ProSoft® TECHNOLOGY

Where Automation Connects.

MVI56E-AFC / MVI69E-AFC

Enhanced Liquid and Gas Flow Computer

ControlLogix® and CompactLogix™

February 25, 2022

SETUP AND CONFIGURATION GUIDE

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MVIxxE_AFC_SCG
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February 25, 2022

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Important Installation Instructions

Power, Input, and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501 to 4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2.

WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES.

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

Class 2

MVI (Multi-Vendor Interface) Modules

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DÉCONNECTER L'ÉQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

Warnings

North America Warnings

Power, Input, and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501 to 4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

A Warning - Explosion Hazard - Substitution of components may impair suitability for Class I, Division 2.

B Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or rewiring modules.

C Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Avertissement - Risque d'explosion - Avant de déconnecter l'équipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux.

D Suitable for use in Class I, Division 2 Groups A, B, C and D Hazardous Locations or Non-Hazardous Locations.

ATEX Warnings and Conditions of Safe Usage

Power, Input, and Output (I/O) wiring must be in accordance with the authority having jurisdiction.

A Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or wiring modules.

B Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

C These products are intended to be mounted in an IP54 enclosure. The devices shall provide external means to prevent the rated voltage being exceeded by transient disturbances of more than 40%. This device must be used only with ATEX certified backplanes.

D DO NOT OPEN WHEN ENERGIZED.

Battery Life Advisory

The modules use a rechargeable Lithium Vanadium Pentoxide battery to back up the real-time clock and CMOS. The battery should last for the life of the module. The module must be powered for approximately twenty hours before the battery becomes fully charged. After it is fully charged, the battery provides backup power for the CMOS setup and the real-time clock for approximately 21 days. When the battery is fully discharged, the module will revert to the default BIOS and clock settings. The battery is not user replaceable.

Electrical Ratings

ControlLogix®

- Backplane Current Load: 800 mA @ 5.1 Vdc; 3 mA @ 24 Vdc
- Operating Temperature: 0°C to 60°C (32°F to 140°F)
- Storage Temperature: -40°C to 85°C (-40°F to 185°F)
- Shock: 30 g, operational; 50 g, non-operational; Vibration: 5 g from 10 Hz to 150 Hz
- Relative Humidity: 5% to 95% with no condensation
- All phase conductor sizes must be at least 1.3 mm^2 and all earth ground conductors must be at least 4mm^2.

CompactLogix™

- Backplane Current Load: 500 mA @ 5.1 Vdc; 3 mA @ 24 Vdc
- Operating Temperature: 0°C to 60°C (32°F to 140°F)
- Storage Temperature: -40°C to 85°C (-40°F to 185°F)
- Shock: 30 g, operational; 50 g, non-operational; Vibration: 5 g from 10 Hz to 150 Hz
- Relative Humidity: 5% to 95% with no condensation
- All phase conductor sizes must be at least 1.3 mm^2 and all earth ground conductors must be at least 4mm^2.

Agency Approvals and Certifications

Please visit our website: www.prosoft-technology.com

Contents

1 Before You Begin

This section describes the pre-configuration process. There are a small number of tasks to complete before configuring your project.

1.1 Pre-Configuration Requirements

Before you start to configure the MVI56E-AFC (ControlLogix) or MVI69E-AFC (CompactLogix), you need the following items:

- Download the EAFC Manager software.
- Download the MVI56E-AFC or MVI69E-AFC Add-On Instructions (AOIs)

1.1.1 Downloading EAFC Manager

The software can be downloaded from www.prosoft-technology.com.

1 Navigate to the appropriate MVI56E-AFC or MVI69E-AFC web page.

2 Click on the **DOWNLOADS** tab.

3 Click on the **PROSOFT EAFC MANAGER** link and follow the prompts to download and install the application.

1.1.2 Downloading AOIs

1 Navigate to the appropriate MVI56E-AFC or MVI69E-AFC web page.

2 Click on the **DOWNLOADS** tab.

3 Select **MVI56E-AFC** or **MVI69E-AFC ADD ON INSTRUCTIONS** link. The AOIs are downloaded as a *.zip* file.

The *.zip* file contains the Main AOI as well as four additional AOIs that pertain to your meter application. The four additional AOIs include:

- Linear Gas
  (MVIxxE-AFC_AddOn_Rung_LinearGas_vx_x.L5X)
- Linear Liquid
  (MVIxxE-AFC_AddOn_Rung_LinearLiquid_vx_x.L5X)
- Differential Liquid
  (MVIxxE-AFC_AddOn_Rung_DifferentialLiquid_vx_x.L5X)
- Differential Gas
  (MVIxxE-AFC_AddOn_Rung_DifferentialGas)vx_x.L5X)

Locate the Main AOI and the AOI file that pertains to your meter type. You will use these files when you set up your RSLogix/Studio 5000 project later in this guide.

1.2 Supported Meters

The MVI56E-AFC and MVI69E-AFC supports the following meters:

- Turbine
- Positive displacement
- Magnetic
- Orifice
- V-cone
- Wedge
- Vortex
- Ultrasonic
- Coriolis
- Thermal mass

Note: Due to the broad range of meters in the market today, refer to the manufacturer specification to evaluate the use of the module (even if listed here).

1.3 Locating Information for Your Meter

While much of the information in this guide pertains to all types of meters, certain sections apply only to particular types. To locate configuration information specific to your meter, refer to the following table:

What type of meter are you configuring?	What is the primary output from your flow meter and associated instrumentation?	Configure the metering principle as…	See the following sections of this guide
Orifice Meter	Differential Pressure	Differential pressure	"Configuring Differential Meter Parameters" on page 81
V-Cone Meter	Differential Pressure	Differential pressure	"Configuring Differential Meter Parameters" on page 81
Wedge Meter	Differential Pressure	Differential pressure	"Configuring Differential Meter Parameters" on page 81
Coriolis Meter	Flow Rate	Flow rate	"Configuring Differential Meter Parameters" on page 81
	Pulse Count and Pulse Frequency	Pulse count	"Configuring Linear Meter Pulse Count Options" on page 84

What type of meter are you configuring?	What is the primary output from your flow meter and associated instrumentation?	Configure the metering principle as…	See the following sections of this guide
	Pulse Frequency Only	Pulse frequency	"Configuring Linear Meter Pulse Frequency Options" on page 86
Vortex Meter	Flow Rate	Flow rate	"Configuring Differential Meter Parameters" on page 81
	Pulse Count and Pulse Frequency	Pulse count	"Configuring Linear Meter Pulse Count Options" on page 84
	Pulse Frequency Only	Pulse frequency	"Configuring Linear Meter Pulse Frequency Options" on page 86
Ultrasonic Meter	Flow Rate	Flow rate	"Configuring Differential Meter Parameters" on page 81
	Pulse Count and Pulse Frequency	Pulse count	"Configuring Linear Meter Pulse Count Options" on page 84
	Pulse Frequency Only	Pulse frequency	"Configuring Linear Meter Pulse Frequency Options" on page 86
Turbine Meter	Flow Rate	Flow rate	"Configuring Differential Meter Parameters" on page 81
	Pulse Count and Pulse Frequency	Pulse count	"Configuring Linear Meter Pulse Count Options" on page 84
	Pulse Frequency	Pulse frequency	"Configuring Linear Meter Pulse Frequency Options" on page 86
	Pulse Count	Pulse count	"Configuring Linear Meter Pulse Count Options" on page 84
Positive Displacement	Same as Turbine		
Magnetic	Same as Turbine		
Thermal Mass	Flow Rate	Flow rate	"Configuring Differential Meter Parameters" on page 81
	Pulse Count and Pulse Frequency	Pulse count	"Configuring Linear Meter Pulse Count Options" on page 84

What type of meter are you configuring?	What is the primary output from your flow meter and associated instrumentation?	Configure the metering principle as…	See the following sections of this guide
	Pulse Frequency Only	Pulse frequency	"Configuring Linear Meter Pulse Frequency Options" on page 86

1.4 Configuration Icons

This manual uses the following icons to assist you during configuration.

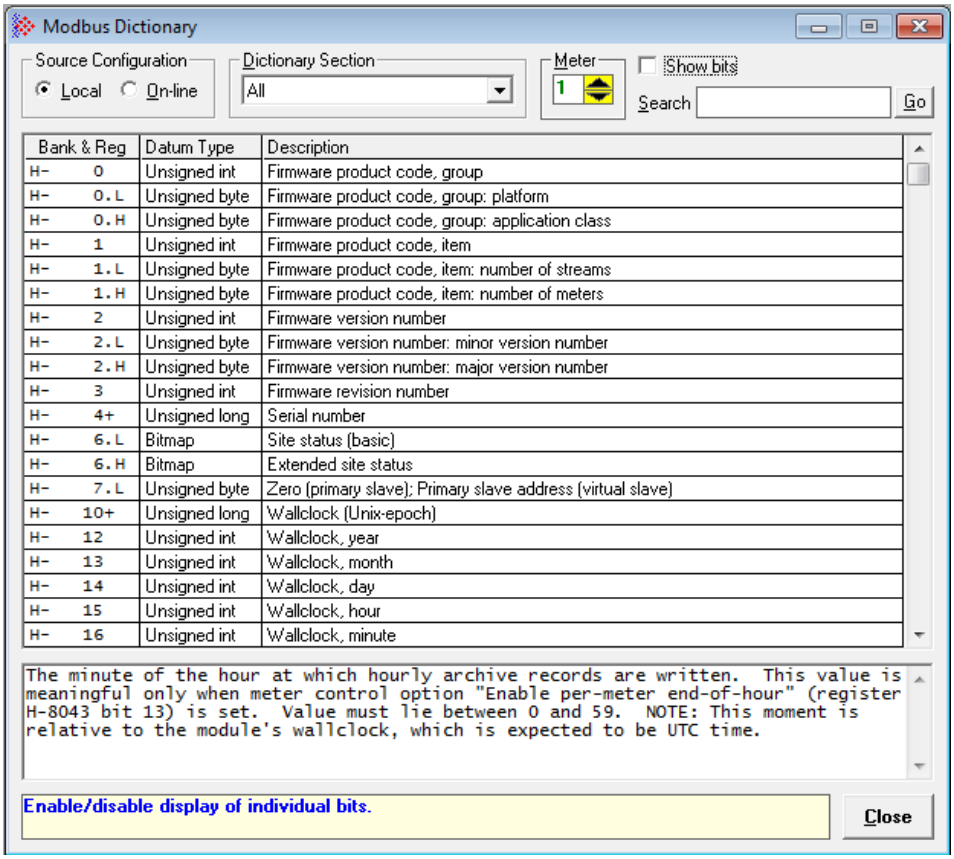
Accumulator		Alarm		Back	
Calculate		Calibrate		Calibrate 2	
Ethernet		Event		Export	
Flow		Gas		Liquid	
Login		Logout		Meter	
Meter		Network		Delete Permission	
Add Permission		Edit Permission		Generic Permission	
Port		Pressure		Prover	
Pulse		Delete Role		Add Role	
Edit Role		Generic Role		Serial Connection	
Site		Stream		Temp	
User		Delete User		Add User	
Edit User		View		Delete View	
Add View		Edit View		Volume	

1.5 Modbus Dictionary

Important: Although this manual is continuously maintained to bring you the latest information, the Modbus Dictionary contains the latest information on registers and dictionary sections. It is recommended that you use the Modbus Dictionary to locate bank and register values to ensure that you are looking at the latest information.

1.5.1 About the Modbus Dictionary

The Modbus dictionary (**PROJECT** > **MODBUS DICTIONARY**) provides a means to locate data anywhere in the module. The dictionary allows you to select various data types from database regions. It then displays the Modbus bank and register values.

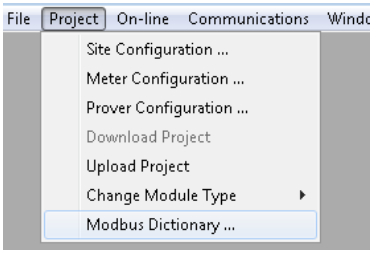


You can use the Modbus Dictionary locally or while EAFC Manager is directly connected to the module.

1.5.2 Accessing and Using the Modbus Dictionary

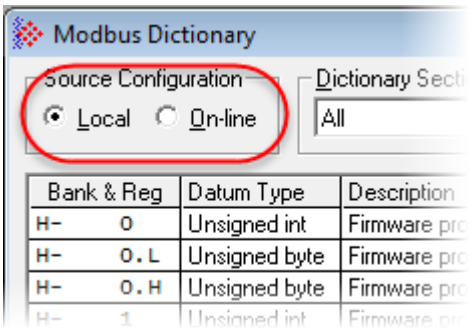
Tip: Ensure that you have a suitable project loaded, paying attention to its version. This ensures that the dictionary items present for your module are available for display.

1 In EAFC Manger, from the **PROJECT** tab, select **MODBUS DICTIONARY**.

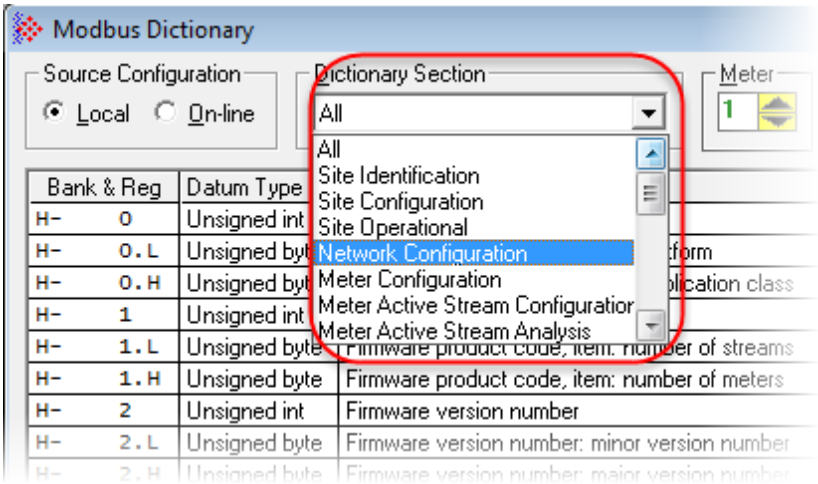


The Modbus Dictionary displays.

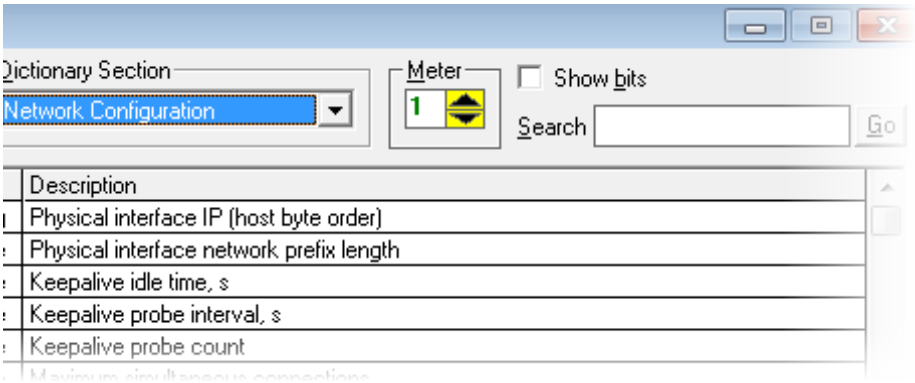
2 In the *Source Configuration* area, select *Local* if you are running the dictionary locally or *On-line* if you are connected to the module.



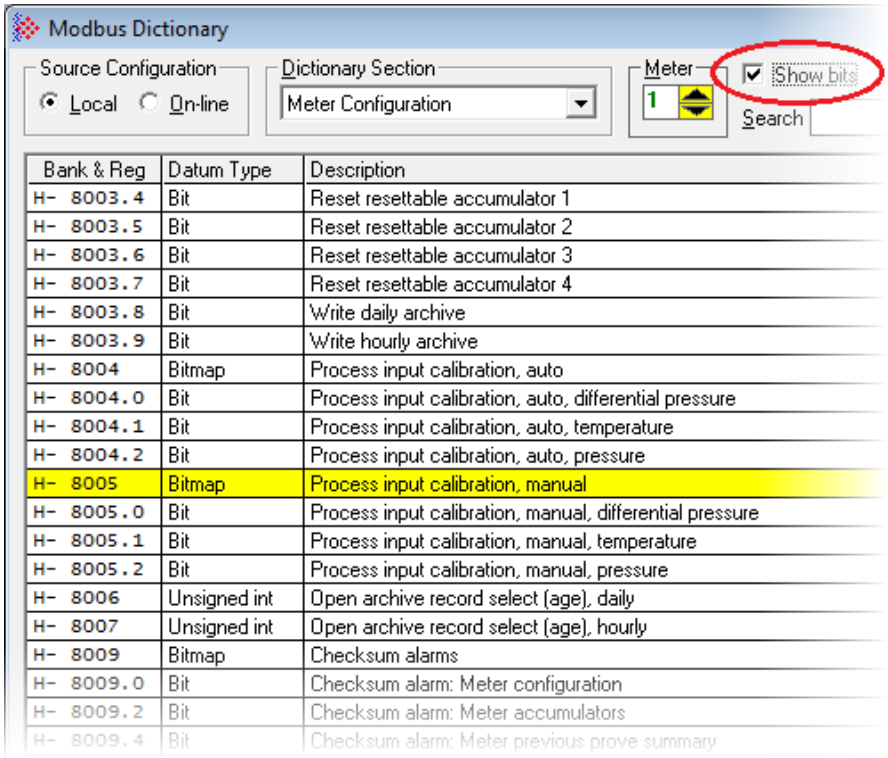
3 Select the *Dictionary Section* from the dropdown list. Each section provides data from a different section of the module.



4 Select the **METER** stream. Information will be displayed only for the selected meter.

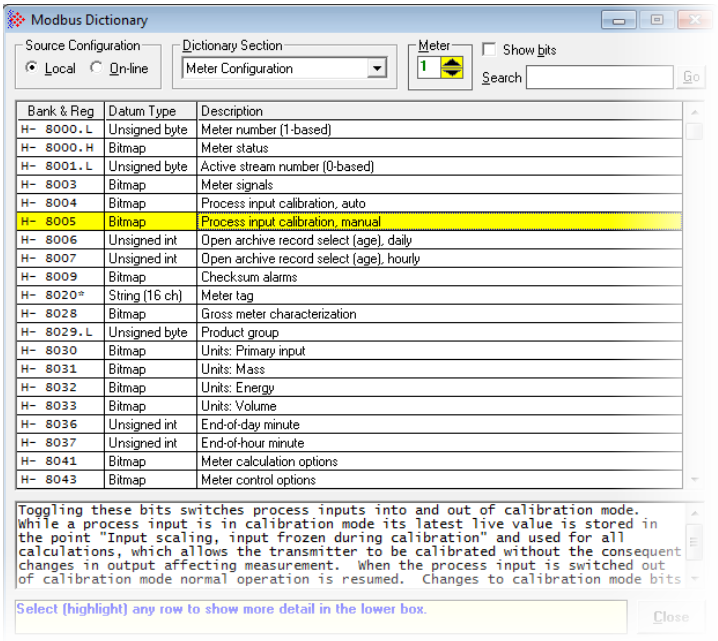


5 Check the **SHOW BITS** checkbox to enable the display of individual bits in the *Bank & Reg* column.

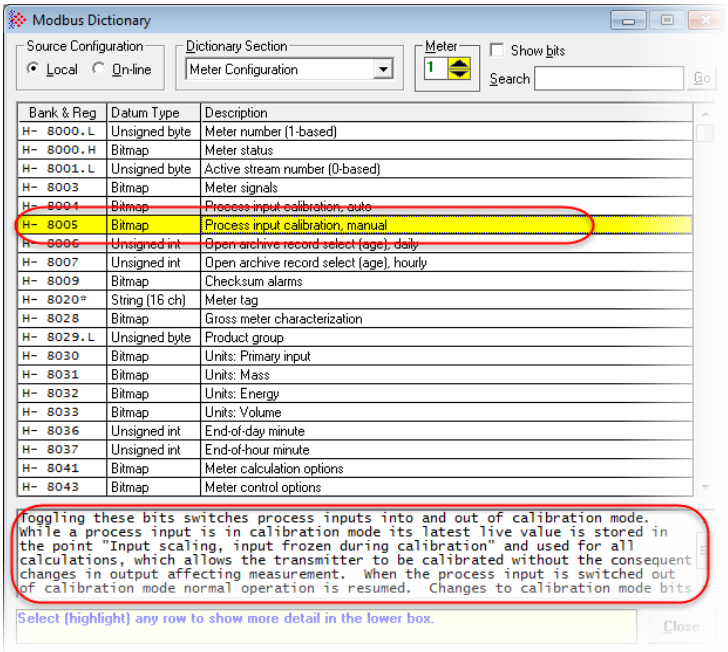


6 Click on the appropriate row.

Tip: The *Search* box allows you to search for specific data. The search is applied to entries in the *Description* column and is not case sensitive.



7 Once a row is selected, additional information is displayed at the bottom of the window.



8 Observe the *Bank and Reg* information in the first column. This column may contain a number of items with different representations.

Bank & Reg	Datum Type	Description
H- 8000.L	Unsigned byte	Meter number (1-
H- 8000.H	Bitmap	Meter status
H- 8001.L	Unsigned byte	Active stream nur
H- 8003	Bitmap	Meter signals

In the first row, the first position indicates whether the register is a Holding Register (**H-**) or an Input Register (**I-**), the second position represents the register (**8000**). The third position indicates high order bytes (**H**), low order bytes (**L**), multiple registers (*****), and a plus sign (**+**) indicates that there are two registers (used for 32-bit quantities, i.e., long integer and floating point elements).

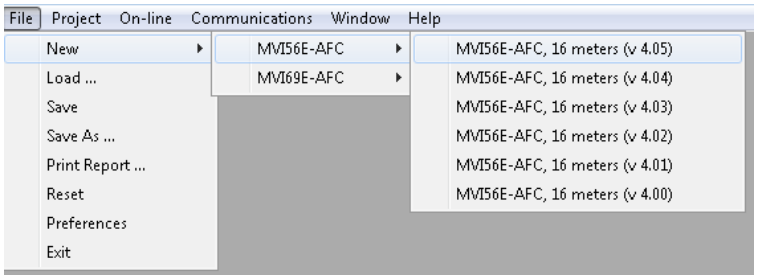
If **SHOW BITS** is checked, a number in the third position is the bit number. For Datum Type “String”, each register holds two characters.

2 Creating an EAFC Manager Project

2.1 Creating the Project

1 From your PC/Laptop, run the EAFC Manager software.

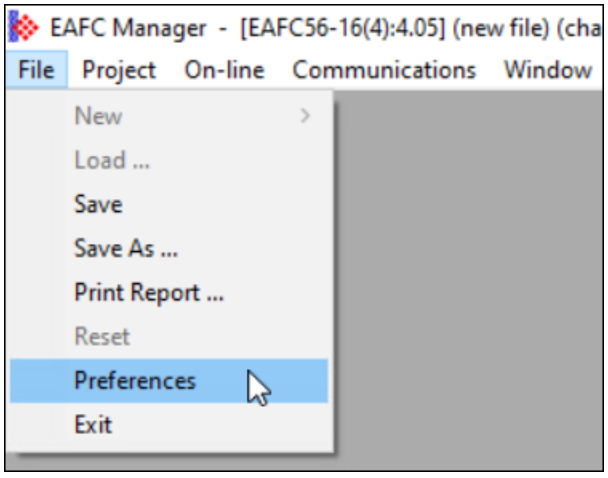
2 Select **FILE > NEW > MVI56E-AFC** (or **MVI69E-AFC**) **> MVIXXE-AFC, XX METERS (VX.XX)**.



Communication between the EAFC Manger and the AFC module is not required during the configuration stage.

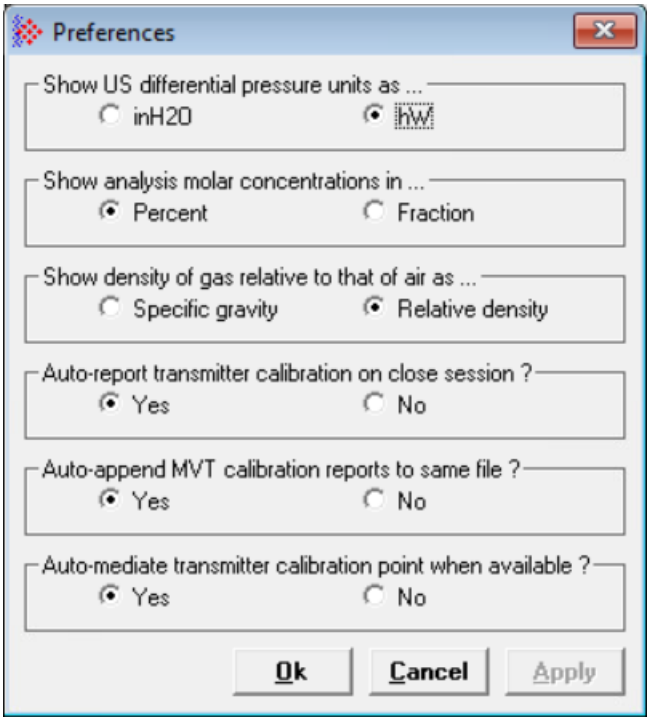
2.2 Setting Project Preferences

1 From the **FILE** menu, select **PREFERENCES**.



The *Preferences* dialog displays.

2 Set the preferences as necessary.



Parameter	Description
Show US differential pressure units as …	This setting determines the units for differential pressure units when using US units. Options are as follows: • inH2O: inches of water column at 4° Celsius (39.2° Fahrenheit) • hW: Inches-of-water (water at 60° Fahrenheit)
Shown analysis molar concentrations in …	This setting determines how molar concentrations are represented in the *Stream Component Analysis* dialog. Options are as follows: ▪ *Percent* ▪ *Fraction*
Show density of gas relative to that of air as …	This setting determines which term is used to indicate the density of gas relative to that of air in EAFC Manager. Options are as follows: ▪ Specific gravity ▪ Relative density
Auto-report transmitter calibration on close session?	To report a transmitter calibration automatically after closing the calibration session, select **YES** for this setting.
Auto-append MVT calibration reports to same file?	To append MVT calibration reports to the same file automatically, select **YES** for this setting.
Auto-mediate transmitter calibration point when available?	To mediate the transmitter calibration point automatically when it is available, select **YES** for this setting

3 Configuring Site Parameters

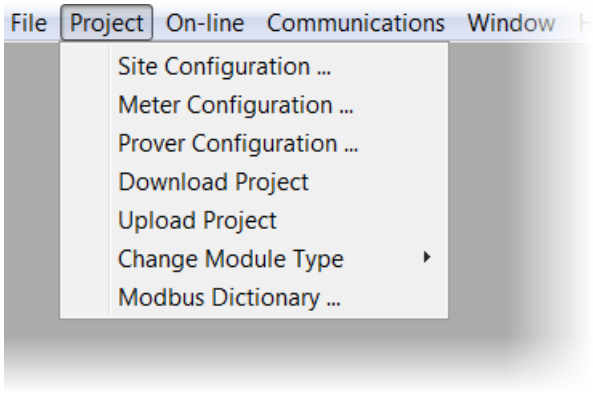
EAFC Manager's *Site Configuration* dialog box allows you to assign the following project settings:

- Project name
- Modbus slave addresses
- Memory allocation
- Port configuration and mapping
- Site options and status

You can also obtain the EAFC firmware version from this window.

