a message window.

GOOD indicates battery is operational and working as specified.

BAD indicates, battery is either not fitted, or should be replaced as soon as possible.

# 30. Log off and close

Logs off from the main connection menu, closes the window and returns the operator to the main configuration menu.