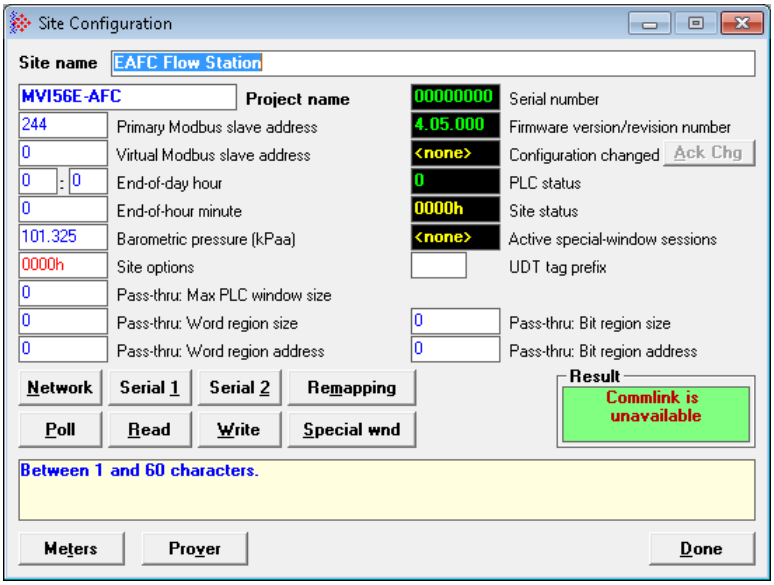
3.1 Accessing Site Configuration Parameters

From the *Project* menu, choose **SITE CONFIGURATION**.



This opens the *Site Configuration* dialog box.

Important: Examples used in this section are based on the MVI56E-AFC module. However, instructions are identical between the MVI56E-AFC and MVI69E-AFC modules.



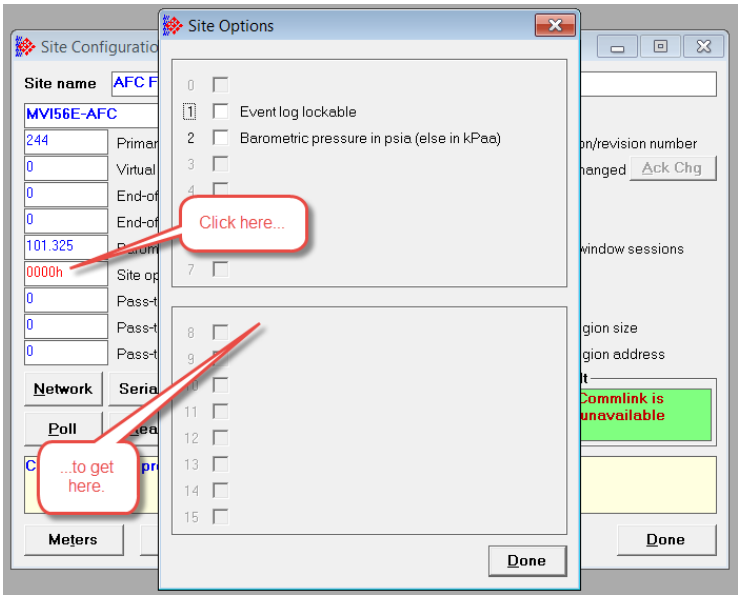
The following table summarizes the site configuration parameters and other information displayed in the *Site Configuration* dialog. The sub-sections that follow describe some of these in further detail.

Parameter	Description
Site name	Enter a site name. This parameter identifies the site (1 to 64 characters). The default is “AFC Flow Station”. Edit this if needed.
Project name	This parameter allows an external application such as EAFC Manager to synchronize its database with the database resident in the module. Default is "MVI56E-AFC" or “MVI69E-AFC”.
Primary and Virtual Modbus slave address	If you plan on setting these parameters, please refer to the *AFC Reference Guide* for additional details.
End-of-day hour	This parameter sets the minute of the day when the daily archives are created. The default value of 0 (zero) creates the daily archive at midnight. The entry format is hh : mm, where hh represents hour and mm represents minute of the hour. Valid values for hour are between 0 and 23. Valid values for minute of the hour are between 0 and 59. The entered hour and minute of the hour values are converted to end-of-day minute values in a range from 0 to 1439 before being written to the module. This moment is relative to the module’s wallclock, which is expected to be UTC time. **Important:** The end-of-period (End-of-day hour and End-of-hour minute) settings are global settings, unless these settings are set by meter on the *Meter Configuration* page. If these parameters are set per meter, and enabled under control options, the options specified per meter take precedence over the same settings on the *Site Configuration* page. For more information see section 4.3, “Setting End-of-Period Parameters,” on page 47.
End-of-hour minute	This parameter sets the minute of the hour when the hourly archives are created. The default value of 0 (zero) creates hourly archives at the top of each hour. Valid values are between 0 and 59. This moment is relative to the module’s wallclock, which is expected to be UTC time.

Parameter	Description
	Important: The end-of-period (End-of-day hour and End-of-hour minute) settings are global settings, unless these settings are set by meter on the *Meter Configuration* page. If these parameters are set per meter, and enabled under control options, the options specified per meter take precedence over the same settings on the *Site Configuration* page. For more information see section 4.3, "Setting End-of-Period Parameters," on page 47.
Barometric pressure	This parameter sets the barometric pressure used on the module calculations. The module expects each meter's pressure input to be in gauge units. Because the AGA8, AGA3, and some API2540 calculations require the pressure of the fluid to be in absolute units, the module adds barometric pressure to the gauge pressure in order to obtain the absolute pressure. The calculation assumes that all meters measured by a single AFC are located at the same site and have the same barometric pressure.
Site Options	See "Configuring Site Options" on page 26 for details.
Pass-Thru Options	See "Configuring Pass-Thru Options" on page 27 for details..
Site configuration status	This series of indicators in the upper-right corner of the dialog show the status of various site parameters. See "Viewing Site Configuration Status" on page 27 for details.
UDT tag prefix	This field shows the prefix used for generated UDT names. See "UDT Tag Prefix" on page 28 for details.
Network	Click this button to configure Modbus TCP/IP. See "Configuring Modbus TCP/IP" on page 29 for details.
Serial 1 and Serial 2	Click these buttons to configure the two serial port connections. See "Configuring Serial 1 and Serial 2" on page 37 for details.
Remapping	Click this button to configure the data remapping between two slaves using the *Indirect Address Remapping* dialog. For more information see the *AFC Reference Guide*.
Poll	Click this button to update the site-status indicators. For more information see "Poll Button" on page 40.
Read	Click this button to read the current site configuration from the module to the local PC. See "Read Button" on page 41 for more information.
Write	Click this button to transfer the site configuration from the local PC to the module. See "Write Button" on page 42 for more information.
Special wnd	Click this button to open the *Special Windows Configuration* dialog to set timeout values for various processes. See "Special Wnd Button" on page 43 for details.
Meters	Click this button to open the *Meter Configuration* dialog. For more information see chapter 4, "Configuring Meter Parameters," on page 44
Prover	Click this button to open the *Prover Configuration* dialog. For more information, see the *AFC Reference Guide*.
Done	Click this button to store your settings temporarily and close the *Site Configuration* dialog. Note that you must also save your project before closing EAFC Manager; otherwise your configuration will be discarded.

3.2 Configuring Site Options

The *Site Options* dialog box opens when you click the **SITE OPTIONS** field in the *Site Configuration* dialog box.

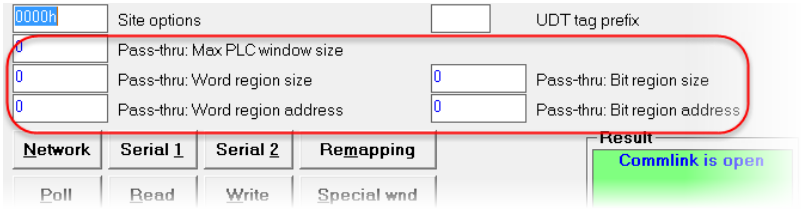


Parameter	Description
Event log lockable	If clear, the event log behaves as a FIFO buffer; a new record overwrites the old one even if the overwritten event has never been downloaded, in which case, the event is permanently lost. If set, and the log is full with never downloaded events, then the log is locked. Controllable events (changes to most datum points) are not allowed to occur. Non-critical, non-controllable events (e.g. checksum alarms) are discarded and are permanently lost, and critical non-controllable events (e.g. PLC mode change) are written as usual and the overwritten, never downloaded events are permanently lost. A locked log must be downloaded to unlock it for normal behavior.
Barometric pressure in psia	If set, the barometric pressure will be expressed in psia units, otherwise it will use kPaa.

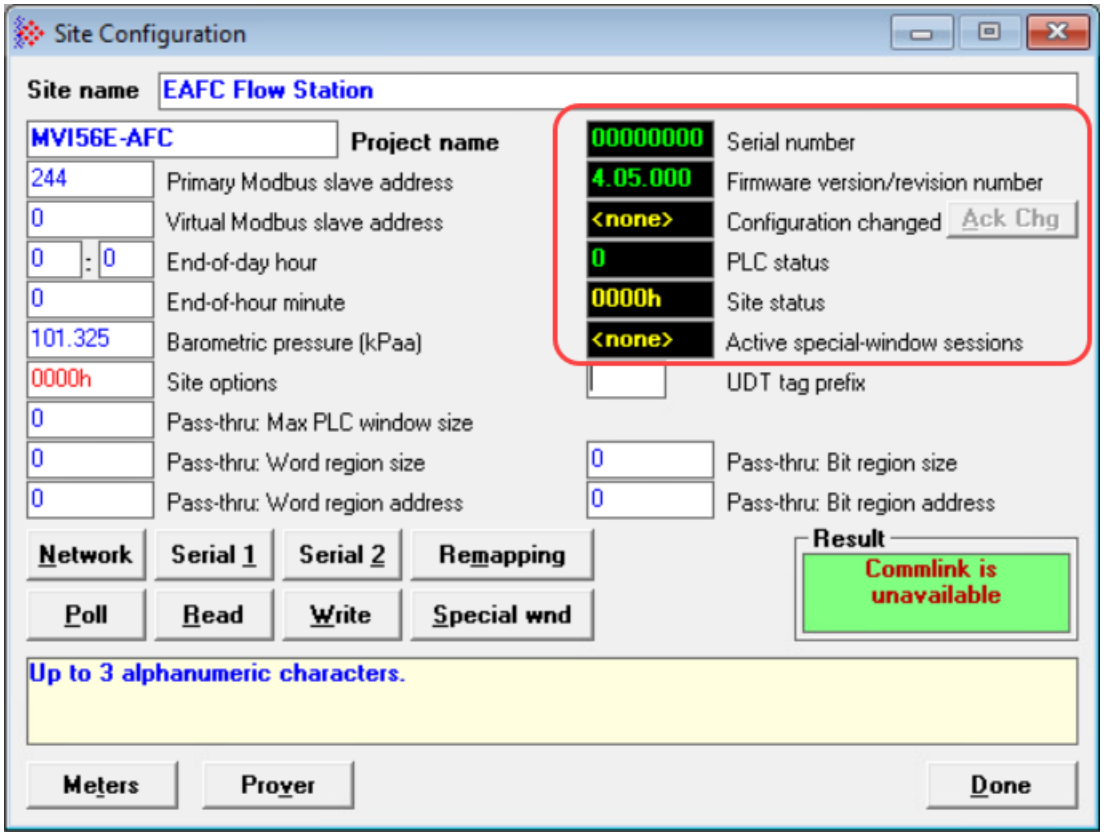
3.3 Configuring Pass-Thru Options

The Pass-Thru feature can be used for delivering data written packets directly to the PLC logic, bypassing the MVI56E-AFC's or MVI69E-AFC's Modbus database. For details on configuring this option, please refer to the *AFC Reference Guide*.

The module supports the Modbus Pass-Thru feature for write commands. When the pass-thru region in the virtual slave is properly configured, all Modbus write commands pointing inside that area will be handled by ladder logic using the Modbus Pass-Thru function block.



3.4 Viewing Site Configuration Status

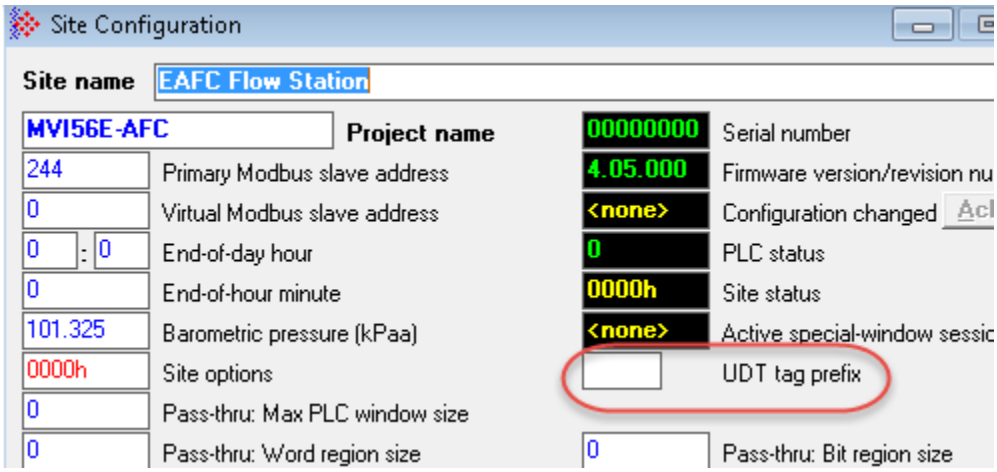


This section of the *Site Configuration* dialog box is used to provide Site status information. Site status features are discussed in the *AFC Reference Guide*.

3.5 UDT Tag Prefix

This field shows the prefix used for generated UDT names. UDT definition files generated for the MVI56E-AFC or MVI69E-AFC projects, including those for backplane-return layouts and archive record layouts, may be imported into the RSLogix/Studio 5000 project. To avoid conflict with names of other types, tags, and files, especially those generated for other AFC modules in the same rack, you can enter an optional prefix in the *UDT Tag Prefix* field. The prefix must be an alphanumeric string of not more than 3 characters. This string will be prepended to each generated name (after the leading "MVIxxE-AFC") with an underscore ("_") separator.

If you do not specify a UDT tag prefix, generated names are not prefixed.

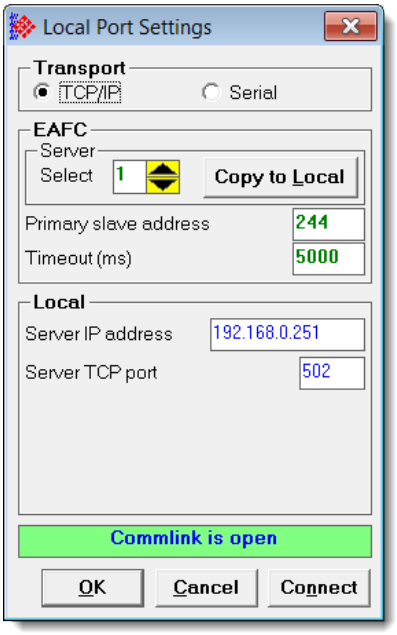


3.6 Configuring Communication Parameters

Note: The examples used in this section show the MVI56E-AFC module. However, instructions are identical (except where noted) for the MVI69E-AFC module.

3.6.1 Local Port Settings

The *Local Port Settings* dialog allows you to define settings for the TCP/IP and serial ports. To access this dialog, select **COMMUNICATIONS > LOCAL PORT SETTINGS**.



Adjust the communication settings if necessary. Click **CONNECT** to save the settings and **OK** to connect.

The *Local Port Settings* dialog will also display anytime you take an action that requires a connection to the module—such as clicking the **READ**, **WRITE**, and **POLL** buttons of the *Site Configuration* dialog—if a connection does not already exist. You must then enter the appropriate port settings and establish a connection before proceeding.

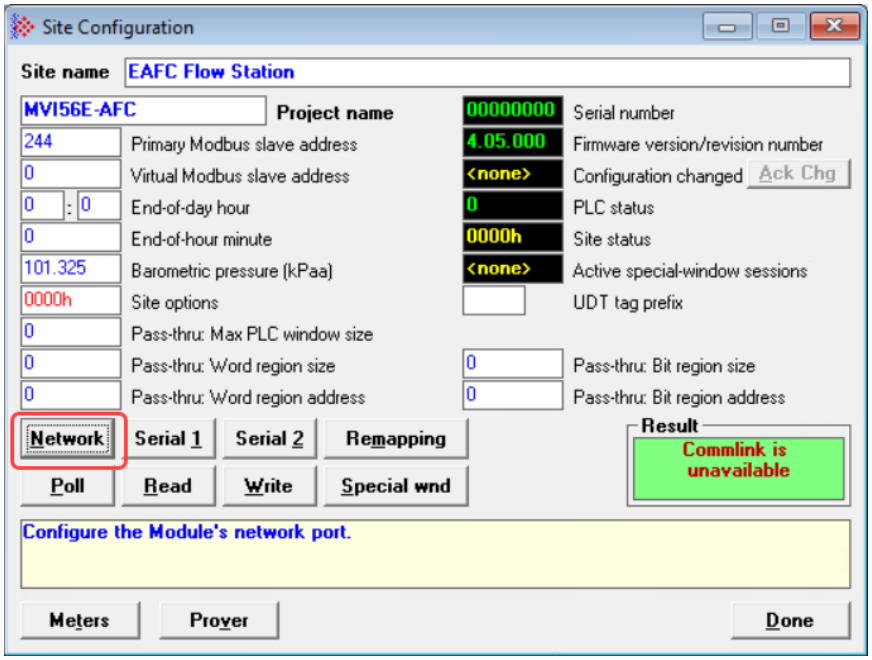
If a connection is already present, the *Local Port Settings* dialog displays only when you access it from the **COMMUNICATIONS** menu.

Similarly, if the connection exists but the operator has not logged in, while the “other action” requires login, the *Login Module* window is automatically displayed.

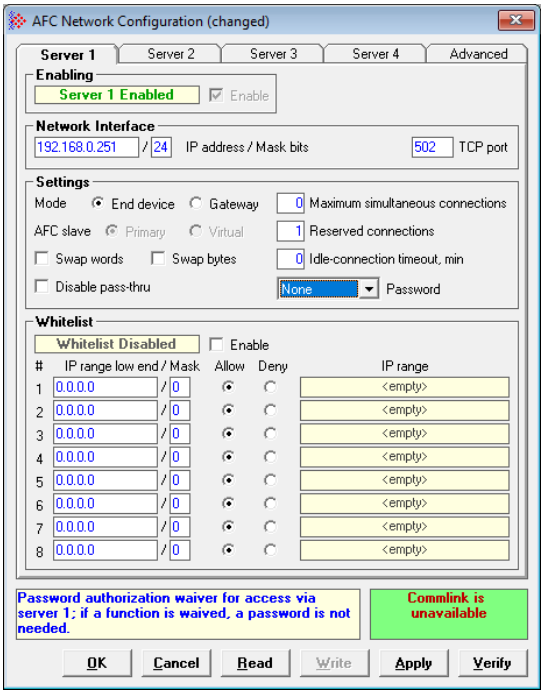
Both conditions are cascaded. For example, a Read (when not connected) first displays the *Local Port Settings* window to connect, then the *Login Module* window to log in.

3.6.2 Configuring Modbus TCP/IP

To configure the Modbus TCP/IP parameters for the Ethernet port, select the **NETWORK** button in the *Site Configuration* dialog.

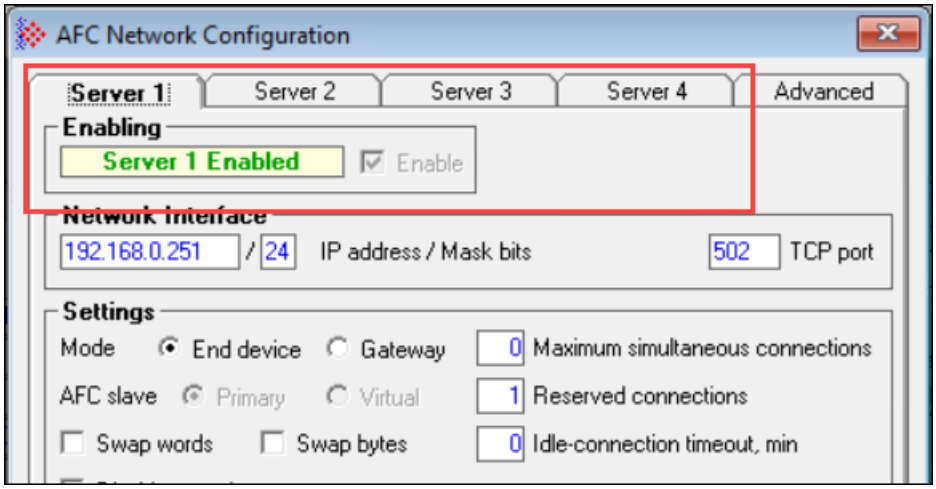


This opens the *AFC Network Configuration* dialog.



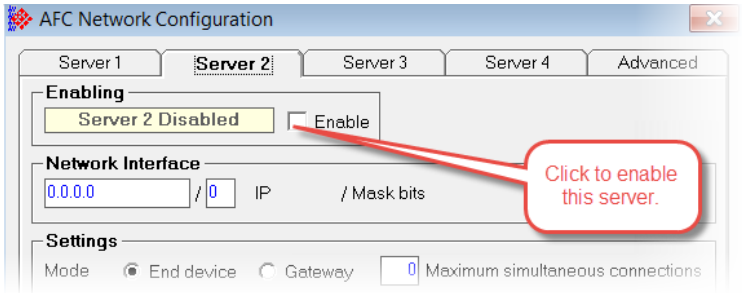
Modbus TCP/IP Server Configuration

The *Server* tabs in the *AFC Network Configuration* dialog allow you set different configurations for up to four servers.

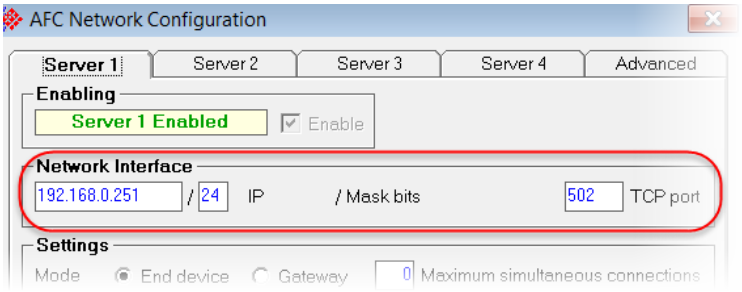


1 Click on the tab of the server that you want to configure.

2 Enable the server by selecting the **ENABLE** checkbox.

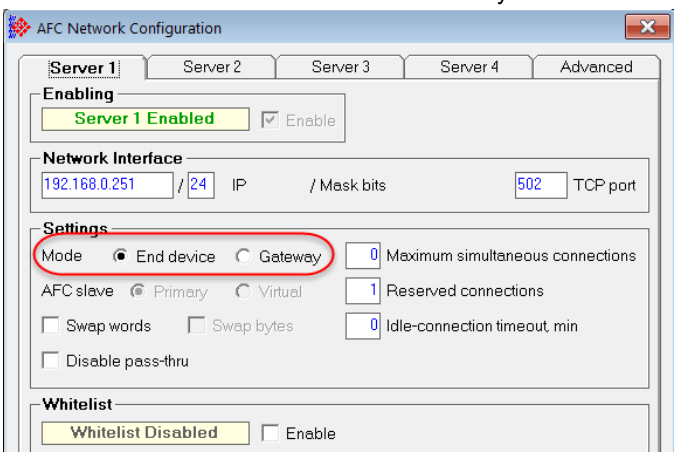


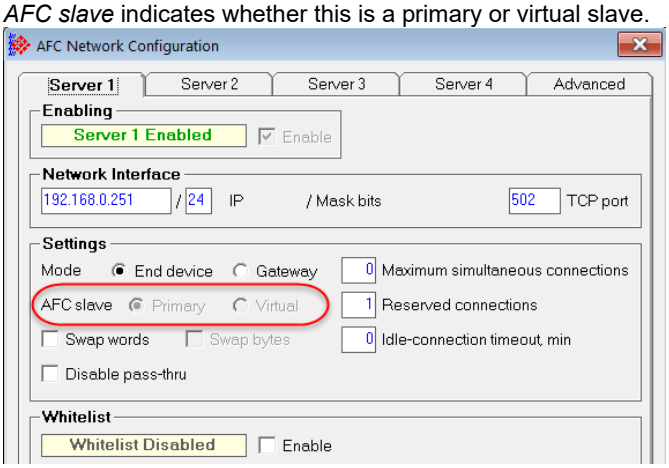
3 In the *Network Interface* area, enter the IP address of the physical interface inconfigure the network interface.



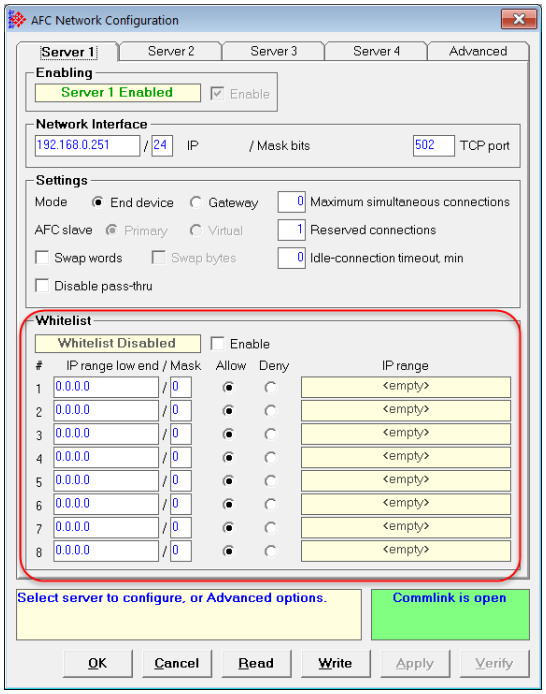
4 Set up *Mode* and *AFC Slave* settings

Modbus TCP/IP Parameters

Parameter	Description/Example
Enabling	
Enable	Enables the Modbus TCP/IP driver
Network Interface	
IP	This field indicates the IP address of the physical interface in dotted decimal format.
Mask bits	The *Mask bits* indicate the network prefix length of the physical interface. This is a number between 1 and 31.
TCP port	*TCP port* is the Modbus TCP/IP port for the selected server. This the MBAP listener port, typically 502 (default). You can use a range between 1024 and 65535.
Settings	
Mode	Set the module as an End Device or a Gateway.  If set to an *End Device* (has its own Modbus database), the unit code is ignored and is echoed verbatim in the response regardless of its value. If set to *Gateway* (protocol converter between the TCP network on one end, and a traditional serial Modbus network on the other end), the serial Modbus network is virtual consisting of the modules primary and virtual slaves (only), and the unit code must be the configured slave address of the targeted AFC slave.
AFC Slave	The effect of the *AFC Slave* option depends on *Mode* setting. If the device is set as *End Device*, this option selects which of the two AFC slaves are to be the addressed end device. If the device is set to *Gateway*, then this option changes to a checkbox that hides the primary slave. If not selected, both slaves are addressable, but if set, only the virtual slave is addressable. In either case, if a command addresses the virtual slave but the virtual slave does not exist, no response is issued.

Parameter	Description/Example
	AFC slave indicates whether this is a primary or virtual slave. 
Swap Words	If checked, swaps the Modbus words transferred through this port. This parameter is only accessible to those data points that hold 32-bit quantities (long integers, floats, totalizers).
Disable pass-thru	The Modbus Pass-thru feature allows you to configure a Modbus Pass-Thru region in the Virtual Slave (Project > Site Configuration). See the *AFC Reference Guide* for detailed information.
Maximum simultaneous connections	Set the maximum number of connections for this server. Eight (8) total connections are available and can be configured as required. For example, each server might represent a different network. Server 1 might have a single connection while server 2 may have 3, server 3 with 2, and server 4 with 2 for a total of 8.
Reserved connections	A *reserved connection* is one whose resources are always available for use by this server, whether or not such a connection is currently in use, so that regardless of activity on other servers, this number of connections to this server can always simultaneously exist. This setting must not exceed the maximum number of connections permitted for this server if that maximum is non-zero. The total number of reserved connections over all servers must not exceed the maximum number of connections permitted overall. Server #1 always has at least one reserved connection. Range 1 to 8, default 1 with corresponding for others as 0 to 8..
Idle connection timeout, min.	Specify the number of minutes that a connection may be idle before being disconnected. A timeout of 0 means no timeout (the connection may remain idle indefinitely).

Whitelist Options



Whitelist configuration is an ordered sequence of eight entries, each of which comprises:

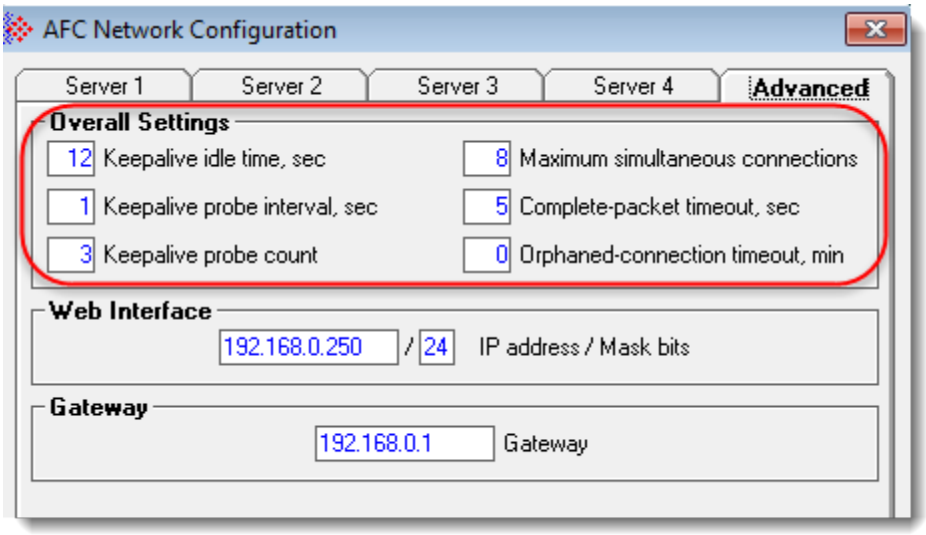
- An IP range (network IP and mask length)
- A true or false "disposition" flag; true = allow, false = deny.

An entry whose components are all zero (IP 0.0.0.0, prefix length is 0, disposition is false) is empty. It is ignored during application of the whitelist and its position in the sequence is irrelevant. The relative positioning of non-empty entries is relevant however, as a later entry can override the effect of an earlier entry.

See the *AFC Reference Guide* for detailed information.

Advanced Tab

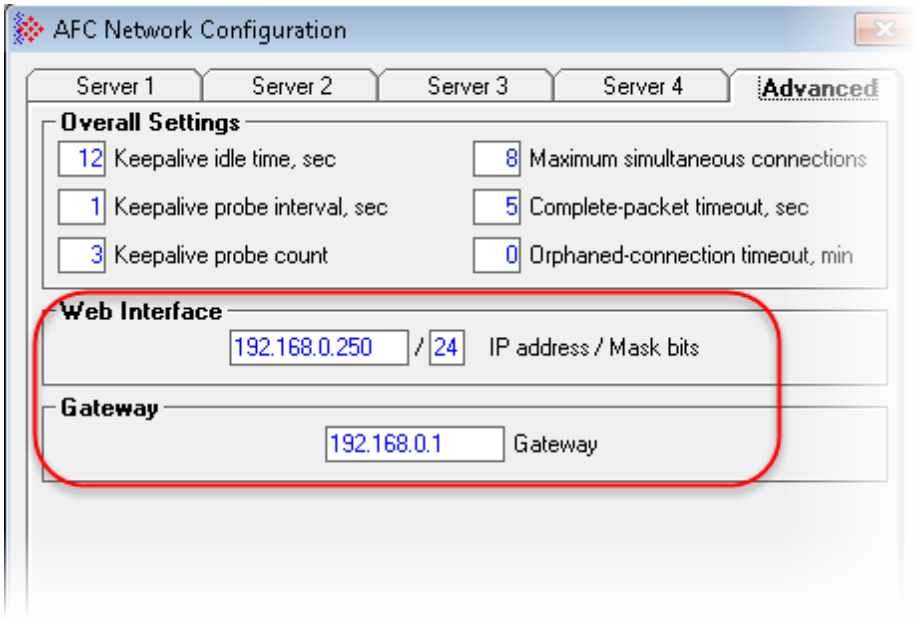
Overall Settings



Parameter	Description
Keepalive idle time	This setting enables a network server to free up resources allocated to broken connections. The three settings are: ▪ Idle time ▪ Probe interval ▪ Probe count When a connection becomes idle (no requests to the server), it could be merely because the client has nothing to say or it could be due to a broken connection. “Keepalive” enables the server to reasonably determine which and act accordingly. When a connection has been idle for the “idle time”, the server sends up to “probe count” probes at the rate of the “probe interval” delay between each. A “probe” is a TCP/IP packet that asks the client “Are you still there?”. If the client answers any probe with “Yes, I’m still here”, then the connection is good. The client is merely silent and the server resets “keepalive” logic for another cycle. If the client does not answer any probe, then the server deems the connection to be broken and closes it to free up its resources for allocation.
Keepalive probe interval	See above.
Keepalive probe count	See above.
Maximum simultaneous connections	The maximum concurrently active connections over all servers. This should be a number between 1 and 8. The default is 8.
Complete packet timeout	The timeout (in seconds) for receiving a complete packet. The timeout becomes effective upon receipt of the first octet of a packet's MBAP header and imposes a limit on the time that may elapse before receiving the last octet of that packet. If the timeout expires, the connection is shut down. Valid range is 1 through 60 with a default of 5 seconds.

Parameter	Description
Orphaned connection timeout	This timeout (in minutes) becomes active when a connection is orphaned by a sufficiently significant change to its parent server's configuration. This setting provides a window of time during which the connection remains alive so that the client can gracefully close it before establishing a replacement connection according to the network's updated requirements. Server changes causing orphans include (but not limited to): ▪ Disabling the server ▪ Change of IP address ▪ Change to whitelist the disallows the client's IP ▪ Reduction or removal of access permitted, e.g. primary vs virtual slave. ▪ Change of protocol; e.g., gateway vs end-device mode, swap options Creating orphans of a connection breaks the association between the connection and its parent server so that the connection no longer belongs to any server. Server settings in effect prior to orphan creation become frozen for that orphan for the remainder of its limited life. A subsequent reconfiguration of this or any other server that reestablishes the frozen settings does not re-associate the connection with the server; the connection remains orphaned and its timeout remains active. Upon timeout expiry, the connection is shut down. A timeout of 0 causes an immediate shutdown. Changing this setting does not adjust timeouts in effect for already existing orphans. Valid values: 0 to 60, Default is 0.

Web Interface/Gateway

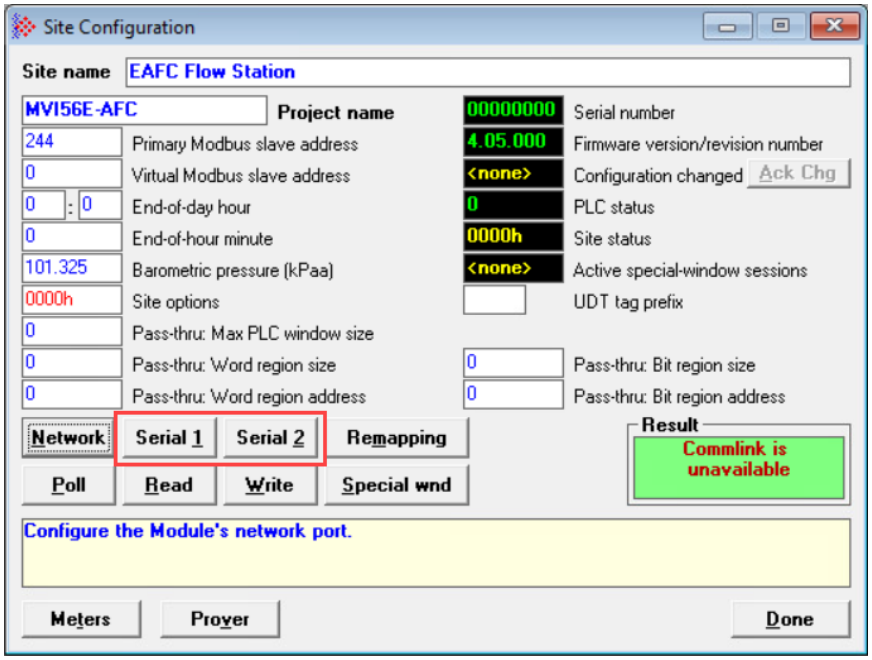


The IP address and Mask bits pertain to the address of the AFC module. This is not a Modbus TCP/IP address used by the AFC module. The default web interface address is 192.168.0.250.

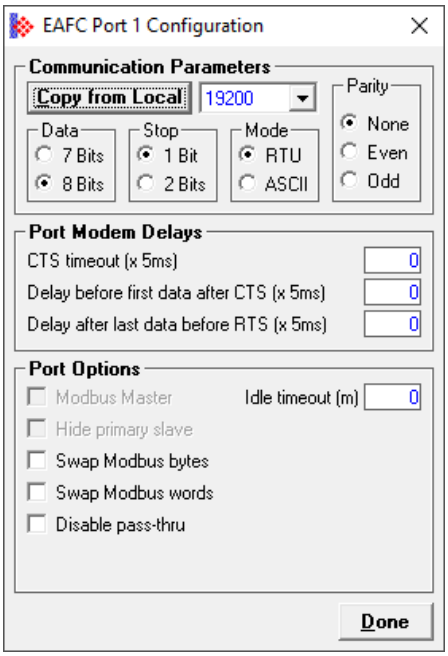
Once configured, click **READ** from the *Site* page to save changes.

3.6.3 Configuring Serial 1 and Serial 2

The AFC modules contain two serial port connections. Serial 2 may be used as a Modbus Master. To configure the serial port connections, select the **SERIAL 1** or **SERIAL 2** button in the *Site Configuration* dialog.



This opens the *EAFC Port Configuration* dialog.



Serial Communication Parameters

The module supports the following communication parameters for each communication port:

Parameter	Values
Baud Rate	9600, 19200, 28800, 38400, 57600, 115200, 230400
Data Bits	7 or 8
Stop Bits	1 or 2 Bits
Mode	RTU or ASCII
Parity	None, Even or Odd

Note: Do not configure a port for both RTU mode and 7 data bits as this combination is not supported by the Modbus protocol.

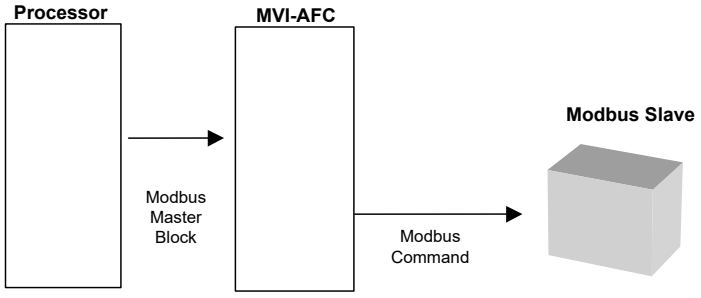
Port Modem Delays

Parameter	Description
CTS timeout (x 5ms)	Timeout period (x 5ms) for transmitter to wait for a clear-to-send frame from receiver before transmitting data frame.
Delay before first data after CTS (x 5ms)	Delay period (x 5ms) after transmitter receipt of clear-to-send frame before transmitting data frame.
Delay after last data before RTS (x 5ms)	Delay period (x 5ms) after transmitter sends last data frame before sending request-to-send frame to receiver for next message.

Port Options

Option	Description
Modbus Master	Enables the Modbus Master for the port (Serial 2). The Modbus Master command is generated from the processor using ladder logic (Modbus master block). After the Modbus Master transaction is completed the module is ready to receive another Modbus Master request from the ladder logic.

Note: This is designed to poll devices such as gas chromatographs but does not poll fast enough to use for instrumentation such as Coriolis meters and multi-variable transmitters.



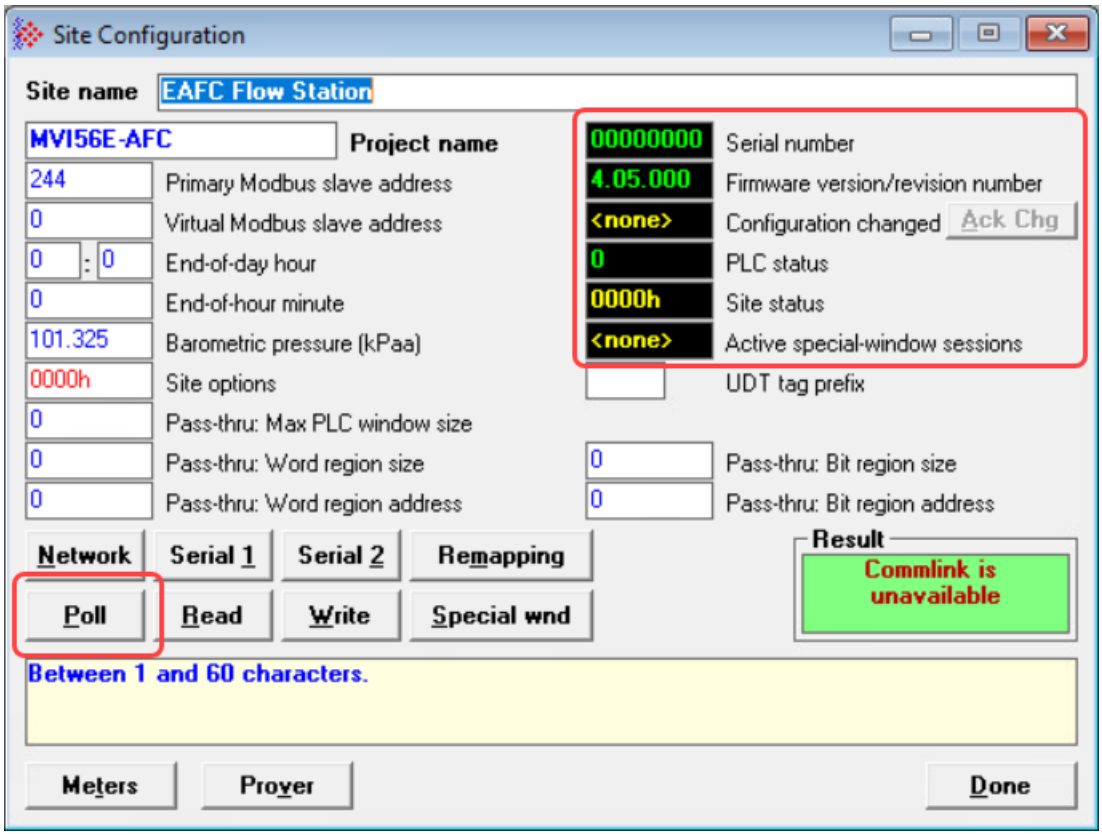
The following Modbus functions are support for Modbus Master operation:

Modbus Function Code	Description
1	Read Coil Status
2	Read Input Status
3	Read Holding Registers
4	Read Input Registers
15	Force (Write) Multiple Coils

Option	Description
	16 — Preset (Write) Multiple Registers The module offers flexibility for Modbus Master operation, allowing ladder logic to select one of the following data types: ▪ Bit (packed 16 to a word) ▪ Word (16-bit register) ▪ Long (32-bit items as register pairs) ▪ Long Remote (32-bit items as single registers) **Note:** Long data type implements each data unit as one pair of 16-bit registers (words). Each register contains two bytes. Long remote data type implements each data unit as one 32-bit register. Each register contains four bytes. The proper choice depends on the remote slave's Modbus implementation.
Hide Primary Slave	When checked, protects the Primary Modbus Slave from any read or write command from a Modbus master device. In this case, you could also remap the register from the Primary Slave to the Virtual Slave protecting each register from write commands (refer to the Primary & Virtual Modbus Slaves Configuration section).
Swap Modbus Bytes	If checked, the bytes transferred by a Modbus master device will be swapped.
Swap Modbus Words	If checked, the words transferred by a Modbus master device will be swapped. This setting only applies to double-register data items (floating point and long integer).
Disable Pass-thru	The Modbus pass-through feature allows you to configure a Modbus Pass-through region in the virtual slave (**Project** > **Site Configuration**). After the module receives a holding register write command (Modbus functions 6 or 16) or a bit write command (Modbus functions 5 or 15), it generates a pass-through block to be sent to the processor containing the Modbus command data. You can define a word pass-through region for words or bits. Note: You must enable the Virtual Slave by configuring a Modbus address greater than 0 (**Project** > **Site Configuration**). You can control which communication parts will support the pass-through (**Project** > **Site Configuration** > **Port X** button). This feature requires ladder logic to read the pass-through block from the module to the processor. Refer to the Ladder Logic section in the *AFC Reference Guide* for more information about the pass-through feature.

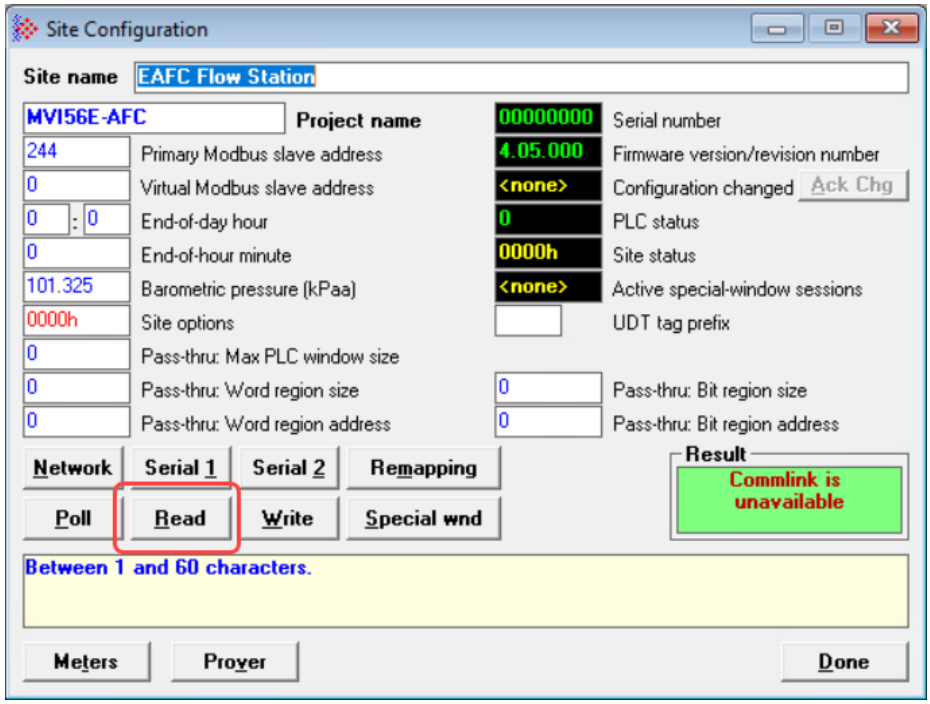
3.7 Poll Button

The **POLL** button updates the display of site status (the black-background boxes in the upper right quadrant of the *Site Configuration* dialog.



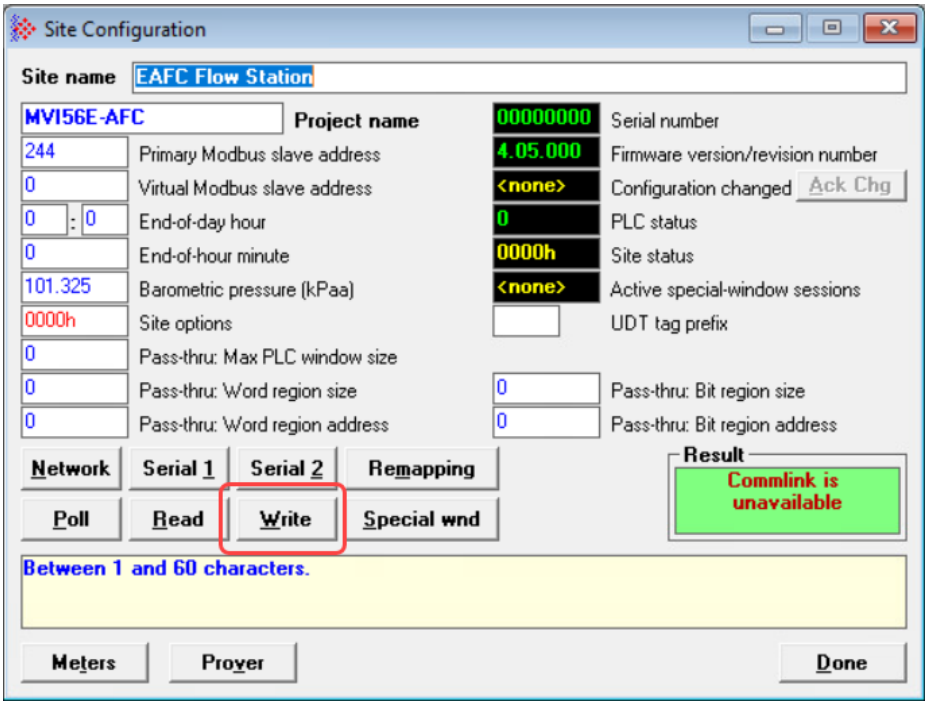
3.8 Read Button

The **READ** button reads the current site configuration from the module to the local PC. Look at the result area (green rectangle) on the *Site Configuration* dialog box for the status of the read operation. When a "Success" indication appears in the result area, it indicates that the site configuration has been successfully read to the local PC.



3.9 Write Button

After you have completed the site configuration on the local PC using EAFC Manager, click the **WRITE** button to transfer the configuration to the module. When the *Result* area shows "Success", the site configuration has been successfully written to the module.

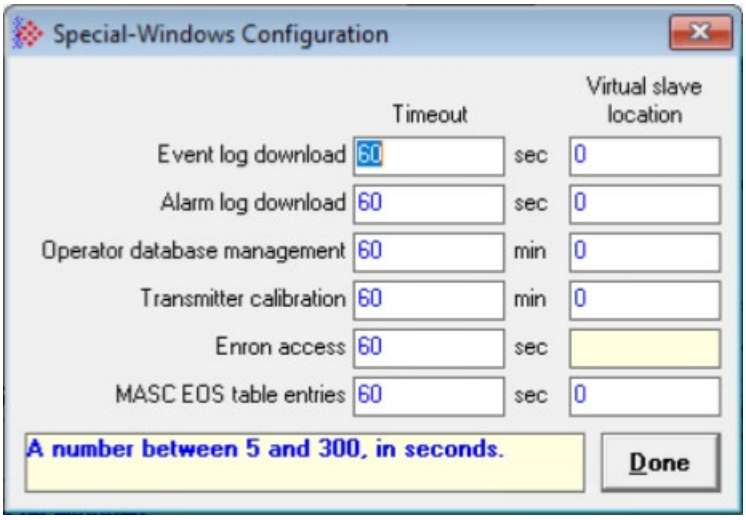


After writing the configuration to the module, you can click the **READ** button to read the current module site configuration. The configuration should match the last write operation data.

If the *Result* area shows "Time out", verify the network connections.

3.10 Special Wnd Button

This button displays the *Special-Windows Configuration* dialog.



This dialog allows you to set times in minutes or seconds. The times represent periods of no activity. For example, if you set *Event log download* to 60 seconds, and no download activity has occurred within that time period, the Event Log activity is abandoned and no data is logged or committed. The same holds true for the alarm log, transmitter calibration, Enron access, and MASC EOS table entries. You must enter the time interval and the optional Virtual Slave location of the data. When you are satisfied with your settings, click **DONE**. You can come back at any time and change your settings.

If you want to access these special windows via the virtual slave, assign an address in the virtual slave to the special window in the *Virtual slave location* column. If the Virtual slave location is set to “0”, the special window is unavailable in the virtual slave.

4 Configuring Meter Parameters

Important: Ensure that all site information is configured as described in the previous chapters.

4.1 What Parameters Do I Have to Configure?

The *Meter Configuration* dialog box (**PROJECT > METER CONFIGURATION**) allows you to configure your meters based on their type and application. The parameters that you see on this page could vary based on information that you provide to EAFC Manager.

Configuring a meter consists of the following steps:

1. Configure the meter and stream identification parameters. For details see section 4.2, "Configuring Meter and Stream Identification Parameters," on page 45.

2. Configure the meter-classification parameters. These include *Product Group*, *System of Units*, *Metering Principle*, and *Group Membership*. For more information see section 4.4, "Configuring Meter Classification Parameters," on 48.

3. Configure parameters that are common to all projects. For more information see chapter 6, "Configuring Common Parameters," on page 60.

4. Configure application-specific parameters. For more information see chapters 7 – 15.

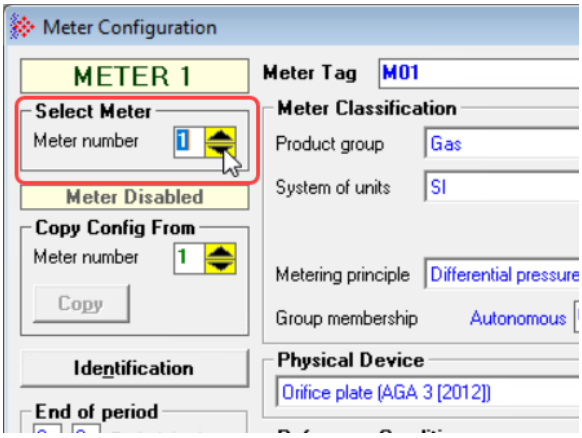
5. Configure component analysis parameters for gas products. For more information see the *AFC Reference Guide*.

4.2 Configuring Meter and Stream Identification Parameters

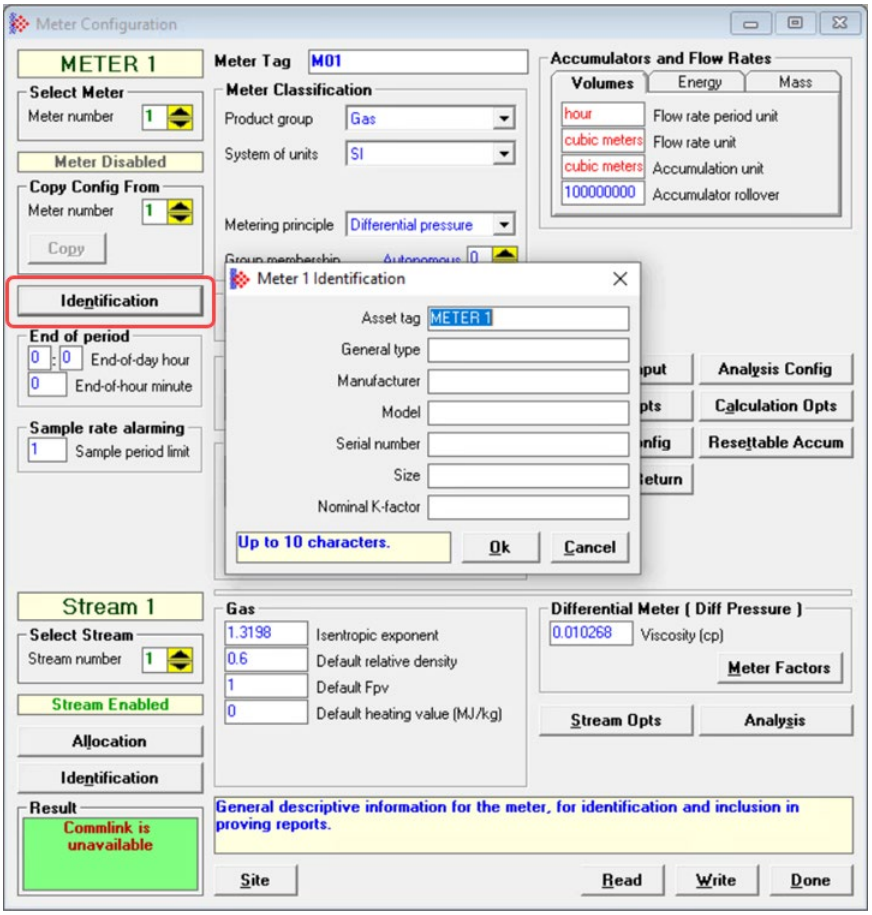
4.2.1 Setting Meter Identification Parameters

The Identification Parameters identify the meter.

1 Select the *Meter number*.



2 Click the **IDENTIFICATION** button in the *Meter* area of the dialog (upper part) to display the *Meter Identification* window.



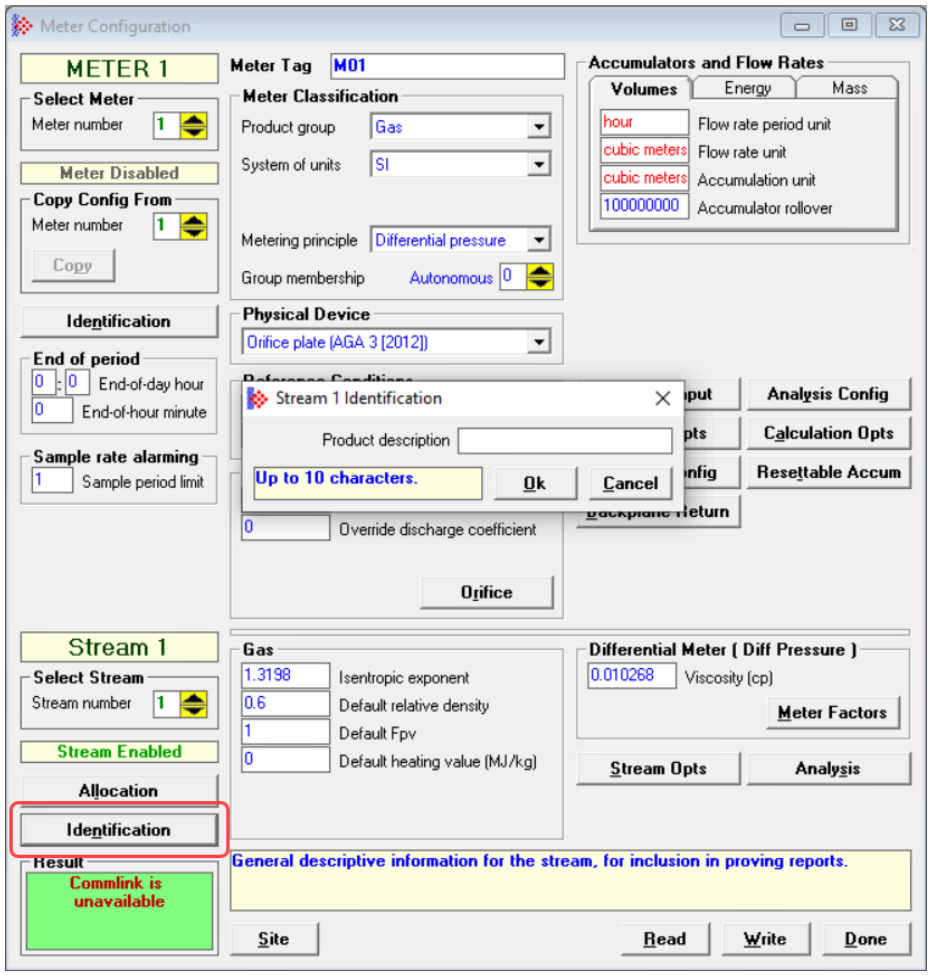
3 Add the following identifying parameters:

- *Asset Tag*
- *General Type*
- *Manufacturer*
- *Model*
- *Serial Number*
- *Size*
- *Nominal K Factor*

4 Click **OK** when complete. Repeat this for every configured meter.

4.2.2 Setting a Stream Name

1 To set a *Stream Name*, click on the **IDENTIFICATION** button under the *Stream Enabled* indicator.



2 Enter a product description and click **OK**.

4.3 Setting End-of-Period Parameters

These parameters set the *End-of-day hour* and *End-of-hour minute* values on a per meter run basis.

4.3.1 End-of-day hour

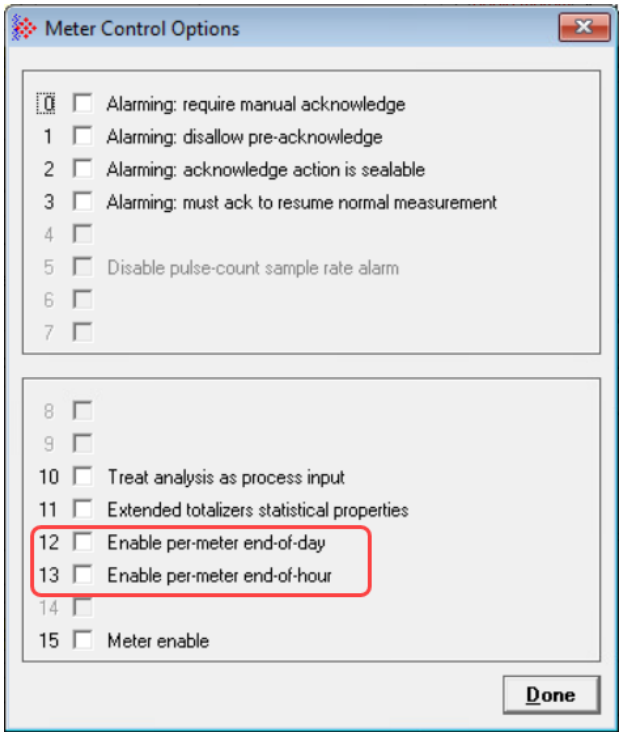
This parameter sets the minute of the day when the daily archives are created. The default value of 0 (zero) creates the daily archive at midnight. The entry format is hh : mm, where hh represents hour and mm represents minute of the hour. Valid values for hour are between 0 and 23. Valid values for minute of the hour are between 0 and 59. The entered hour and minute of the hour values are converted to end-of-day minute values in a range from 0 to 1439 before being written to the module. This moment is relative to the module's wallclock, which is expected to be UTC time.

4.3.2 End-of-hour minute

This parameter sets the minute of the hour when the hourly archives are created. The default value of 0 (zero) creates hourly archives at the top of each hour. Valid values are between 0 and 59.

4.3.3 Setting Precedence

Global settings for *End-of-day hour* and *End-of-hour minute* are located in the *Site Configuration* dialog box. By default, these take precedence over the *End-of-day hour* and *End-of-hour minute* parameters in the *Meter Configuration* dialog box. However, you can give the meter setting precedence using the *Meter Control Options* dialog.



1 From the *Meter Configuration* dialog, click on the **CONTROL OPTS** button.

2 Select the *Enable per-meter end-of-day* and *Enable per-meter end-of-hour* check boxes.

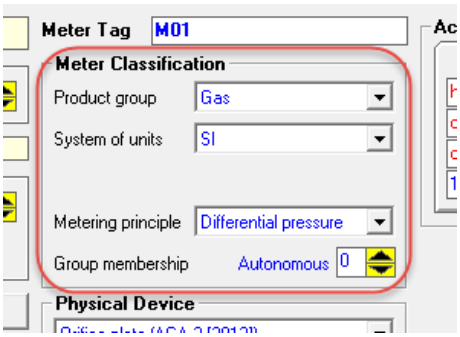
3 Click **DONE**.

The settings in the *End of Period* section for the meter now take precedence over those set on the Site page.

4.4 Configuring Meter Classification Parameters

Meter classification parameters include meter type, product group, units, and primary input. These parameters must be configured before you configure any common or application-specific parameters.

What you select here affects the available parameters that must be configured for your application. EAFC Manager needs these parameters in order to hide or show parameters that pertain specifically to your meter and its primary output based on your meter and associated instrumentation.



4.4.1 Product Group

The *Product Group* represents what you are measuring (i.e., gas or liquid). The *Product Group* dropdown list allows you to select the appropriate *Product Group* for your application. Refer to the *AFC Reference Guide* for detailed information.

4.4.2 System of Units

System of Units pertains to how measurements are displayed and are used for calculations.

- ***US*** – Temperature in °F, Pressure in psi, Differential Pressure in hw@60°F.
- ***SI*** – Temperature in °C, Pressure and Differential Pressure in kPa.

Troubleshooting Tip: If EAFC Manager displays an "Illegal Data Value" message, it typically indicates an invalid metering principle or product group configuration. The module does not accept a configuration file that attempts to change a metering principle or product group for a meter that is currently enabled. Disable all meters, change the metering principle and product groups as needed, and then enable the meters again.

4.4.3 Metering Principle

Metering principle internally combines device type, primary input, and the meter-group parent flags to characterize a type of meter. Options are as follows:

- Differential pressure
- Pulse count
- Pulse frequency
- Flow rate
- Meter-group parent: Selecting this option designates the meter channel as the parent of a meter group. For more information see chapter 5, "Configuring Meter Groups," on page 51.

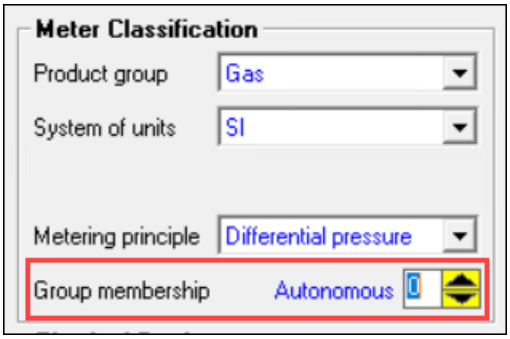
Note: If you select a metering principle of *Meter-group parent*, information that is not sourced from the meter-group parent is hidden.

Use the following table to determine which metering principle you should select based on the type of meter and its primary output:

What type of meter are you configuring?	What is the primary output from your flow meter and associated instrumentation?	Configure the metering principle as…
Orifice Meter	Differential Pressure	Differential pressure
V-Cone Meter	Differential Pressure	Differential pressure
Wedge Meter	Differential Pressure	Differential pressure
Coriolis Meter	Flow Rate	Flow rate
	Pulse Count and Pulse Frequency	Pulse count
	Pulse Frequency Only	Pulse frequency
Vortex Meter	Flow Rate	Flow rate
	Pulse Count and Pulse Frequency	Pulse count
	Pulse Frequency Only	Pulse frequency
Ultrasonic Meter	Flow Rate	Flow rate
	Pulse Count and Pulse Frequency	Pulse count
	Pulse Frequency Only	Pulse frequency
Turbine Meter	Pulse Count and Pulse Frequency	Pulse count
	Pulse Frequency	Pulse frequency
	Pulse Count	Pulse count
Positive Displacement	Same as Turbine	
Magnetic	Same as Turbine	
Thermal Mass	Flow Rate	Flow rate
	Pulse Count and Pulse Frequency	Pulse count
	Pulse Frequency Only	Pulse frequency

4.4.4 Group Membership

Group membership specifies whether the meter is a member of a meter-group parent or a standalone (autonomous) meter channel. When 0 (not a member of a meter-group parent), the meter is a standalone, autonomous meter channel.



When the *Group membership* value is a number from 1 to 16, the meter is a member of a meter-group parent.

Note: If you assign the meter to a group, information and parameters that are sourced from the meter-group parent are disabled.

For more information on meter groups, see the following chapter.

5 Configuring Meter Groups

5.1 About Meter Groups

The purpose of a meter group is to link multiple meters to a single parent meter channel so that data from the meters can be summarized or averaged.

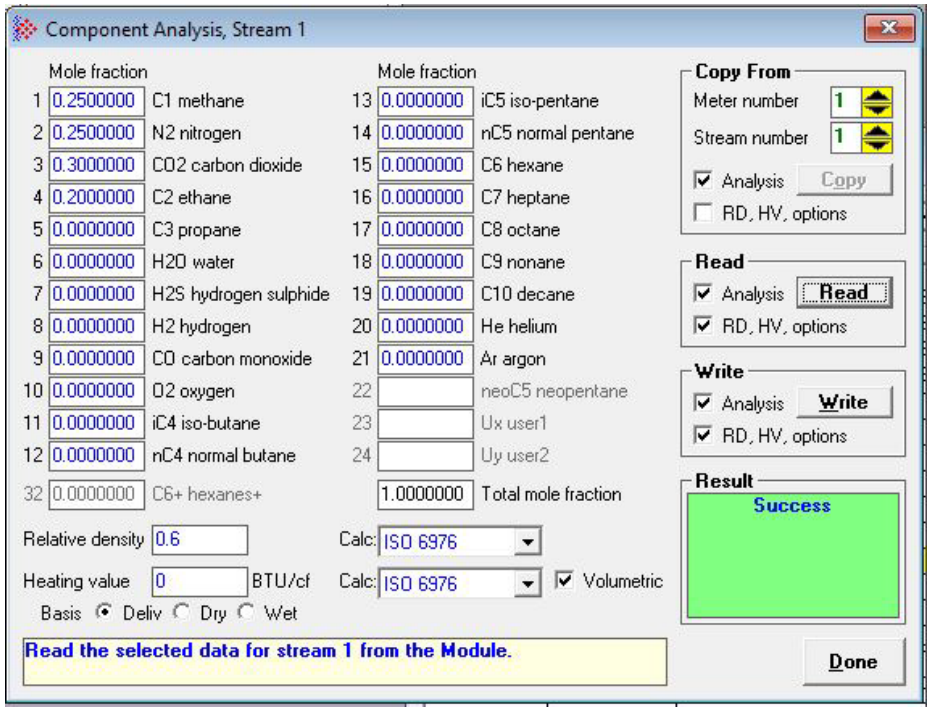
5.1.1 How configuration is sourced from the parent to the group members

In order for meter-group parent calculations to accurately reflect the summations or averages of the meter-group members, certain configuration parameters must be consistent for all members, while other member configuration parameters may be configured independently for each member. We use the following terms to refer to these two categories of parameters:

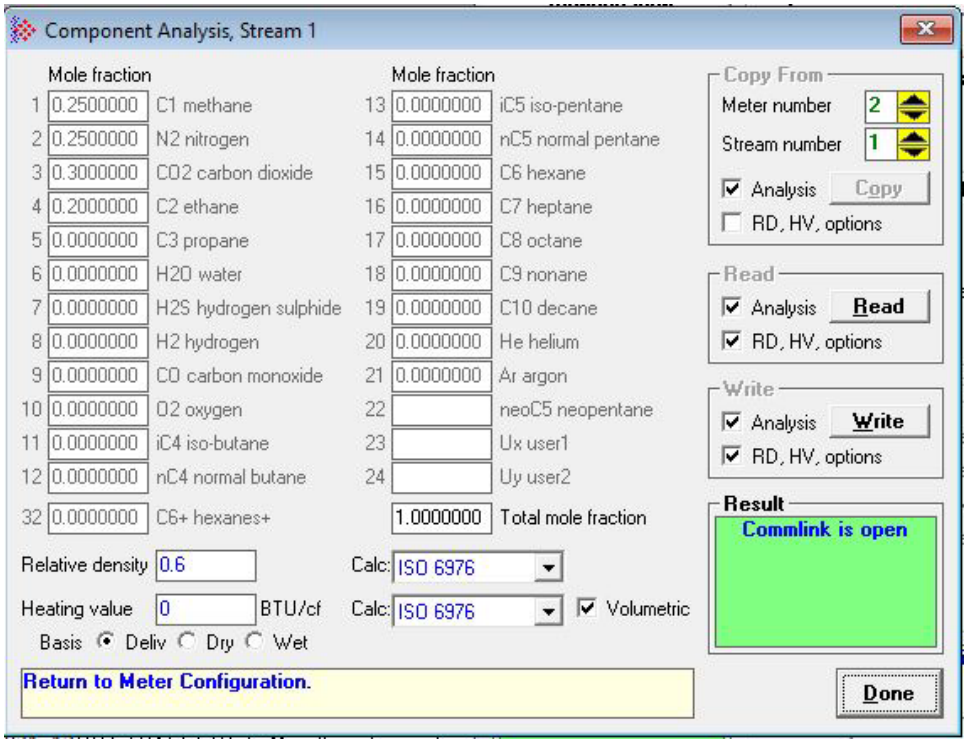
- "Group Member Synchronization" refers to configuration parameters that are sourced from the meter-group parent's configuration parameters.
- "Group Parent Not Applicable" refers to configuration parameters that may be configured independently for each member within a group.

In EAFC Manager, configuration parameters that are sourced from a meter-group parent to each meter-group member are disabled when the user is viewing a member.

For example, the following screen capture shows what the *Component Analysis* dialog box would look like for a meter-group parent:



The *Component Analysis* dialog box for a member of the parent's group would look like the following screen capture. Note that many of the parameters are disabled (grayed out). That is because the values for these parameters are sourced from the meter-group parent.



These two categories of parameters are explained in further detail in the following subsections.

Group-Parent Not Applicable

"Group-Parent Not Applicable" means that a data point has no meaning or relevance to a group-parent. When written to a group-member, these points behave as if the meter were autonomous, fully independent from other meters. When such a parameter is written to a group-parent, however, the change attempt is denied by overwriting the request with the original before verification, exactly the same technique as denying changes to "Group-Member Full Propagation" points of group-member meters.

An example of a "Group-Parent Not Applicable" module is meter physical device. Only a group-member or autonomous meter can have an associated physical device. Such a device is meaningless for a group-parent, which represents only the consolidation of measurement data from its membership. Other examples of "Group-Parent Not Applicable" configuration parameters include the following:

- acknowledge alarms
- meter process input calibration
- densitometer
- meter process input ranges
- low pulse flow threshold

- meter/K factor curve
- master pulse-count rollover
- physical device
- pulse input rollover
- sample period limit
- MVT linkage

Group-Member Synchronization

"Group-member Synchronization" configuration parameters consist of parameters which are defined in the meter-group parent and kept consistent for all meter-group members. Configuration parameters changed via a Modbus write to a group-parent are propagated to all its group-members, and no additional side-effects (a.k.a. "consequences") are required. That is, the update of the database due to the write is the complete and sufficient change needed.

When a "Group-Member Synchronization" configuration parameter is written to a group-member, the change attempt is denied by overwriting the requested data with the original before verifying the request, just as if the point had been written with no change requested; the member can be updated only by writing the change to its parent.

An example of a "Group-Member Synchronization" configuration parameters are the meter reference conditions; both reference temperature and pressure are determined by the group-parent, and update consists of writing the new values to the database with no additional touches required other than that database change itself.

Other examples of "Group-Member Synchronization" configuration parameters include the following:

- product group
- system of units
- density units
- reference conditions
- end-of-period settings
- Units
- accumulation rollovers
- analysis component map
- active stream select
- composite subcomponent molar fractions
- calculation methods: relative density and heating value
- heating value basis
- analysis normalization error tolerance
- stream product description

- analysis molar fraction
- meter options
- meter parameter value
- stream parameter value
- stream options

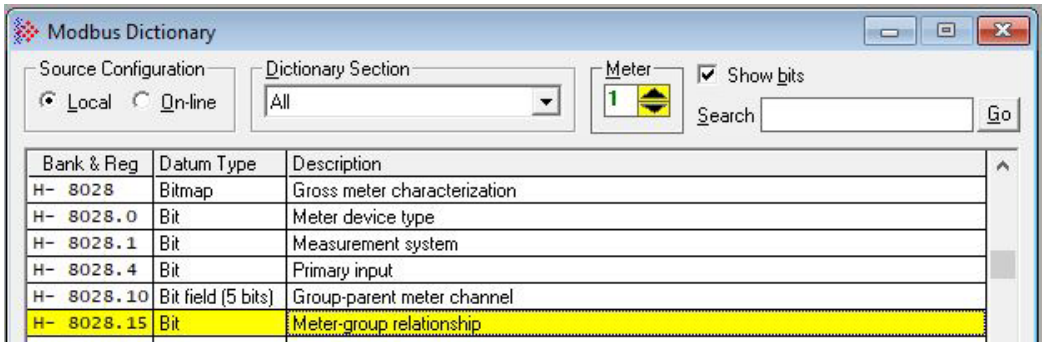
5.1.2 Data Points Related to Meter Groups

Group-Parent Meter Channel

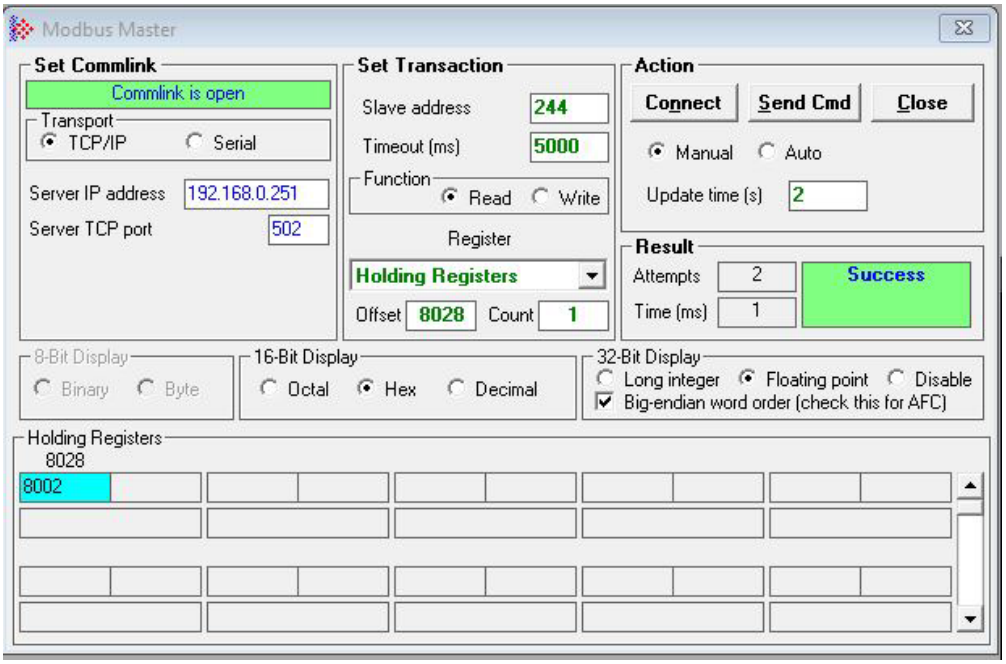
The *Group-parent meter channel* data point specifies details of group relationship. If the meter channel is a "group-parent," this bit field is interpreted as a binary value 0. If the meter channel is a "group-member," this bit field is the 1-based index of the meter channel that is configured as this member's parent. If the meter channel is "*autonomous,*" performing measurement associated with a physical meter but not related with or to any meter group, then this bit field has value 0.

Meter-Group Relationship

If the meter-group relationship bit is set, the meter channel has a relationship to a meter group, either as a group-member or as the group-parent. If clear, this meter channel is autonomous, having no relationship to any meter group.

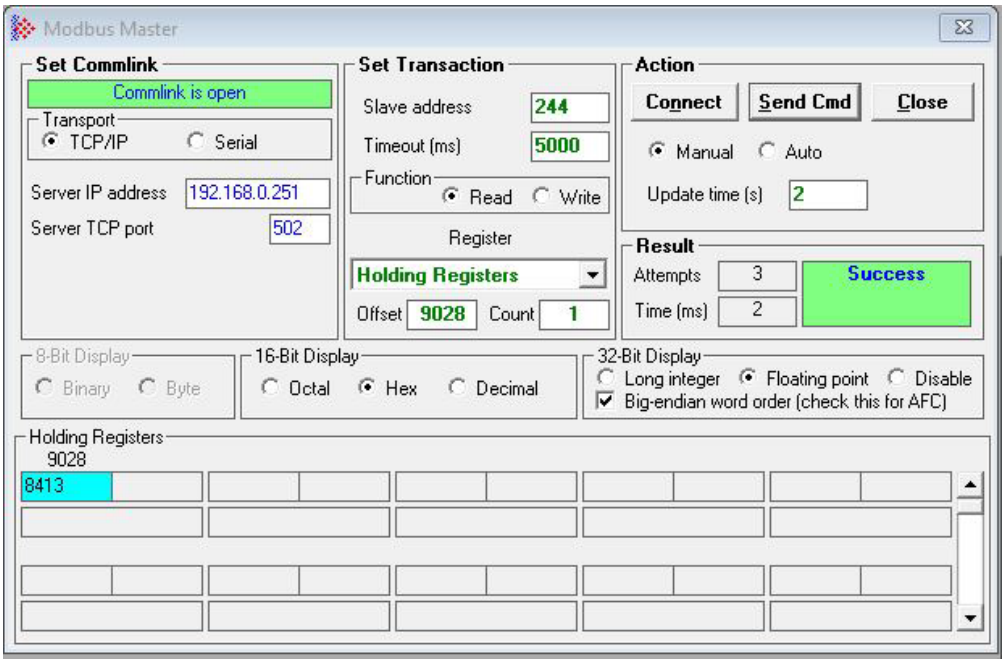


If Meter 1 is configured as a meter-group parent, we can use the Modbus Master dialog to poll the meter and obtain the value for holding register 8028, as shown in the following screen capture:



The hexadecimal value of the register is 8002, which is 1000 0000 0000 0010 in binary. The *Meter-group relationship* data point (position 15) has a value of 1, indicating that the meter has a relationship to a meter group. The *Group-parent meter channel* data point (positions 10 – 14) has a value of 0, indicating that Meter 1 is the parent of the group.

The following screen capture shows Meter 2 configured as member of group 1:



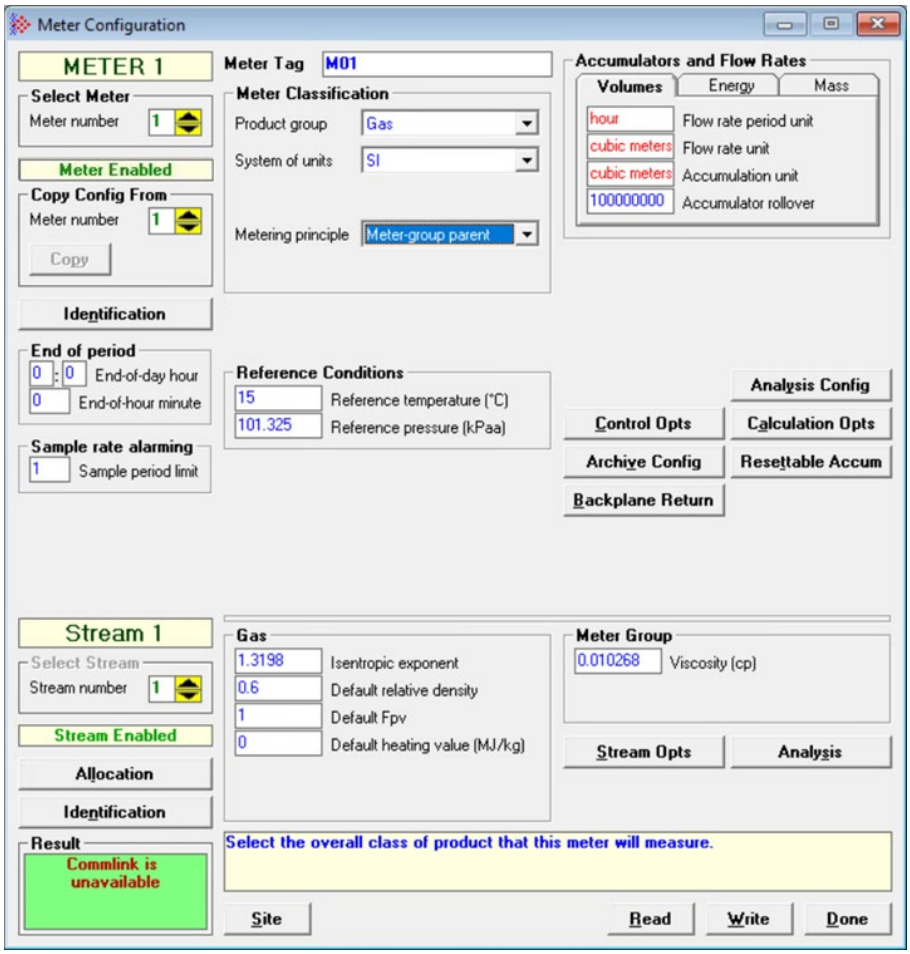
In this example the hexadecimal value of the register is 8413, which is 1000 0100 0001 0011 in binary. The *Meter-group relationship* data point (position 15) has a value of 1, indicating that the meter has a relationship to a meter group. The *Group-parent meter channel* data point (positions 10 – 14) has a value of 1, indicating that Meter 2 is a member of the group having Meter 1 as its parent.

5.2 Configuring the Meter-Group Parent

This selection configures the meter channel as a group-parent. There is no physical metering device directly associated with the channel. Instead, the function of the channel is to summarize the results of other group-member channels that do have associated physical metering devices and perform the actual measurement.

Note: The meter-group parent must be configured prior to the members of the group.

Note: If downloading multiple meter configurations to a module at once in the meter-group relationship, the meter index of the meter-group parent must be less than the meter index of all the meter-group members of the meter-group parent.



To configure the meter-group parent:

1 From the *Project* menu, select *Meter Configuration*.

The *Meter Configuration* dialog displays.

2 In the *Meter Classification* area, select a product group and system of units. For definitions of these parameters, see section 4.4, "Configuring Meter Classification Parameters," on page 48.

Note: The meter group-parent and group-members must have the same product group.

3 If you selected *Gas* for the product group, set up the gas component analysis configuration. See the *AFC Reference Guide* for more information.

4 From the *Metering principle* dropdown list, select *Meter-group parent*.

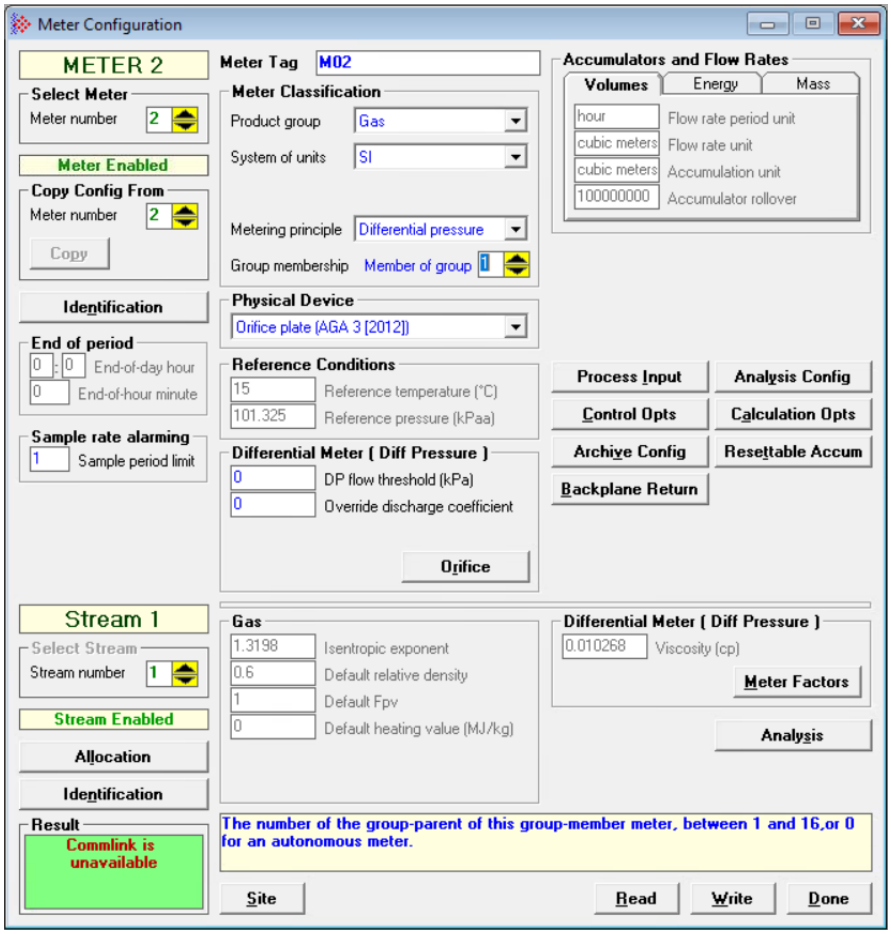
5 Write the configuration to the module by selecting the **WRITE** button in the lower-right corner of the *Meter Configuration* dialog box.

5.3 Configuring Meter-Group Members

The meter “group-member” (member of some group, the parent of which is identified by giving its meter-channel number). This distinction is made by the value of *Group membership* field, which if zero indicates an “autonomous” meter (and textually confirmed as so by the adjacent label, and if non-zero indicates a “group-member” meter (and textually confirmed as so by the adjacent label reading “Member of group”) and is the 1-based number of the group-parent which itself has its *Metering principle* dropdown configured as “Meter-group parent”.

Note: The meter-group parent must be configured prior to the members of the group.

Note: If a meter-group member has multiple streams, only the first stream is used in the meter group.



To configure meter-group members:

1 From the **PROJECT** menu, select **METER CONFIGURATION**.

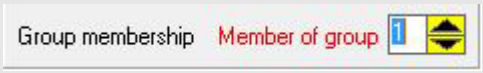
The *Meter Configuration* dialog displays.

2 In the *Select Meter* area, select the meter to configure.

3 In the *Meter Classification* area, select the same product group and system of units that you selected for the parent.

4 In the *Group membership* field, (displayed only when *Metering principle* is not set to *Meter-group parent*), enter the 1-based meter number of the group parent. The text "Member of group" will appear in blue next to the field.

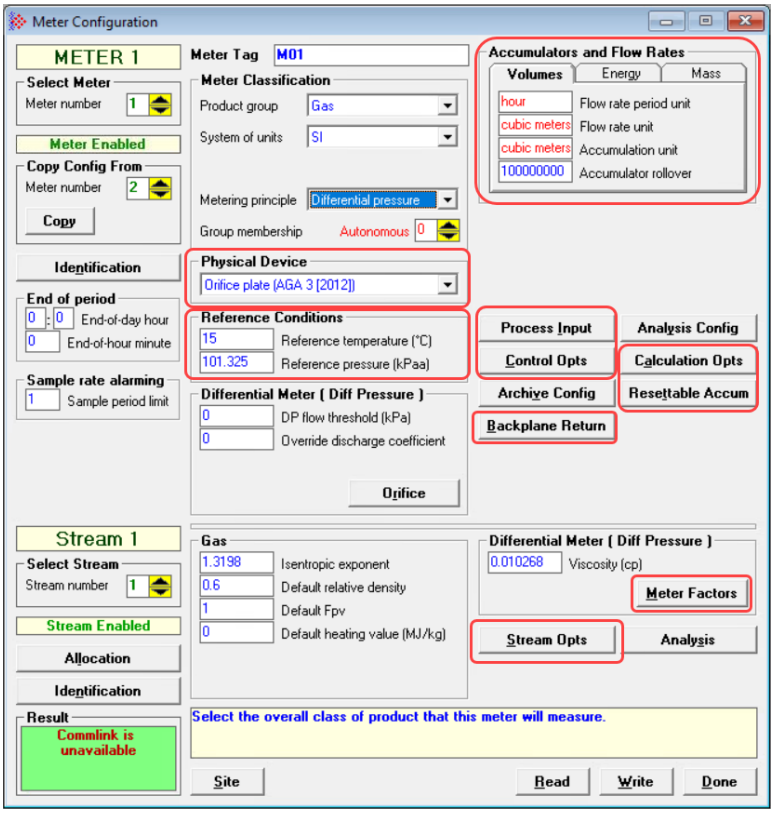
Note: If the parent was not configured before the member, the text "member of group" will appear in red to indicate an error. Red text will also appear if the member is not of the same product group and system of units as the parent.



5 Write the configuration to the module by selecting the **WRITE** button in the lower-right corner of the *Meter Configuration* dialog box.

6 Configuring Common Parameters

The Common parameters in the *Meter Configuration* dialog box must be configured for all projects.

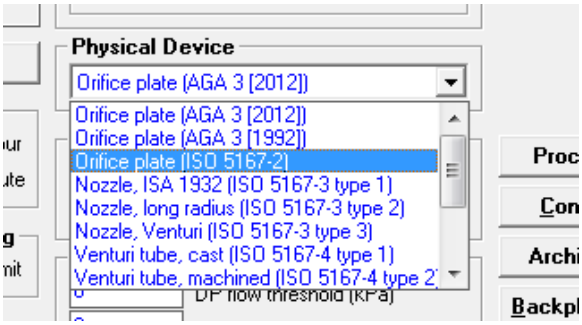


Common parameters include:

- Physical Device
- Reference Conditions
- Accumulators and Flow Rates
- Process Input
- Control Options
- Backplane Return
- Calculation Options
- Resettable Accumulators
- Meter Factors
- Stream Options

6.1 Selecting the Physical Device

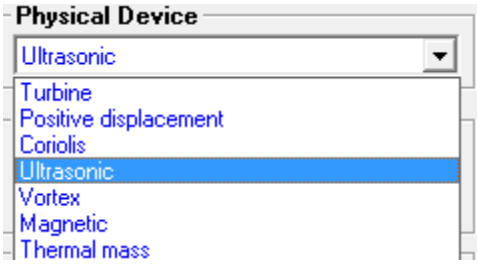
Select your device from the dropdown list. Your selection changes the calculation methods based on the meter.



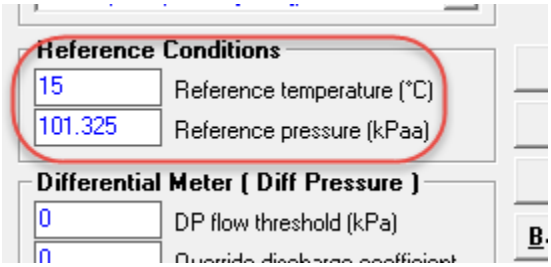
If you are using a differential gas type principle, measuring differential pressure, you have the option of selecting from the following standards:

- Orifice plate (AGA 3 [2012])
- Orifice plate (AGA 3 [1992])
- Orifice plate (ISO 5167-2)
- Nozzle, ISA 1932 (ISO 5167-3 type 1)
- Nozzle, long radius (ISO 5167-3 type 2)
- Nozzle, Venturi (ISO 5167-3 type 3)
- Venturi tube, cast (ISO 5167-4 type 1)
- Venturi tube, machined (ISO 5167-4 type 2)
- Venturi tube, rough (ISO 5167-4 type 3)
- V-cone [Rev 3.2]
- V-cone [Rev 2.5]
- Wafer-cone
- Wedge

For example, if you select a metering principle of flow rate, pulse count, or pulse frequency, the following physical device types are available:



6.2 Specifying Reference Temperature and Pressure

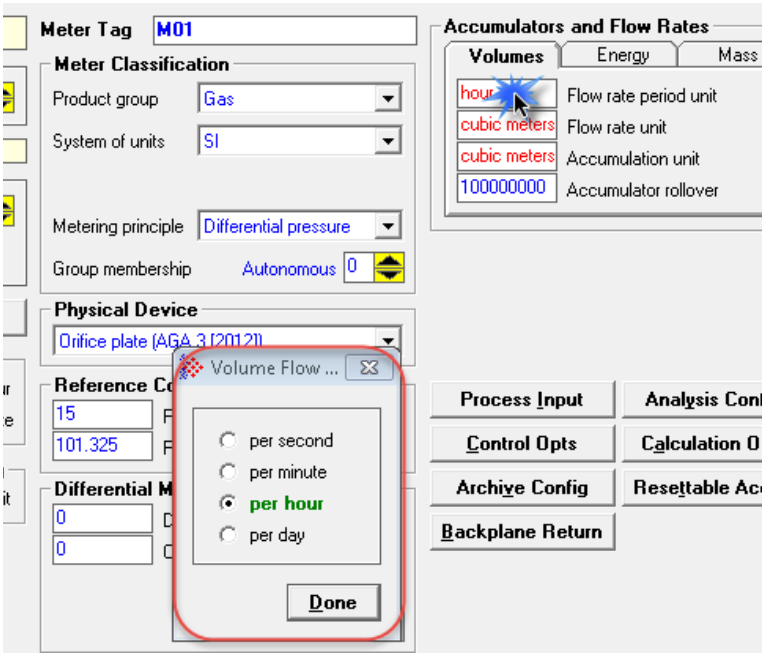


Measurements of gas and liquids are calculated based on their characteristics at a specific temperature and atmospheric pressure. Specify the reference conditions in the *Reference Conditions* area. The default values are 15°C/101.325 kPaa (SI) and 60°F/14.696psia (US), which are the standard API base conditions. If the configured reference conditions are different from API base, the API calculations are done twice as necessary to correct from flowing conditions to API base and then de-correct from API base to your selected reference.

6.3 Setting Accumulators and Flow Rates

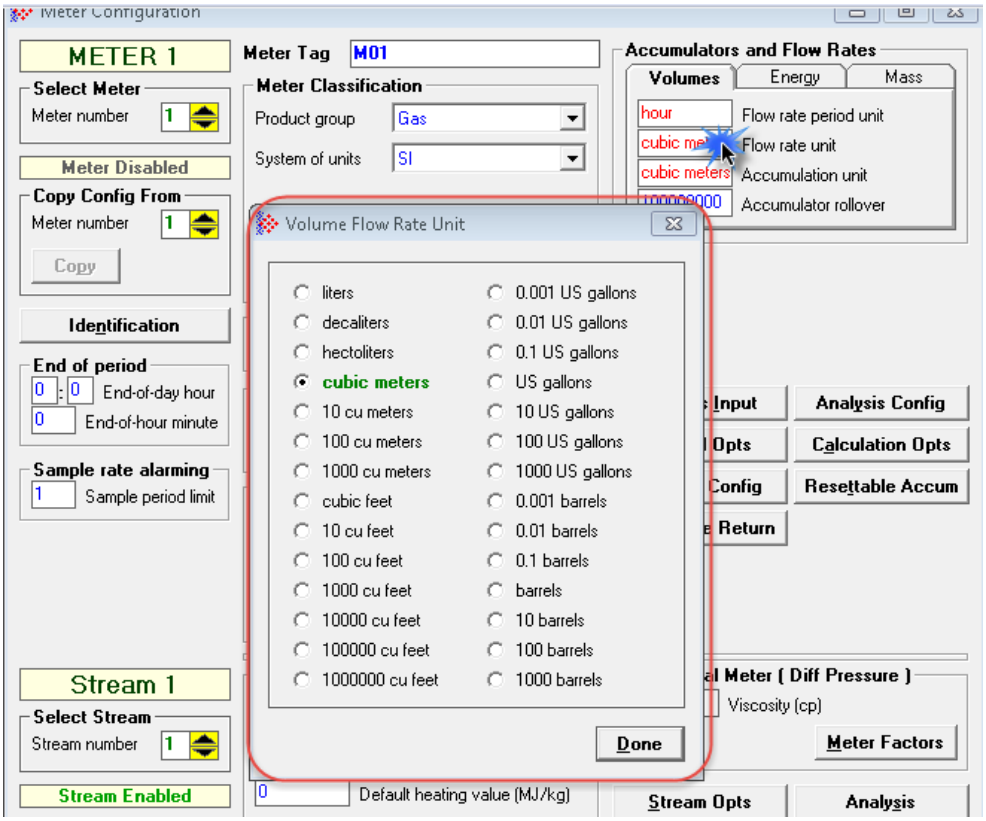
6.3.1 Flow Rate Period Unit

Click on the **FLOW RATE PERIOD UNIT** box to change the flow rate period.



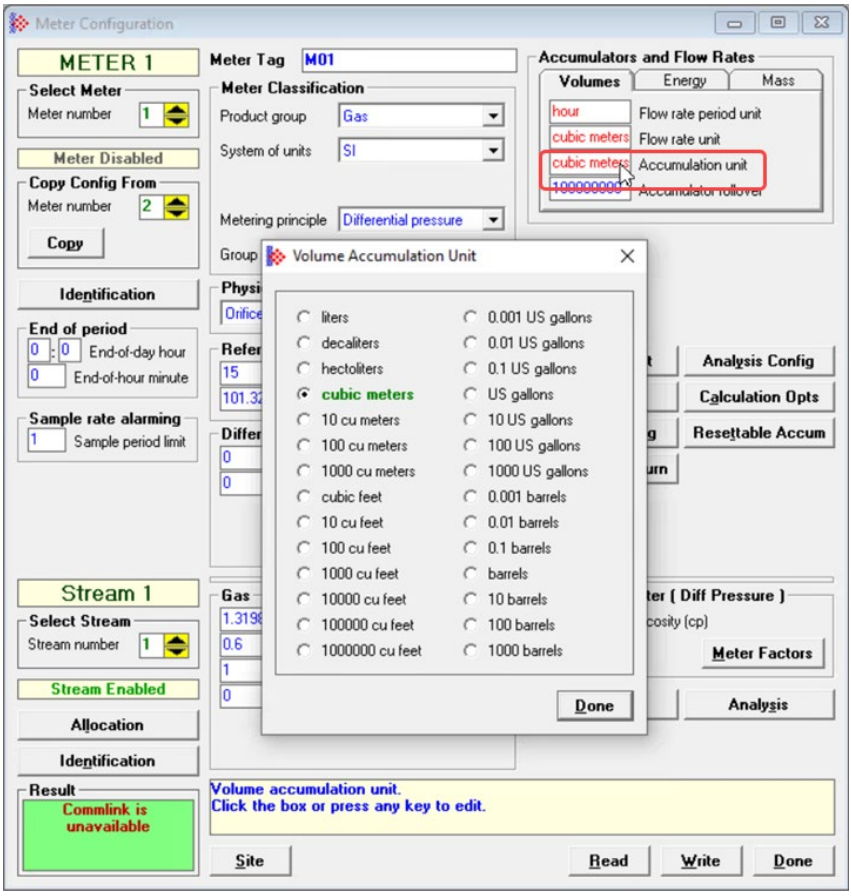
6.3.2 Flow Rate Unit

Click on the **FLOW RATE UNIT** box to change the flow rate unit.



6.3.3 Accumulation Unit

Click on the **ACCUMULATION UNIT** box to change volume accumulator units.



6.3.4 Accumulator Rollover

This is the value when mass accumulators are reset to zero and it is 1 greater than the highest value that the accumulator may hold.

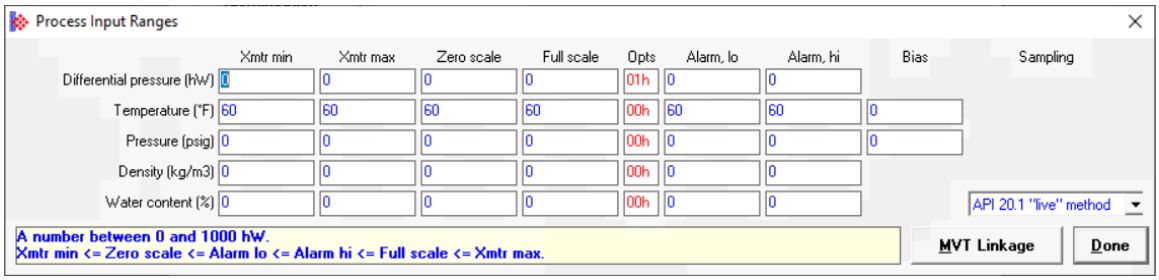
A value of 1000000 specifies a 6-digit accumulator that rolls over to 0 from 999999. Any unsigned 32-bit value may be entered. A value of 0 indicates a free-running accumulator, which rolls over to 0 from 4294967295. The default value is 100000000 (8 zeros).

6.4 Configuring Process Input Ranges

The *Process input Ranges* dialog allows for the configuration of the allowable ranges of values returned to the E-AFC module over the backplane for various input parameters.

6.4.1 Process Input Ranges

From the *Meter Configuration* dialog, click the **PROCESS INPUT** button to open the *Process Input Ranges* dialog. If input data read from the PLC is not within the confiigured ranges in this dialog, the AFC module will flag an alarm on the *Meter Monitor* dialog box (refer to *Meter Monitor* section of the *AFC Reference Guide* for more information) and the alarm bit for the meter will be set.



The entries available on this dialog box depend on the selected product group, metering principle, and physical device.

Product Group	Input Variables
Gas	Temperature, Pressure, Flow Rate, Differential Pressure, Pulse Frequency
Liquid	Temperature, Pressure, Flow Rate, Differential Pressure, Pulse Frequency, Density, Water Content (If you choose produced/injected water as product group, then water content is not a process input.)

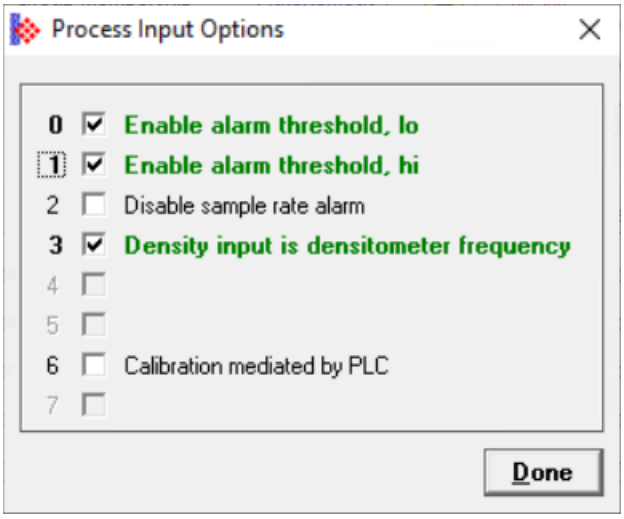
Following are descriptions of the parameters in the *Process Input Ranges* dialog:

Parameter	Description
Xmtr min and Xmtr max	Xmtr min and Xmtr max are the minimum and maximum values supported by the transmitter. These values are used as the upper and lower range values for any transmitter calibration functions. **Note:** In most instances the values for *Xmtr min* and *Xmtr max* will match the values for *Zero Scale* and *Full Scale* respectively.
Zero scale and Full scale	*Zero scale* and *Full scale* are the minimum and maximum values supported by the AFC module. Any value outside of this range will cause an error to be logged and an alarm condition to be triggered. The invalid value will be substituted with the last known good value.
Opts	The value in this field represents the bits that are currently enabled for process input options. Click in this field to open the *Process Input Options* dialog. For more information see section 6.4.2.

Alarm, lo and Alarm, hi	The low and high thresholds for triggering an alarm. Any value outside of this range will cause an error to be logged and an alarm condition to be triggered. These values can be configured to set an alarm at values that are lower or higher than the *Zero scale* and *Full scale* values respectively. **Note:** Alarm thresholds are disabled by default. They can be enabled in the *Process Input Opions* dialog. See section 6.4.2 for more information.
Bias (Applies only to *Temperature* and *Pressure*)	Enter a value for this parameter to apply a bias to the process input value for temperature or pressure coming from the instrumentation. If negative, the bias will be deducted from the value obtained from the instrumentation. If positive, it will be added to the incoming value.
Sampling (Applies only to *Water content*)	This parameter determines the sampling method used to determine water content. Options are as follows: ▪ API 20.1 “static” method” – a water cut value derived from a static sample is entered on the meter’s configuration inputs tab. ▪ API 20.1 “live” method” – the water cut is provided via a live water cut instrument. The source of the dynamic water cut value is configured on the meter’s configuration inputs tab. ▪ Density-based – the water cut value is calculated using the emulsion density value configured for the meter and computed water and hydrocarbon densities at meter conditions. **Note:** This value may also be set in the *Mass Allocation Shrinkage Calculation Configuration* dialog, as explained in the “MASC Configuration Reference” section of the AFC Reference Guide.

6.4.2 Process Input Options

The *Process Input Options* dialog provides the following options:



Parameter	Description
Enable alarm threshold, lo	When this option is set, an alarm will be triggered when the value of a process input variable falls below the value in the *Alarm, lo* field in the *Process Input Ranges* dialog.
Enable alarm threshold, hi	When this option is set, an alarm will be triggered when the value of a process input variable is higher than the value in the *Alarm, hi* field in the *Process Input Ranges* dialog.

Disable sample rate alarm	When this option is set, it disables the *Sample rate too low* alarm, which is triggered when EAFC Manager determines that a process input (differential pressure, temperature, or pressure) is being delivered from the PLC at an unacceptably slow rate. For more information see the “Process Inputs” section of the AFC Reference Guide.
Density input is densitometer frequency (applies only to density)	When this option is set, the density value is calculated from the densitometer frequency. **Note:** This option is available only if a densitometer is configured.
Calibration mediated by PLC	When this option is set, calibration of the transmitter is mediated by the PLC. When this option is clear, transmitter calibration does not make use of any mediation via the PLC, and adjustments must be performed by other means such as manual adjustments of traditional transmitters. For more information see the “PLC Mediation” section of the AFC Reference Guide.

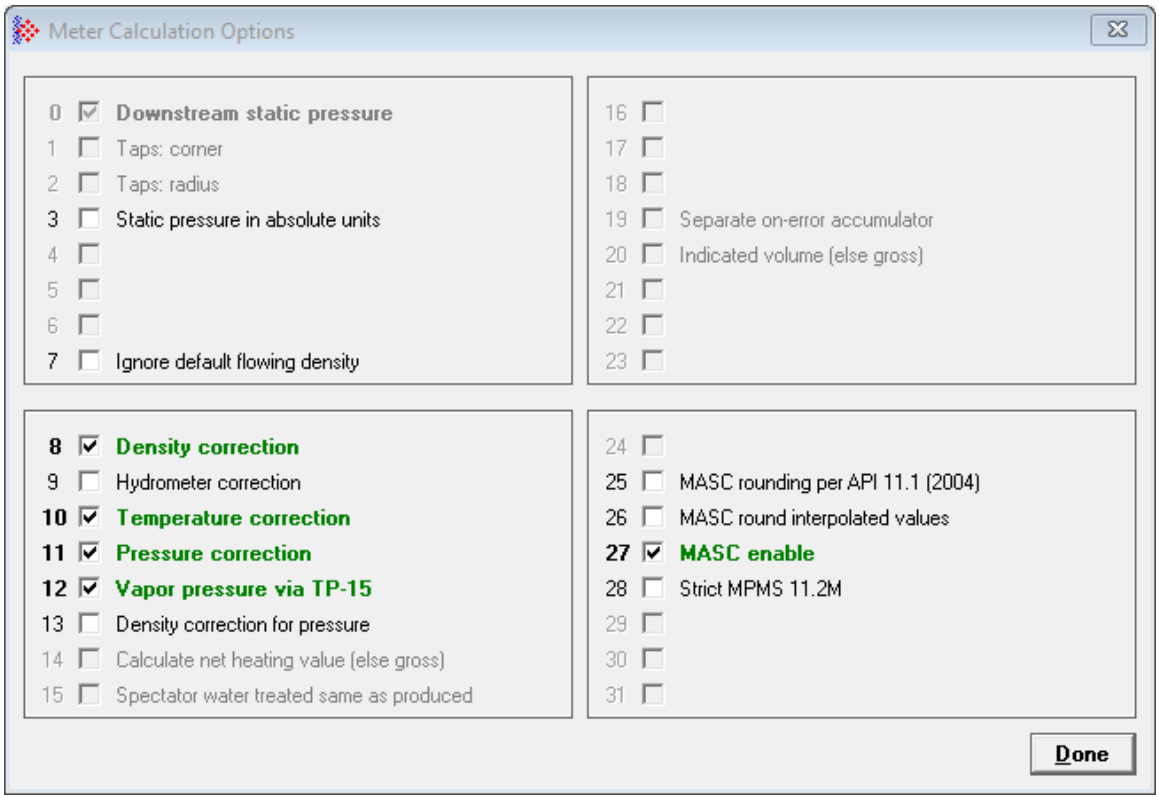
6.5 Enabling/Disabling the Meter (Control Opts)

When this option is selected, the meter will begin processing calculations. You must disable the meter by unchecking this box before you can change the meter type or product group. You should also disable any meter that is not being used to allow for best possible module performance. After enabling or disabling the meter, click **DONE**, and then click the **WRITE** button in the *Meter Configuration* area. To retrieve the status of a meter, click the **READ** button in the *Meter Configuration* area.

Note: The meter can also be enabled or disabled from ladder logic (refer to the “Enable/Disable” section of the AFC Reference Guide).

6.6 Configuring Calculation Options

From the *Meter Configuration* dialog, click on the **CALCULATION OPTS** button to access the *Meter* Calculations *Options* dialog. Details on each option can be found in the Modbus Dictionary.

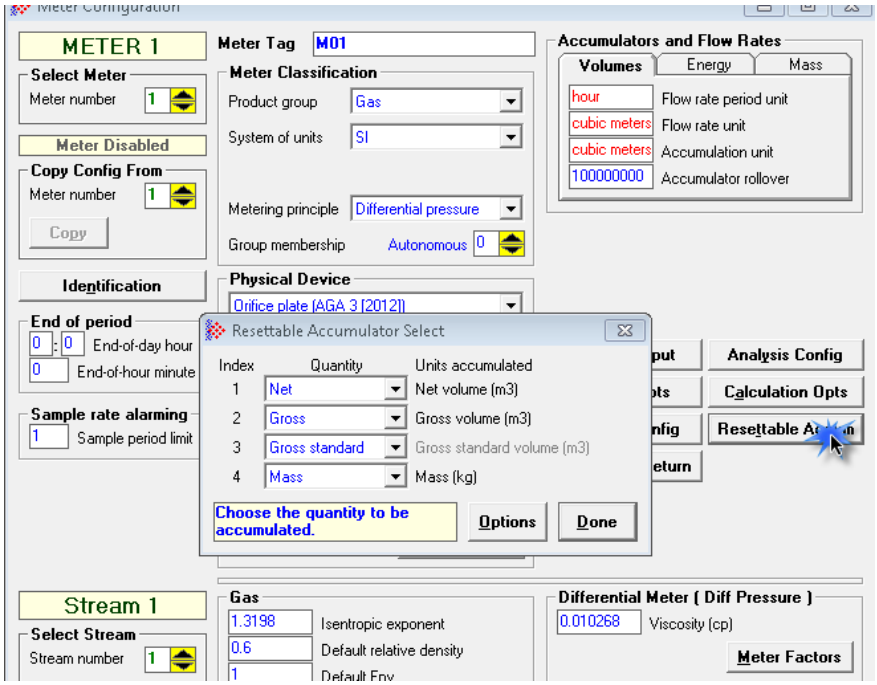


Options that to not apply to the current application are grayed out. See “Meter Calculation Options” in the *AFC Reference Guide* for detailed information.

6.7 Configuring Resettable Accumulators

The AFC modules support a total of 12 accumulators per meter channel, divided into the following categories:

- Non-Resettable Accumulators (6)
- Resettable Accumulators (4)
- Archive Accumulators (2)



Click the **RESETTABLE ACCUM** button.

The accumulator types are independent. For example, resetting a resettable accumulator does not affect the other accumulators.

For multiple-stream firmware, each stream also has a set of ten accumulators (six non-resettable, and four resettable). Increments are applied both to the meter accumulators and to the accumulators for the active stream.

6.7.1 Non-Resettable Accumulators

The non-resettable accumulators are only reset when the accumulator rollover value is reached. The accumulator rollover value, and the accumulator unit must be configured using EAFC Manager.

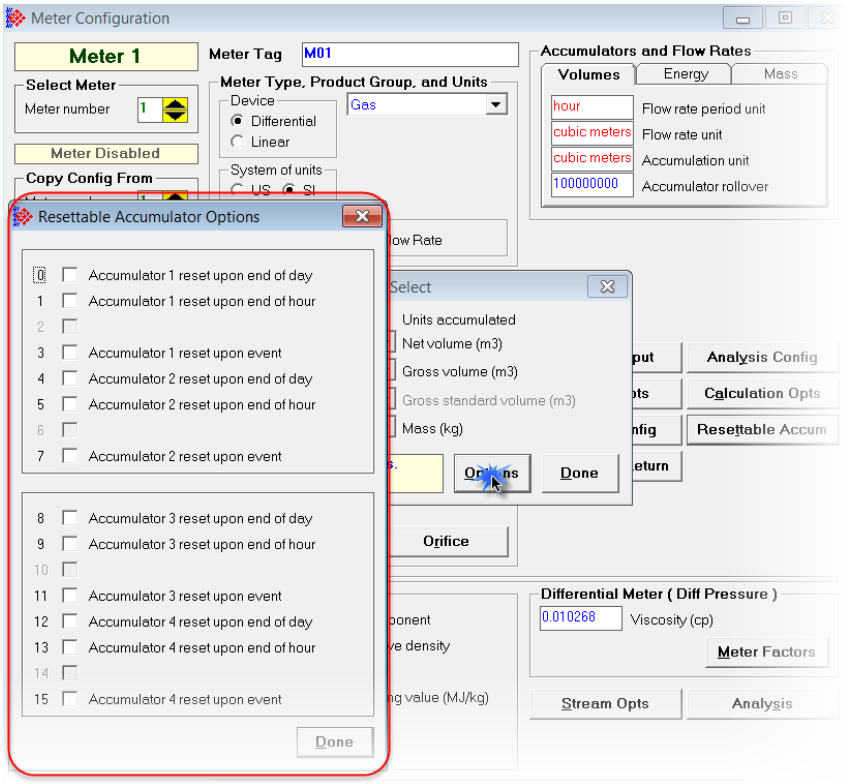
The module supports six non-resettable accumulators in order to show the measured quantity to be totalized.

- Non-resettable accumulator mass
- Non-resettable accumulator energy (Gas applications)
- Non-resettable accumulator net
- Non-resettable accumulator gross
- Non-resettable accumulator gross standard (Liquid apps only). For Oil-water emulsion, this is a non-resettable accumulator for gross clean oil.
- Non-resettable accumulator water (Liquid apps only)

Refer to the Modbus Dictionary in EAFC Manager for more information about the Modbus addresses for these registers.

6.7.2 Resettable Accumulators

From the *Resettable Accumulator Select* window, click **OPTIONS**.



The resettable accumulators are referred to as:

- Resettable Accumulator 1
- Resettable Accumulator 2
- Resettable Accumulator 3
- Resettable Accumulator 4

Resettable Accumulators are configured from the *Resettable Accumulator Select* dialog box. To open this dialog box, click the **RESETTABLE ACCUM** button on the *Meter Configuration* dialog box.

Each Resettable Accumulator can be configured to represent a different quantity as follows:

Accumulator	Modbus address for accumulator select (Meter-relative)	Default Value
Resettable accumulator 1	126	Net (code 3)
Resettable accumulator 2	127	Gross (code 4)
Resettable accumulator 3	128	Gross Standard (code 5)
Resettable accumulator 4	129	Mass (code 1)

Valid Configuration Codes

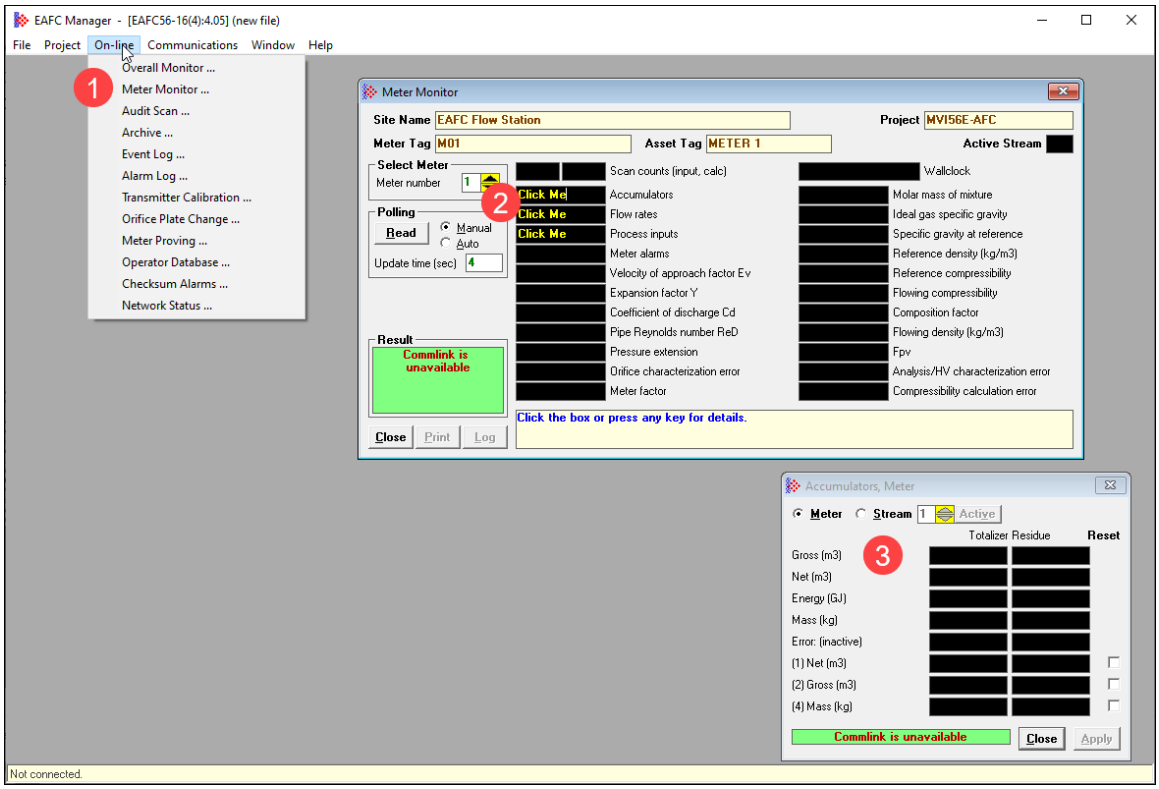
The valid configuration codes are:

Code	Quantity
0	None
1	Mass
2	Energy (Gas Only)
3	Net
4	Gross
5	Gross Standard (Liquid Only)
6	Water (Liquid Applications Only)

For example, moving a value of “4” to holding register 8126 will configure Meter 1’s resettable accumulator 1 as "Gross Volume". Moving "0" to holding register 9128 configures Meter 2’s Resettable Accumulator 3 to accumulate nothing (takes it out of service).

Resetting from EAFC Manager

You may reset any of the resettable accumulators using the Meter Monitor dialog in EAFC Manager.

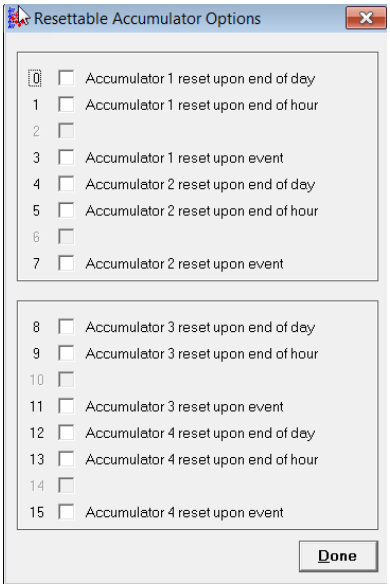


Resetting from Ladder Logic

The ladder logic may send a meter signals block to command one or more resettable accumulators to be reset. This feature is especially important for applications involving field installations that require shipping and/or receiving product batches of predetermined size. Refer to the *Ladder Logic* section of the *AFC Reference Guide* for your module type for more information.

Resetting upon Archive Period End or Reset upon Event

Use EAFC Manager to configure the resettable accumulator to be reset when the archive period ends or when an event occurs. Refer to *Event Log* in the *AFC Reference Guide* for more information on configuring and monitoring events.



Resetting when the Accumulator Rollover Value is reached

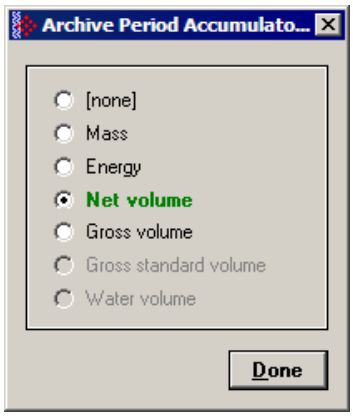
The resettable accumulator is reset when the accumulator rollover value is reached. You must configure the accumulator rollover value using EAFC Manager (*Meter Configuration*).

Resetting a resettable accumulator applies to that accumulator for both the meter and for all its streams.

Archive Accumulators

The archive accumulators are part of the current archive (archive 0) data. These accumulators are automatically reset when a new archive is generated. Refer to the Modbus Dictionary – *Meter Accumulator* section.

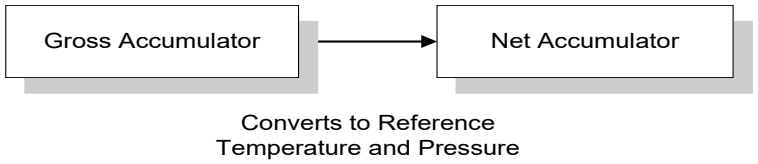
You may configure the accumulator quantity to be used for each archive accumulator using EAFC Manager (**METER CONFIGURATION > ARCHIVE CONFIG > ACCUMULATOR SELECT**):



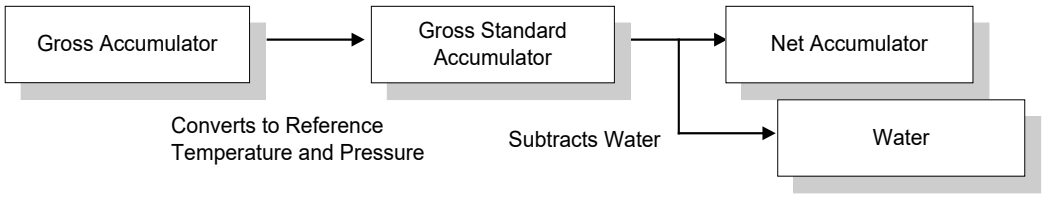
6.7.3 Net Accumulator Calculation

The Net Accumulator Calculation depends on the product group (gas or liquid).

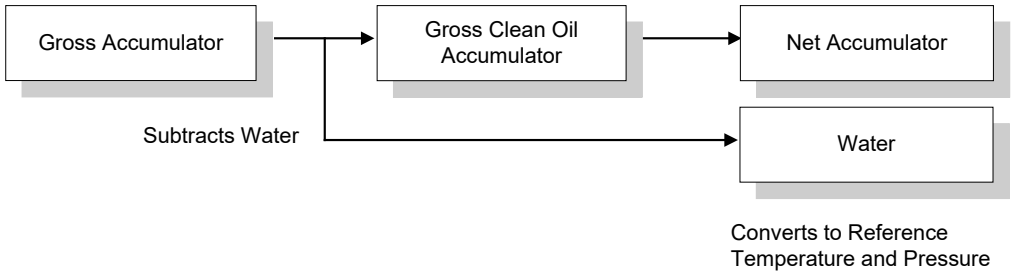
- For gas applications, the Net Accumulator is calculated as follows:



- For liquid applications (all except Emulsion), the Net Accumulator is calculated as follows:



- For liquid applications (Oil-Water Emulsion), the net accumulator is calculated as follows, using API ch 20.1:



6.7.4 Accumulator Totalizer and Residue

The accumulators are expressed as the totalizer and residue parts. This implementation allows the accumulation of a wide range of increments, while keeping a high precision of fractional part with an approximately constant and small round off error.

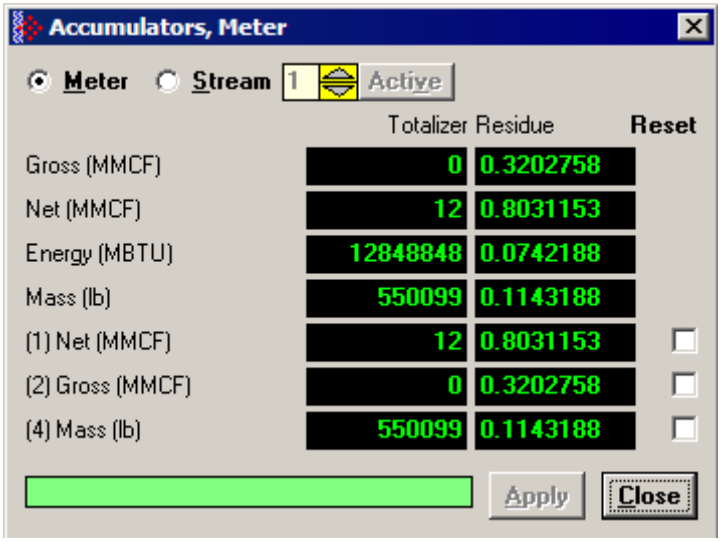
The totalizer stores the integral part of an accumulator as a 32-bit unsigned integer. The residue is the fractional part (always less than 1.0) expressed as a 32-bit IEEE floating point.

The *Total Accumulator* value is given by the formula:

```
ACCUMULATOR = TOTALIZER + RESIDUE
```

Accumulator Example

If you click in the *Accumulators* field in the *Meter Monitor* dialog and see the following values for the accumulators:



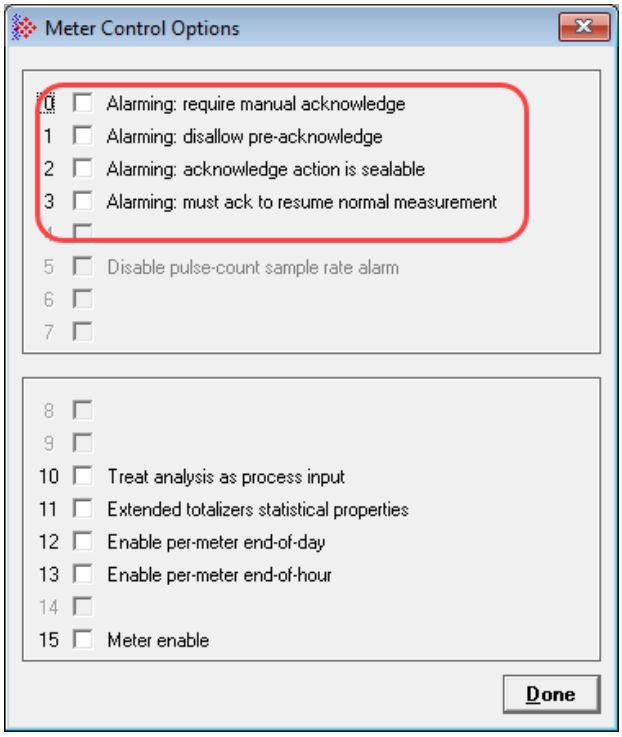
The total resettable accumulator 1 value (net) is 12.8031153.

6.8 Meter Factors

See *Configuring Meter Factors.*

6.9 Meter Alarm Control Options

Click **CONTROL OPTIONS** from the *Meter Configuration* page. Bits 0 through 3 allow you to set up alarm configurations.

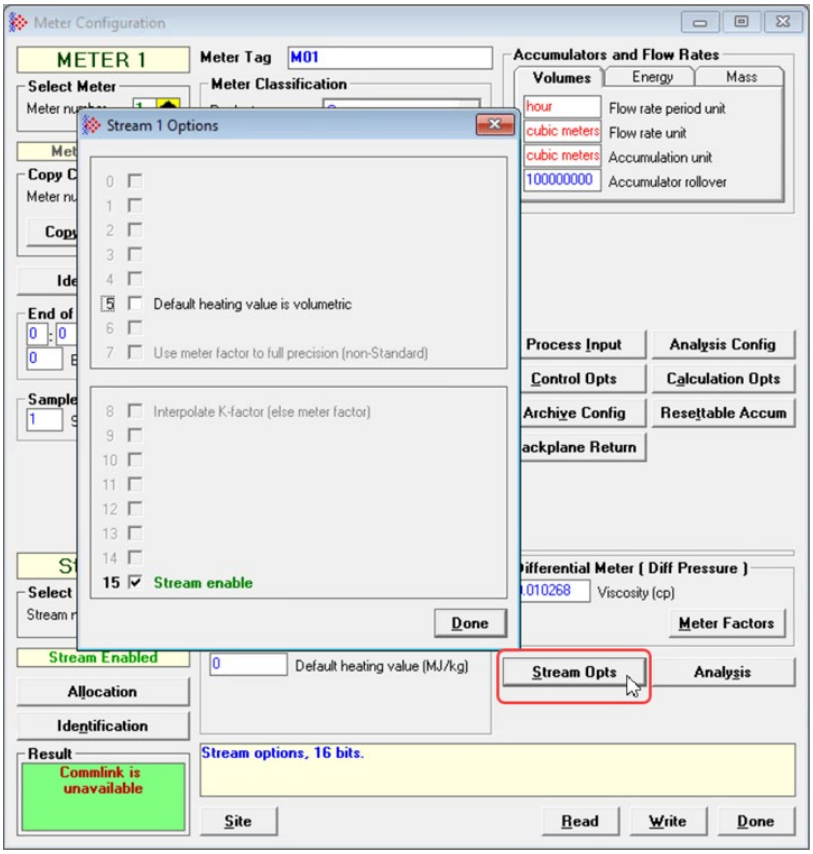


Alarming	Action
Alarming: require manual acknowledge	- If set, any alarm appearing in the Meter Alarms, registers (I-30 through I-37) must be manually acknowledged by writing a “1” bit to the corresponding bit in the “Acknowledgement Required” registers (meter relative), subject to further constraints configured by the other three “Alarming” meter control options (this register, bits 1, 2, and 3). - If clear, any alarm is deemed to be automatically acknowledged at the moment that it occurs: the “Acknowledgement required” bit is never raised, so no “Alarm Acknowledged” record is written to the Alarm Log, and the following three meter control options have no effect. - For more information, see the other three “Alarming” meter control alarms, the “Acknowledgement required” registers and the “Meter alarms” registers themselves.
Alarming: Disallow pre-acknowledge	- If set, the acknowledgement of any alarm requires the alarm condition to have been resolved and its corresponding bit in the "Meter alarms" registers to be clear. If clear, then alarm acknowledgement may be performed at any time after the "Acknowledgement required" bit has been raised, even if the alarm condition itself has not yet been resolved and the alarm bit is still set; in this case, the continuing presence of the alarm condition does not cause the "Acknowledgement required" bit to be re-raised, but after the alarm condition has been resolved (and its alarm bit cleared) a recurrence of the alarm will again raise the "Acknowledgement required" bit. If meter control option "Require manual acknowledge" is clear (this register bit 0), then this option is deemed to be clear and has no effect. - For more information, see the other three "Alarming" meter control options (this register, bits 0, 2, and 3), the "Acknowledgement required" registers (meter relative), and the "Meter alarms" registers (meter relative).

Alarming	Action
Alarming: Acknowledge action is sealable	- If set, the acknowledgement of any alarm requires that the Weights & Measures switch be in the "unlocked" position. - If clear, then alarm acknowledgement requires only that the acknowledging operator have the necessary permission ("Troubleshooting", permission bit 13). If meter control option "Require manual acknowledge" is clear (this register bit 0), then this option is deemed to be clear and has no effect. - For more information, see the other three "Alarming" meter control options (this register, bits 0, 1, and 3), the "Acknowledgement required" registers (meter relative), and the "Meter alarms" registers (meter relative).
Alarming: Must Ack to resume normal measurement	- If set, any divergent measurement behavior that occurs consequent to an alarm (e.g. value substitution, separate accumulation) persists until both the alarm condition has disappeared and the alarm has been acknowledged, at which time normal measurement is resumed. - If clear, normal measurement is resumed when the alarm condition has disappeared, regardless of whether or not the alarm has been acknowledged. This option causes value substitution persistence for only analog process input alarms; the clearing of a pulse count, calculation, or configuration alarm condition always allows resumption of normal counting and/or calculation even if that alarm has not yet been acknowledged. However, this option causes separate accumulation persistence for any alarm that affects calculated quantities, including pulse count failure and calculation alarms. If meter control option "Require manual acknowledge" is clear (this register bit 0), then this option is deemed to be clear and has no effect. For more information, see the other three "Alarming" meter control options (this register, bits 0, 1, and 2), the "Acknowledgement required" registers meter relative), and the "Meter alarms" registers (meter relative).

6.10 Setting Stream Options and Enabling/Disabling Meters

Meters are often used for the measurement of different products at different times. The reasons for doing so include cost and convenience (a pipeline may carry gasoline one day and fuel oil the next) and accounting (a plant may receive product from several different suppliers who must be paid).



A meter has one active stream which corresponds to the particular product that flows though the meter at that moment.

The active stream may be switched to any enabled stream via a Modbus transaction. Enabling a stream allows it to become active and disabling it prevents it from becoming active. The currently active stream may not be disabled.

As the physical switching of a product stream through a meter is almost always accompanied by additional actions such as changing the position of valves, it is expected that the stream-switching transaction will be issued by the processor. To reduce the likelihood of unfortunate errors, EAFC Manager provides no specific method for issuing that transaction. Issuing a stream-switch transaction however, is like issuing any other Modbus transaction. In this case, it writes the value of the new active stream to the “active stream number” Modbus register. In exceptional circumstances it can be issued from anywhere, such as a SCADA system connected to one of the Modbus ports, or by EAFC Manager itself via the Modbus Master window.

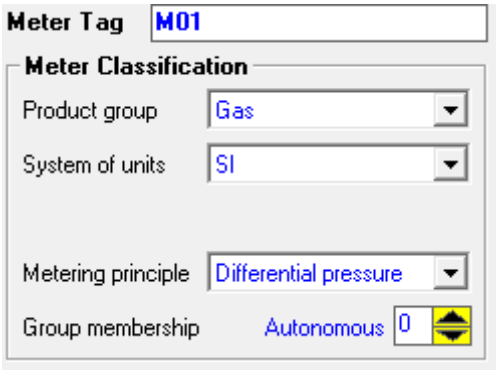
Parameters whose values may depend on the properties of the product being measured are configured for each stream separately. Such parameters include product descriptions (e.g. density, viscosity, analysis) and those that describe indirect effects of the product (e.g. meter factor). Measurement calculations always use the parameters for the active stream.

The output of each stream consists of a complete set of accumulators laid out like those of the meter itself. Computed increments are accumulated simultaneously in both the meter accumulators and those of the active stream.

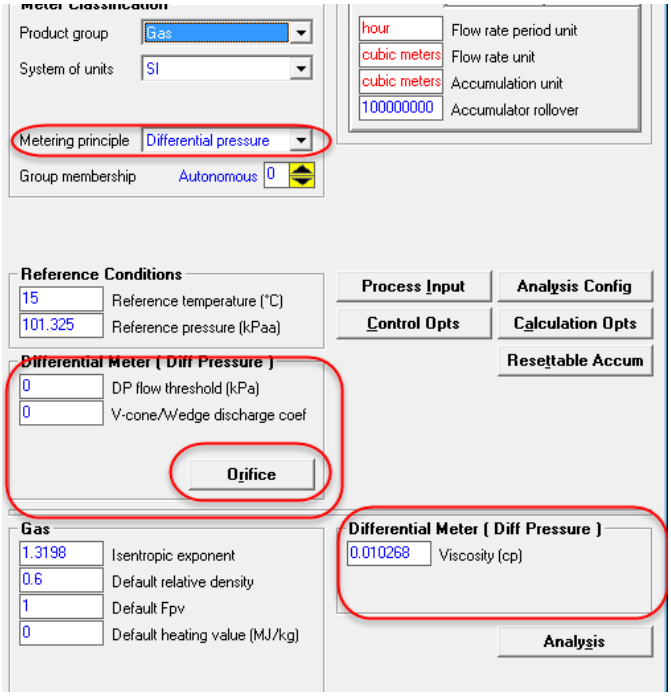
Stream Option	Definition
Default heating value is volumetric	If this option is set, then the point “Default heating value” is configured in volumetric units (energy per volume at reference conditions); if clear, then the point is considered in mass units (energy per mass). **Note:** You can also make the default heating value volumetric by selecting the *Volumetric* checkbox in the *Stream Component Analysis* dialog.
Use meter factor to full precision (non-Standard)	If "Use meter factor to full precision" is clear, the Meter Factor is rounded to four decimal places before being used to calculate gross volume (gross = pulses / KF * MF). If the option is set, the MF is used as is without rounding. Rounding applies only to the meter factor; the K-factor is always used to its full precision.
Interpolate K-factor	This option bit swaps the roles of K-factor and meter factor, so that when this option is selected, the "K-factor" entry becomes "Meter factor" and the "Meter Factor Linearization" table becomes "K-factor Linearization". The calculations described up to this point are those recommended by API and performed by the vast majority of users of linear meters. Some users, however, may prefer to keep the meter factor at exactly 1.0000 and periodically adjust the K-factor with a meter prove; and then the K-factor may depend on the flow rate.
Stream Enable	Select to enable the current stream. Unselect (uncheck) to disable the current stream. A disabled stream cannot be made active. When downloading the configuration to the module, this option is silently forced for the active stream.

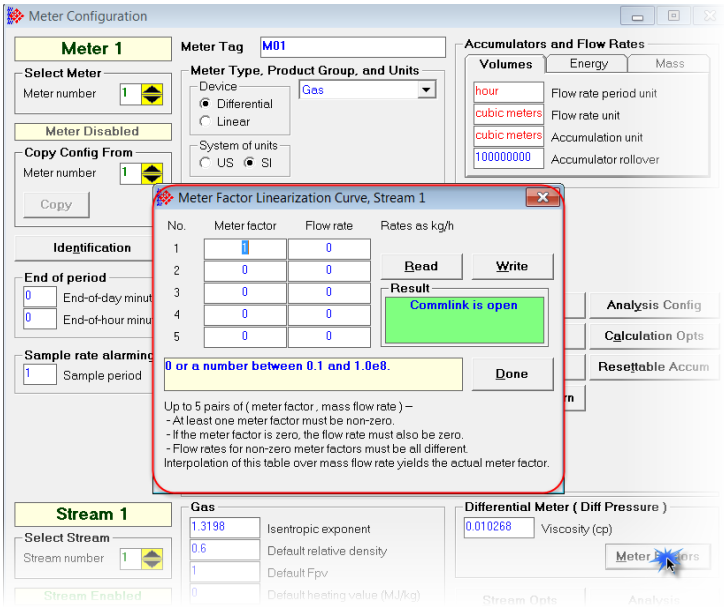
7 Configuring Differential Meter Parameters

If you are using a differential meter, select either *Differential Pressure* or *Flow Rate* as the metering principle.

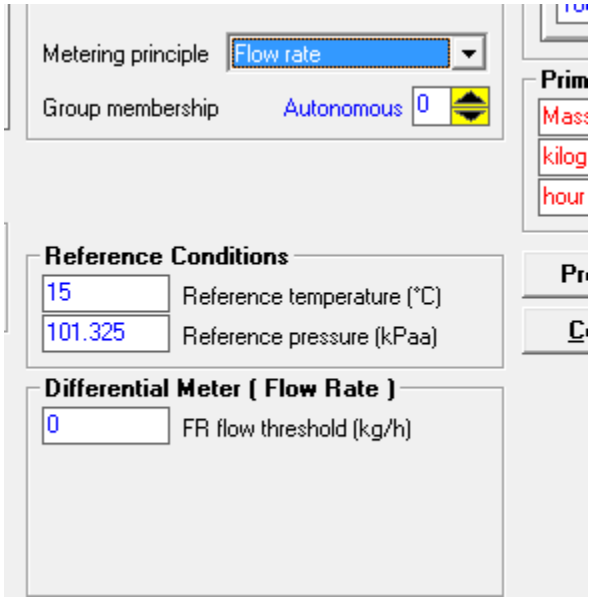


If you select *Differential Pressure* as the metering principle, you must configure the following parameters. You must also click on the **ORIFICE** button in order to specify orifice geometry.



Parameter	Description
DP Flow Threshold	If at any time the differential pressure input value is less than the DP Flow Threshold parameter, the module will treat the differential pressure as zero (no flow).
Override discharge coefficient	For an Orifice meter, AGA3 dictates the calculation of the "Coefficient of Discharge", a multiplicative factor used in calculating the flow rate. For a V-cone meter, there is no corresponding calculation, so the Coefficient of Discharge must be entered from the manufacturer's data sheet. The "V-Cone Discharge Coefficient" has no meaning unless the "V-Cone Device" option is selected (see Calculation Options button).
Viscosity	The viscosity of the fluid, used only in the calculation of the meter's coefficient of discharge. For this product group, the default value for this point is the viscosity recommended by AGA 3 for natural gas fluids, 0.010268. For liquid fluids, a more representative value should be chosen.
Meter Factors	Displays the *Meter Factor Linearization Curve* dialog for this stream. 

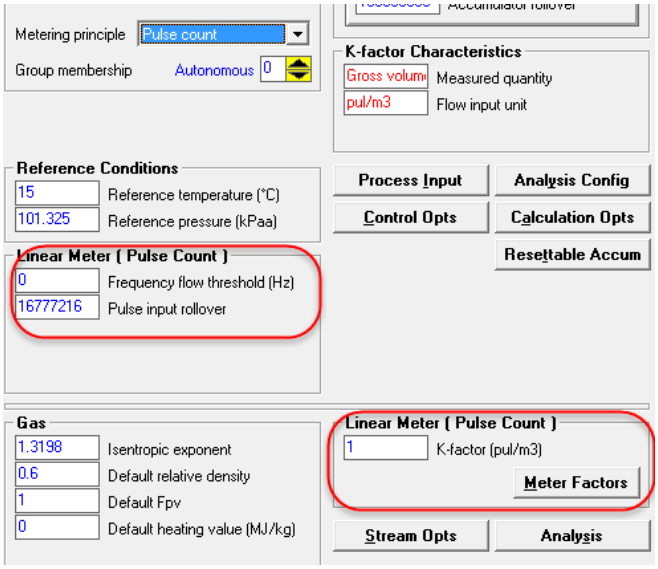
If you select *Flow Rate* as the metering principle, you must configure the following parameter:



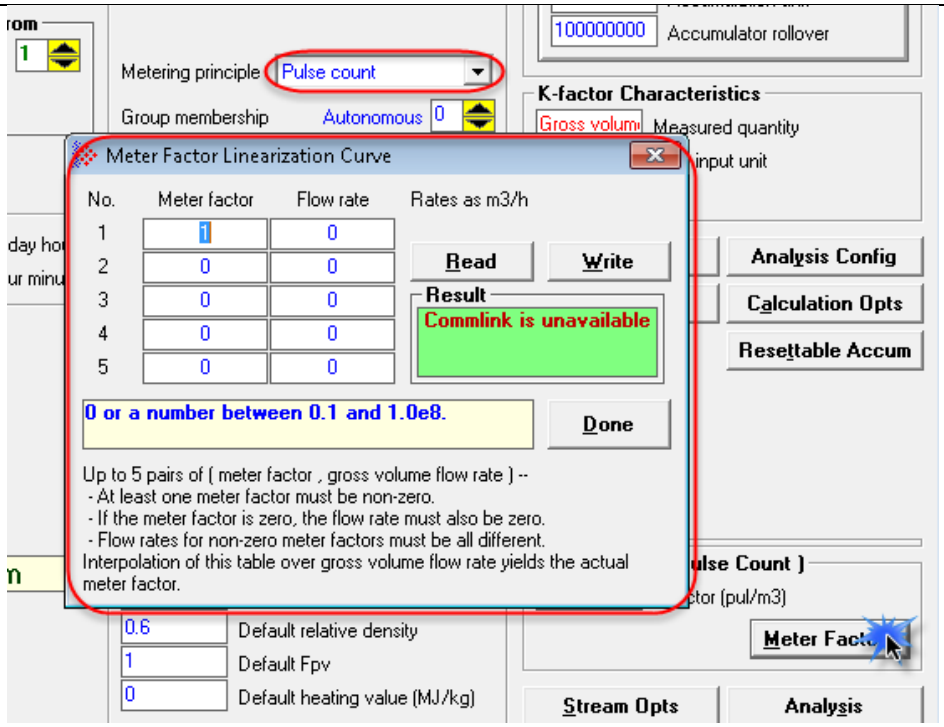
FR Flow Threshold – If at any time, the flow rate value is less than the FR Flow Threshold parameter, the module will treat the flow rate as zero (no flow).

8 Configuring Linear Meter Pulse Count Options

If you select *Pulse Count* as the metering principle, you must configure the following parameters:

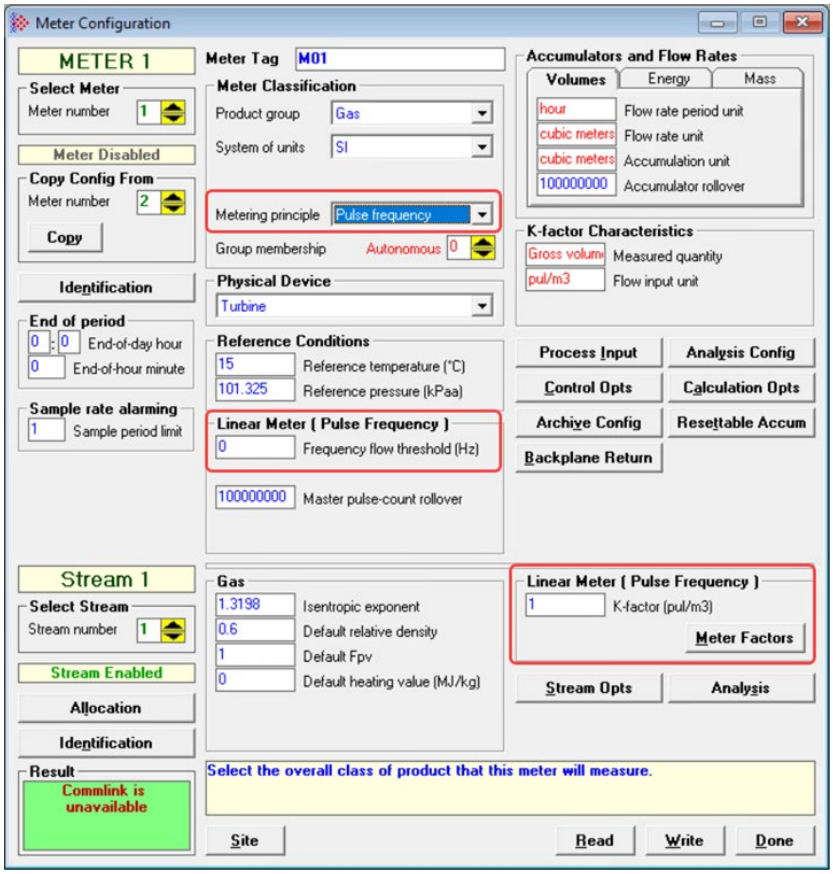


Parameter	Description
Frequency flow threshold	This is the threshold value for pulse frequency. If the received value is less than the configured threshold, it is deemed to be zero.
Pulse input rollover	When the meter is selected as a Pulse Meter, one of the input variables transferred from the programmable logic controller is Pulse Count value. This is the number of pulses transferred from the Pulse Meter or the High Speed Counter module. This parameter sets the value at which the pulse count will rollover to zero. It is essential that this value match the actual pulse rollover used in the field by the pulse meter or counter module, otherwise the flow calculation will generate unexpected values. Enter this value as (maximum value)+1.
Master pulse-count rollover	This is a value that is 1 greater than the highest value that master pulse counters will contain. Enter 0 for free-running counters which rollover to 0 from 4294967295.
Pulse flow threshold; count, time(s)	The first field should be 0 or a number between 2 and 20. The default is 0. The second field should be 0 or a number between 5 and 60 in seconds. The default is 0.
K-factor	A number between 0.1 and 1.0e+8. The default is 1.0. Units show is the setting of “Flow input unit” of the “K-factor Characteristics” panel shown in the previous screen example.
Meter Factors	Click the **Meter Factors** button to display the *Meter Factor Linearization Curve* for this stream. See above.

Parameter	Description
	

9 Configuring Linear Meter Pulse Frequency Options

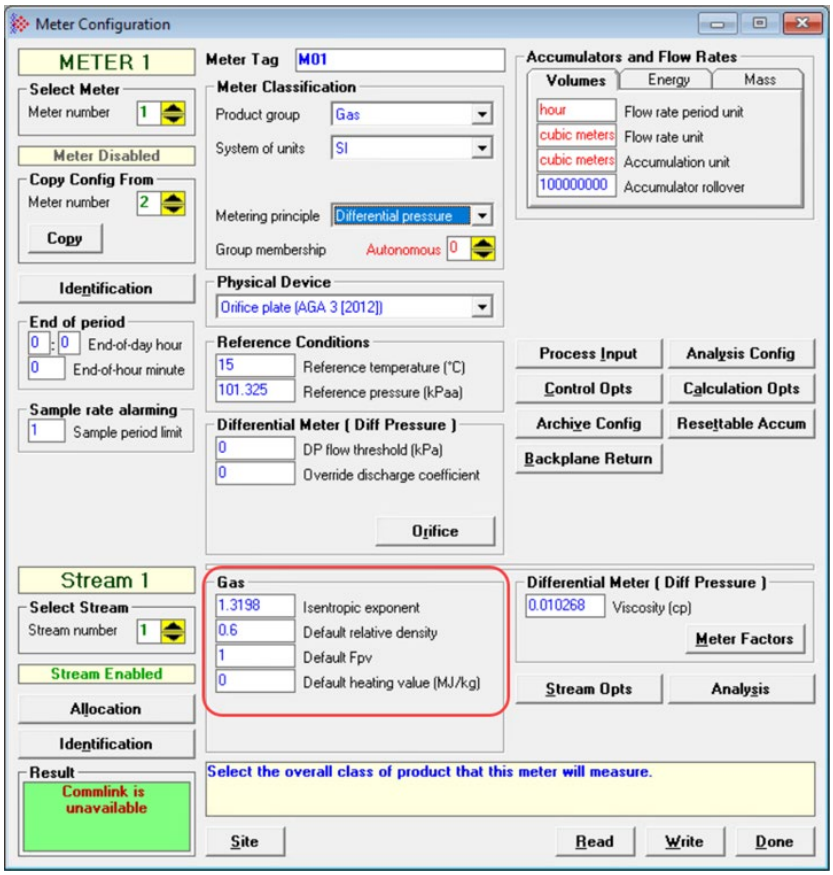
If you select *Pulse Frequency* as the metering principle, you must configure the following parameters:



Parameter	Description
Frequency Flow Threshold	This is the threshold value for pulse frequency. Values can range between 0 and 1.0e+06 Hz. The default is 0.0.
Master pulse-count rollover	This is a value that is 1 greater than the highest value that master frequency counters will contain. Enter 0 for free-running counters which rollover to 0 from 4294967295.
K-factor	This is the expected number of pulses expected per unit of fluid passing through a flow meter. Values can range between 0.1 and 1.0e+8. The default is 1.0. Units shown is the setting of Flow input unit of the K-factor Characteristics panel above.
Meter Factors	Click the **Meter Factors** button to display the *Meter Linearization Curve* setting for this stream.

10 Configuring Gas Parameters

10.1 Gas Parameter Descriptions



The *Gas* area of the *Meter Configuration* dialog is visible when the product group is set to *Gas*.

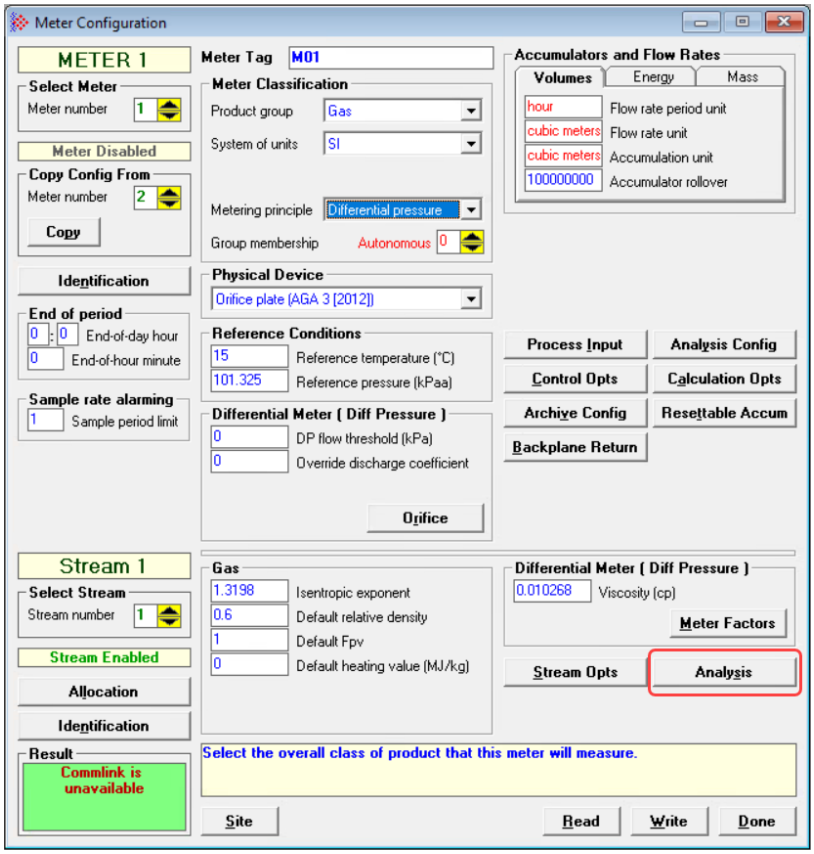
Parameter	Description
Isentropic exponent	The ratio of (specific heat and constant pressure) to (specific heat at constant volume).
Default specific gravity or Default relative density	Normally, the AFC modules use the Detail Characterization Method of the AGA 8 standard to calculate the density of the gas from its composition as given by the molar analysis. The density is used in all subsequent calculations. When AGA 8 cannot be applied because no analysis is available (no components selected, or analysis is all zero), then this value supplies the density at reference conditions (relative to the density of air at reference conditions) to be submitted for the output of AGA 8. You can override the default specific gravity or default relative density value by taking the steps in section 10.2 on page 89.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Default Fpv</td><td>Normally, the AFC modules use the Detail Characterization Method of the AGA 8 standard to calculate the compressibility of the gas from its composition as given by the molar analysis. The compressibility is used in all subsequent calculations. When AGA 8 cannot be applied because no analysis is available (no components selected, or analysis is all zero), then this value supplies the super-compressibility (which combines the effects of the compressibility at both reference and operating conditions) to be substituted for the output of AGA 8.</td></tr>
<tr><td>Default heating value</td><td>Typically, the AFC modules use the Detail Characterization Method of the AGA 8 standard to calculate the heating value of the gas from its composition as given by the molar analysis. The heating value is used in all subsequent calculations. When AGA 8 cannot be applied because no analysis is available (no components selected, or analysis is all zero), this value supplies the mass heating value to be substituted for the output of AGA 8.
The units for default heating value are based on whether the system of units (located in the Meter Classification area of the Meter Configuration dialog) is either SI or US and whether or not Default heating value is volumetric, as follows:
<table>
<tr><th>Units</th><th>Mass</th><th>Volumetric</th></tr>
<tr><td>SI</td><td>MJ/kg</td><td>MJ/m^3</td></tr>
<tr><td>US</td><td>BTU/lb</td><td>BTU/cf</td></tr>
</table>
You can override the default heating value by taking the steps in section 10.3 on page 91.</td></tr>
</table>

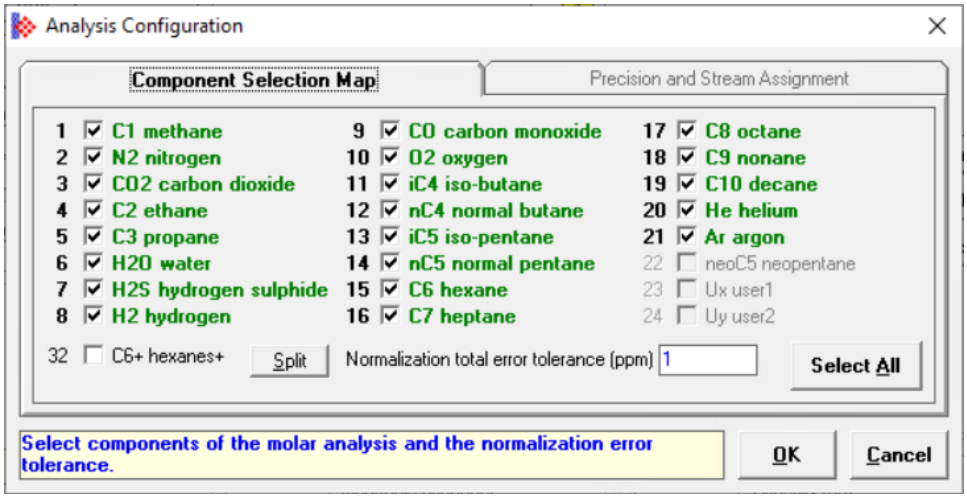
10.2 Override the Default Specific Gravity or Default Relative Density

You can override the default specific gravity or default relative density and suppy your own calculated value for this field.

1 From the *Meter Configuration* dialog, select **ANALYSIS**.

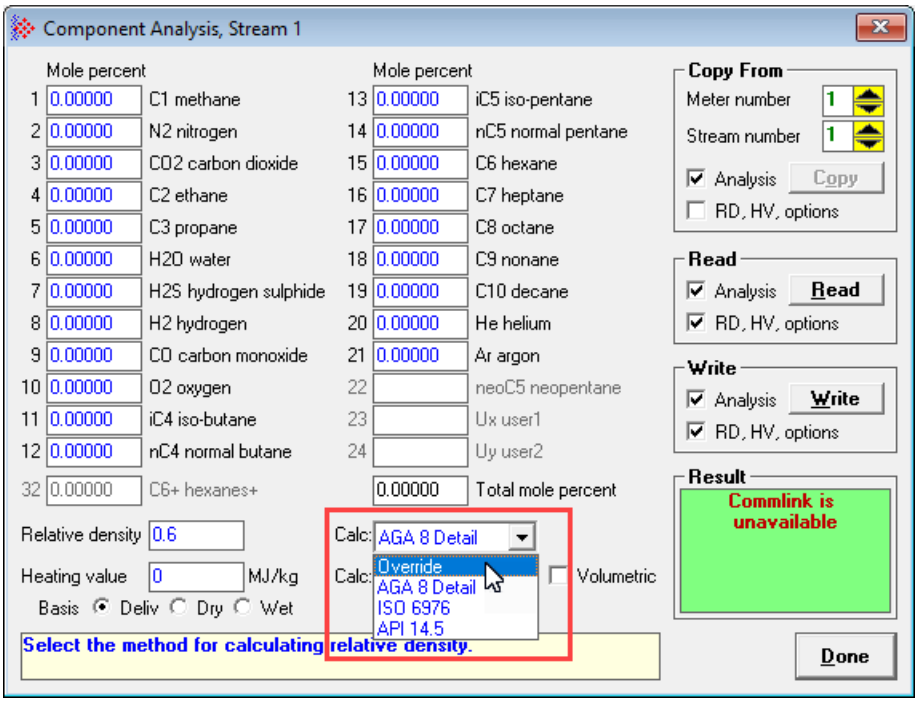


If you have not already selected the components to include in the analysis, the *Analysis Configuration* dialog displays. If this is the case, make the appropriate selections and then click **OK**.



The *Stream Component Analysis* dialog displays.

2 Click the *Calc* dropdown to the right of the *Relative density or Specific gravity* field and select **OVERRIDE**.



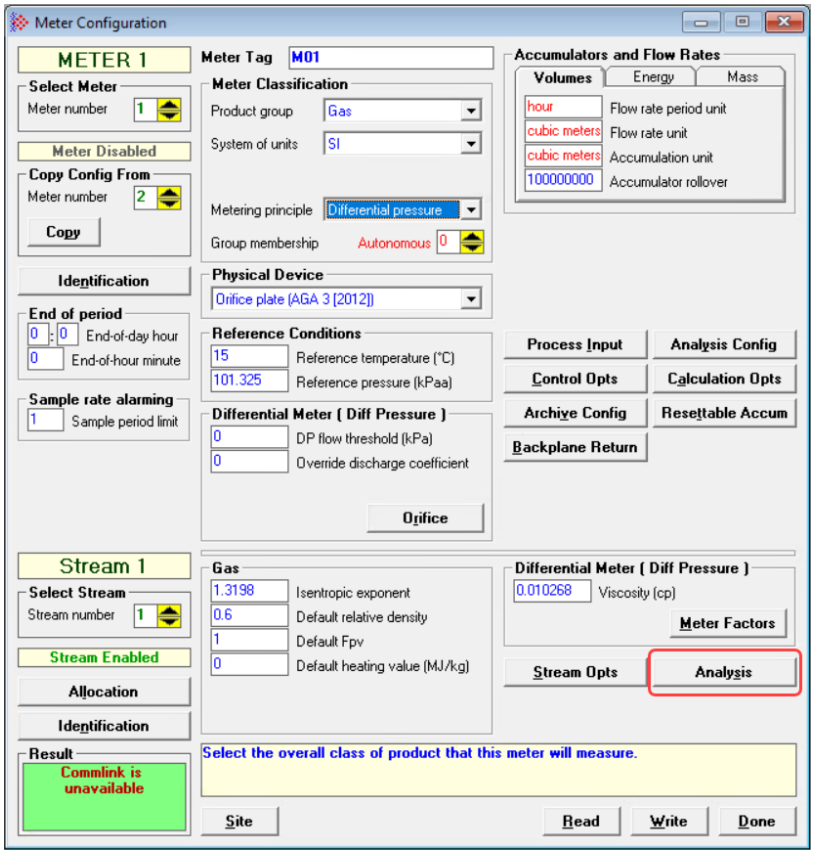
3 In the *Specific gravity* or *Relative density* field, enter the new value for the default heating value.

4 Click **DONE**.

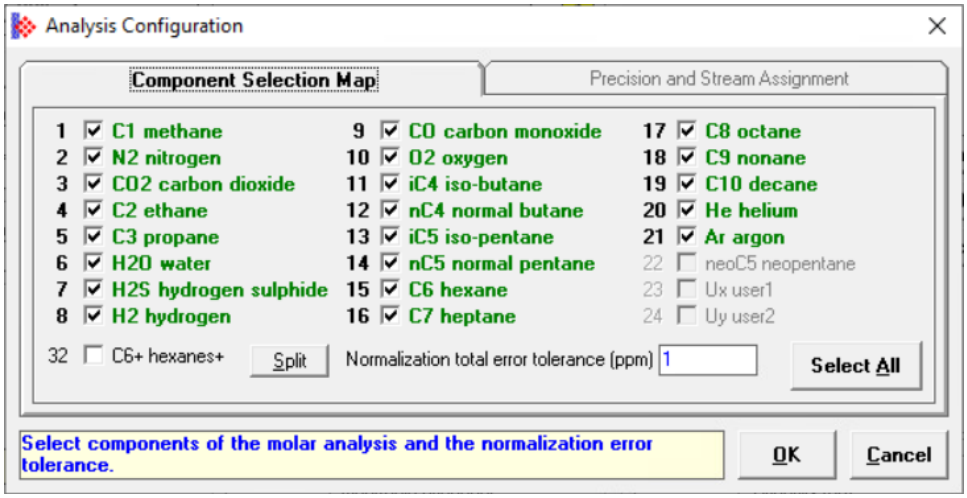
10.3 Override the Default Heating Value

You can override the default heating value and suppy your own calculated value for this field.

1 From the *Meter Configuration* dialog, select **ANALYSIS**.

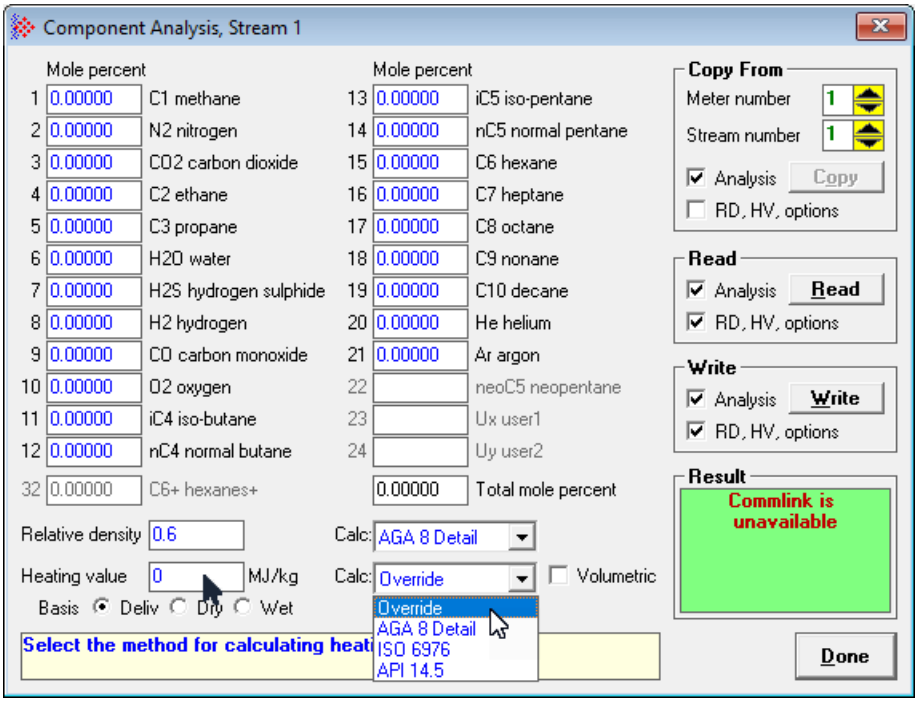


If you have not already selected the components to include in the analysis, the *Analysis Configuration* dialog displays. If this is the case, make the appropriate selections and then click **OK**.



The *Stream Component Analysis* dialog displays.

2 Click the *Calc* dropdown to the right of the *Heating value* field and select **OVERRIDE**.



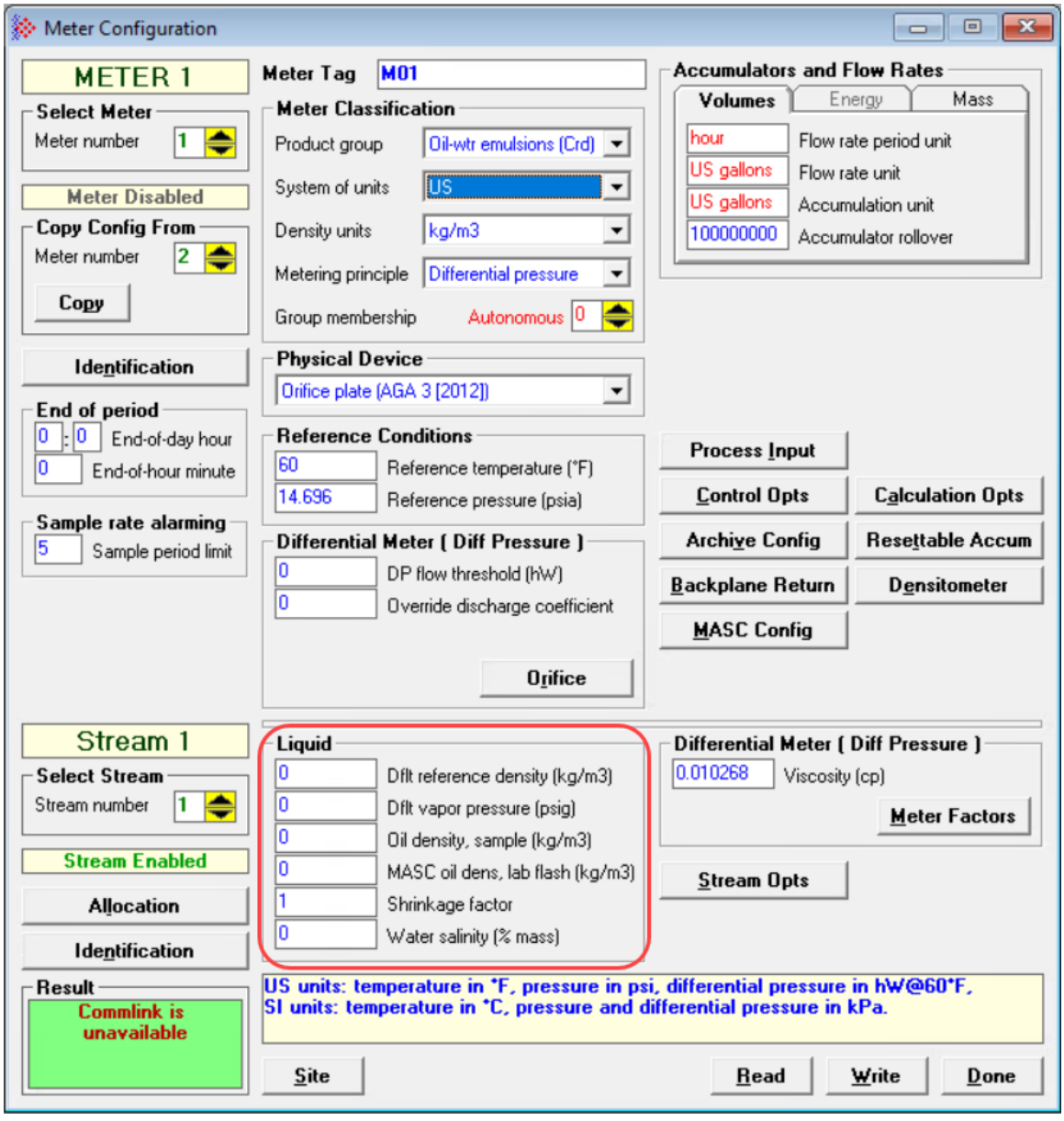
3 In the *Heating value* field, enter the new value for the default heating value.

4 Click **DONE**.

11 Configuring Liquid Parameters

11.1 About the Liquid Parameters

The liquid parameters display in the *Liquid* area of the *Meter Configuration* dialog when the *Product group* field is set to a liquid group.



The following are descriptions of the liquid parameters. Some of these display only for certain product groups.

Parameter	Description
Dflt reference density	Default reference density. The units displayed here depend on the value selected in the *Density units* list.
Dflt vapor pressure	Default vapor pressure. The units displayed here depend on the value selected in the *System of units* list.
Oil density, sample	Oil sample density at standard conditions. This parameter is visible only if *Product group is* set to *Oil-wtr emulsions (Crd)* or *Oil-wtr emulsions (NGL)*. **Note:** This parameter can also be configured in the *Mass Allocation Shrinkage Calculation Configuration* dialog. For more information see the MASC chapter of the AFC Reference Guide.
MASC oil density, lab flash	The oil base density derived from the Equation of State (EOS) for cases in which the EOS performs a virtual flash of the hydrocarbon. This value is used in the calculation for density correction factor. **Note:** This parameter can also be configured in the *Mass Allocation Shrinkage Calculation Configuration* dialog. For more information see the MASC chapter of the AFC Reference Guide.
Shrinkage factor	Shrinkage factor
Thermal exp'n coef	The thermal expansion coefficient. This parameter is visible only if *Product group is* set to *Special applications*. The units displayed here depend on the value selected in the *System of units* list.
Water salinity	Salinity of the water. This parameter is visible only if *Product group is* set to *Oil-wtr emulsions (Crd)*, *Oil-wtr emulsions (NGL)* or *Produced/injected water*.

11.2 Liquid Parameter Requirements

The following parameters describe requirements for the parameters:

Parameter	Low Limit	High Limit	Default
Dflt Reference Density	0 kg/m3 0 Rd60 -60.75°API	2000 kg/m3 2.0 Rd60 320°API	0
Default Vapor Pressure	0	100,000 kPa (14,000 psi)	0
Default Ctl	0.5	2.0	1
Default Cpl	0.5	2.0	1
Shrinkage factor	0	1.0	1
Water Salinity (% mass)	0	36.25	0

Parameter	Low Limit	High Limit	Default
Thermal exp'n coef (/°C e-6)	414	1674	0

Tip: To see the limits and defaults for each parameter, view the blue text in the *Note* box when you click in the entry text box.

12 Configuring Density Units

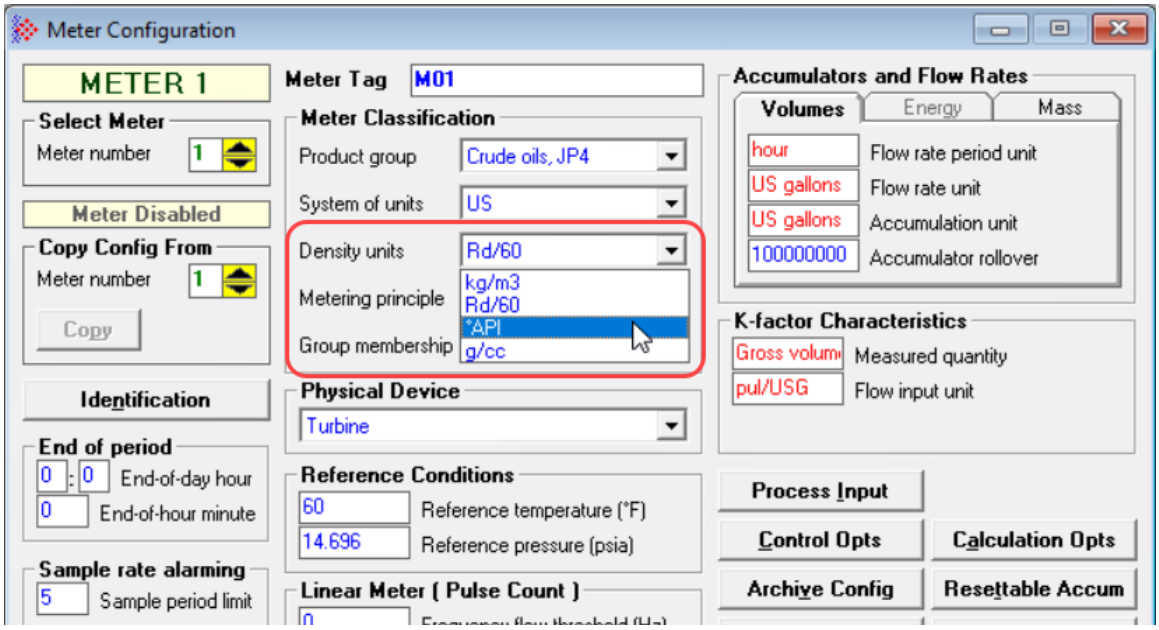
12.1 About Density Units

Liquid density may be expressed using any of the following units:

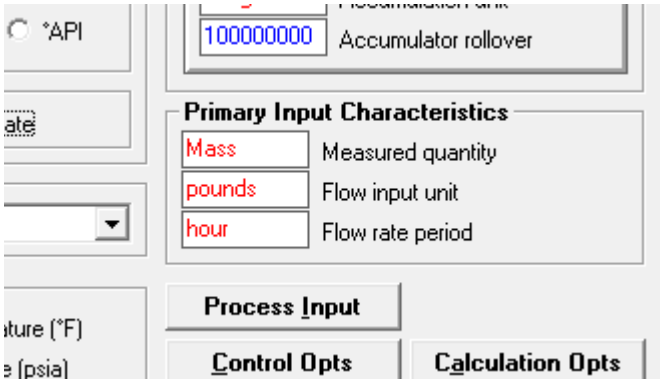
Units	Abbreviation
kilograms per cubic meter	kg/m^3
relative density at 60° F	Rd/60
API gravity	*API
grams per cubic centimeter	g/cc

12.2 Setting the Density Units

To set the density units, select one of the options from the *Density units* dropdown list in the *Meter Configuration* dialog. The selected units will be used for density values throughout EAFC Manager independent of the value selected for *System of units*.

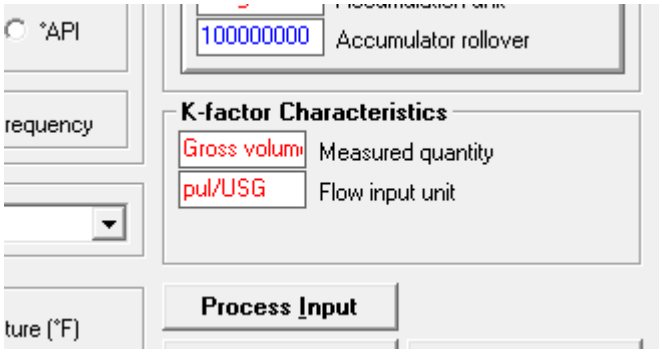


13 Configuring Primary Input Characteristics



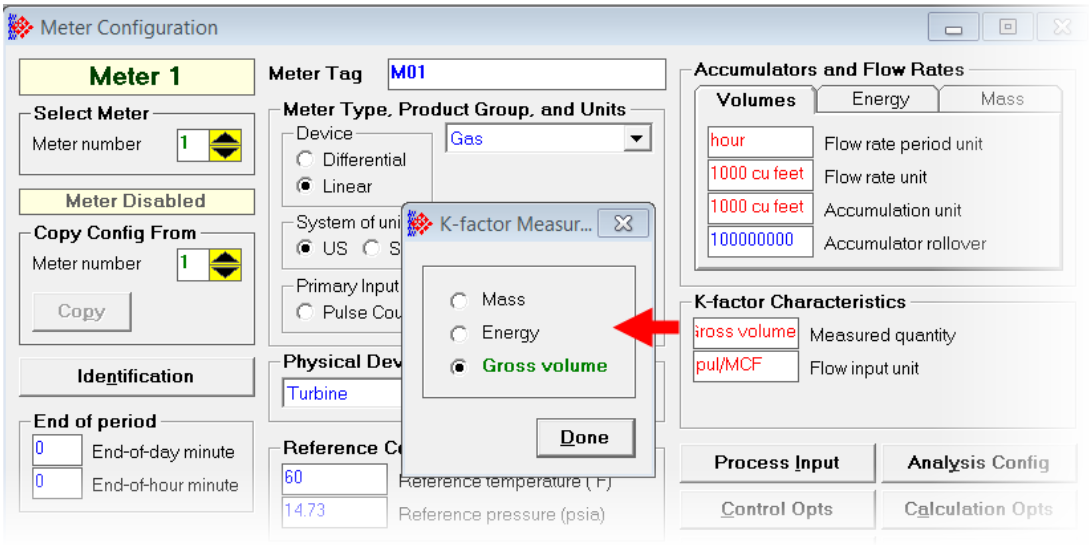
Parameter	Description
Measured quantity	This value specifies the physical property of the fluid that is measured directly or indirectly by the primary input. ▪ Mass ▪ Energy (heating value) ▪ Gross volume (volume at operating conditions) For some meter types (notably a traditional orifice), this value is fixed and cannot be changed. For a linear (pulse) meter it characterizes the K-factor. For a traditional pulse meter such as a turbine, this quantity is Gross Volume.
Flow input unit	This value specifies the engineering units base and scaling of the measured quantity selected for the primary input. For some meter types, for example a traditional orifice, this value is fixed and cannot be changed. For a linear (pulse) meter, it specifies K-Factor characteristics.
Flow Rate Period	This value specifies the time period to which the primary input flow rate is referenced. ▪ Second ▪ Minute ▪ Hour ▪ Day For all meter types except flow rate integration, this value is fixed and cannot be changed.

14 Configuring K-factor Characteristics

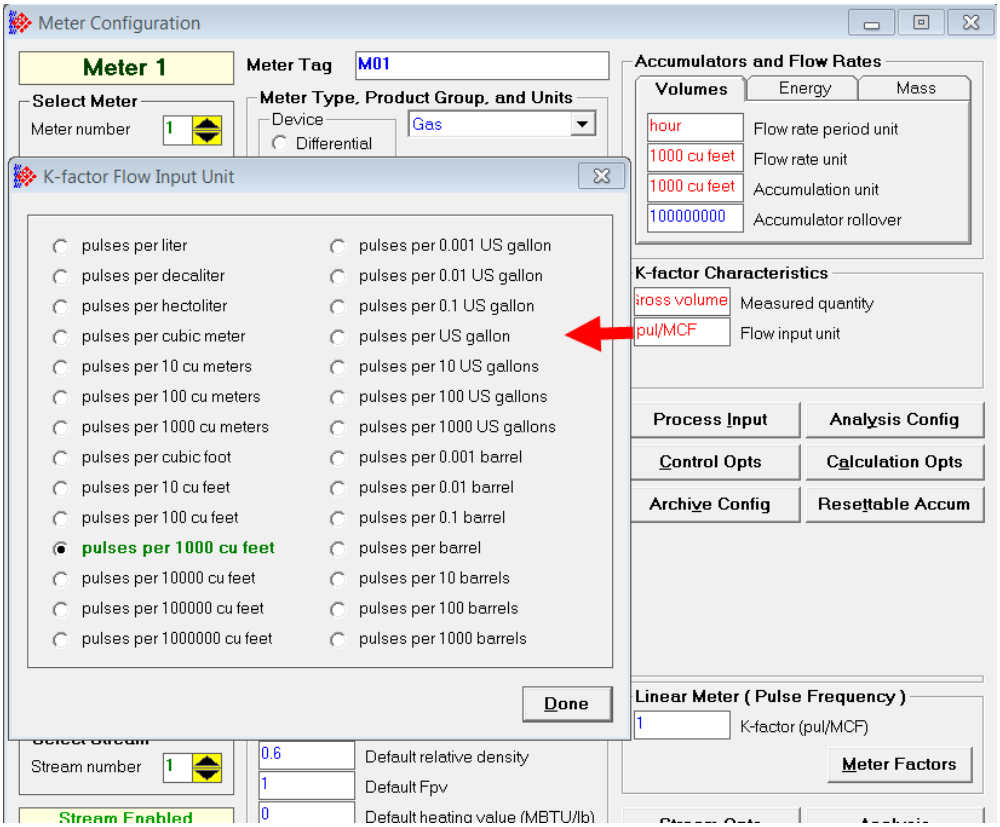


The *K-factor Characteristics* area of the *Meter Configuration* dialog is visible when the metering principle is either *Pulse Frequency* or *Pulse Count*.

Click the *Measured quantity* field to choose the quantity type for this meter.



Click the *Flow input unit* field to choose the flow input unit for this meter.



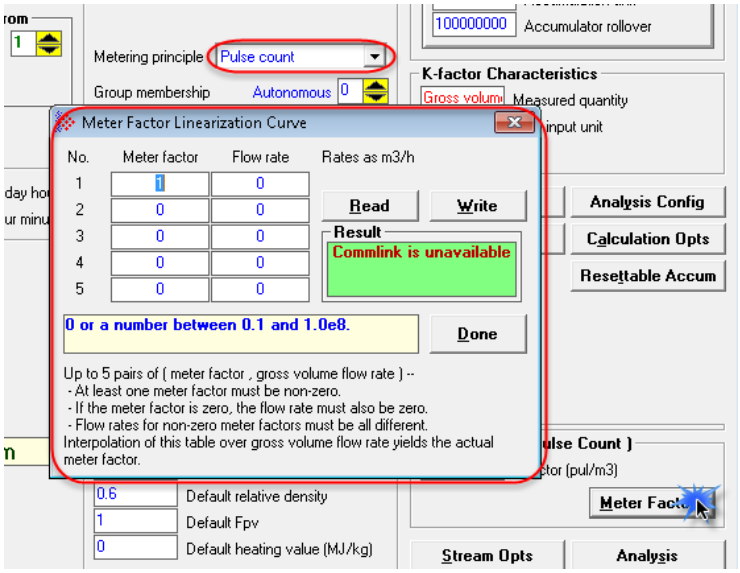
The K-factor itself is entered as a stream parameter. The K-factor units available for selection will depend on the selected measured quantity.

For a linear (pulse) meter:

```
Gross volume = (pulses/K-factor) x meter factor
```

The K-factor is a factor that converts raw pulse count (from the Pulse Meter) to a volume and is expressed as *Pulses per unit volume*, such as "1000 pulses per gallon" or "3578.224 pulses per cubic meter". This number, found on the manufacturer's datasheet for the meter, is determined at the factory for the specific unit before shipping. Dividing "pulses" by "pulses per gallon" gives you "gallons". API calls the value "*pulses / K-factor" as "indicated volume"*.

15 Configuring Meter Factors



Meters may begin to wear out over time and the actual measured volume (the "gross volume") will tend to drift from the nominal measured volume (the "indicated volume"). The factor that corrects "indicated" to "gross" is called the "meter factor", and is a number very close to 1.

The procedure that is periodically performed to determine a (new) meter factor is called "proving". A pulse type meter is "proved" periodically to ensure that the meter performs as expected over a period of time.

A prover passes a known volume of product through the meter and compares the volume indicated by the meter against the fixed volume of the prover (measured with a high degree of precision). If the meter indicates the measured volume to be exactly the same as the known prover volume, the Meter Factor is said to be equal to 1.00000 (*Meter Factor = Prover Volume/Metered Volume*).

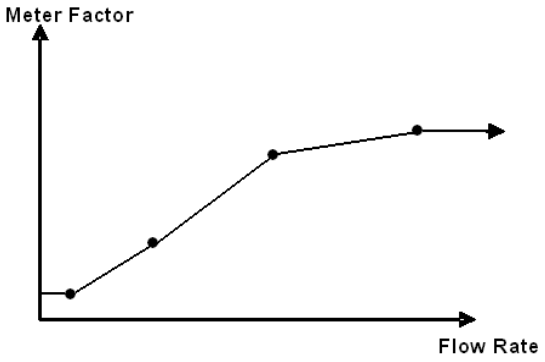
A meter's behavior may differ depending on the rate of flow through the meter. That is, the meter factor may depend on the flow rate at which the measurement is performed. EAFC Manager accommodates this by allowing you to enter up to 5 factor-flowrate pairs (the "Meter Factor Linearization" table); the AFC modules determine the meter factor to be used by linear interpolation on this table from flow rate at operating conditions (Since flow rate depends on the meter factor according to API, but meter factor depends on flow rate according to the linearization table, the AFC module performs a second iteration of the interpolation in order to obtain an accurate meter factor).

In the *Meter Factor Linearization Curve* dialog box, click the **READ** button to transfer the current Meter Factor Linearization configuration from the AFC module to the local PC.

When the Meter Factor Linearization configuration is concluded, click the **WRITE** button to transfer it to the AFC module.

The AFC module will use the configuration to interpolate the values so it can use a specific meter factor depending on the current flow rate.

For example, if you enter four points (flow rate, meter factor) the module would interpolate the points as shown below:



In order for the AFC module to accept the values you entered, the following conditions are required:

- All values are non-negative.
- At least one meter factor is non-zero.
- If a meter factor is zero, the corresponding flow rate is also zero.
- The flow rates corresponding to non-zero meter factors are all different.

You do not need to enter factor/flowrate pairs in any particular order, or even enter them all as a contiguous group. You may enter each factor-flowrate pair into any of the five table entries and the AFC module will sort it.

If you do not want to enter meter factor linearization data, then populate only one entry leaving the other four empty (all zero). In this case, the flow rate value does not matter and the single meter factor applies to all flow rates. EAFC Manager's initial default table is populated in this way with a meter factor of 1.

16 Installing the Module in the Rack

If you have not already installed and configured your processor and power supply, please do so before installing the AFC module. Refer to the processor documentation for installation instructions.

Warning: You must follow all safety instructions when installing this or any other electronic devices. Failure to follow safety procedures could result in damage to hardware or data, or even serious injury or death to personnel. Refer to the documentation for each device you plan to connect to verify that suitable safety procedures are in place before installing or servicing the device.

After you have checked the placement of the jumpers, insert the AFC module into the rack. Use the same technique recommended by the processor manufacturer to remove and install AFC modules.

Warning: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Verify that power is removed or the area is non-hazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

Note: If you insert the module improperly, the system may stop working, or may behave unpredictably.

16.1 Module Initialization

When the module is powered up for the first time, both the **OK** and **ERR** NVRAM LEDs are illuminated. This indicates that the module is in the *Cold Start* state and is not yet ready to perform calculations. The following steps initialize the module:

- Configure Site Parameters
- Enable at least one meter
- Set the processor to RUN mode

After these three steps are accomplished, the state is changed from *Cold Start* to *Released*. This indicates that that module is ready to perform flow calculations. When in the *Released* state, the **OK** LED is on and the **ERR** LED is off.

When the module is ready, you will use EAFC Manager to monitor meter operation, archives, and events.

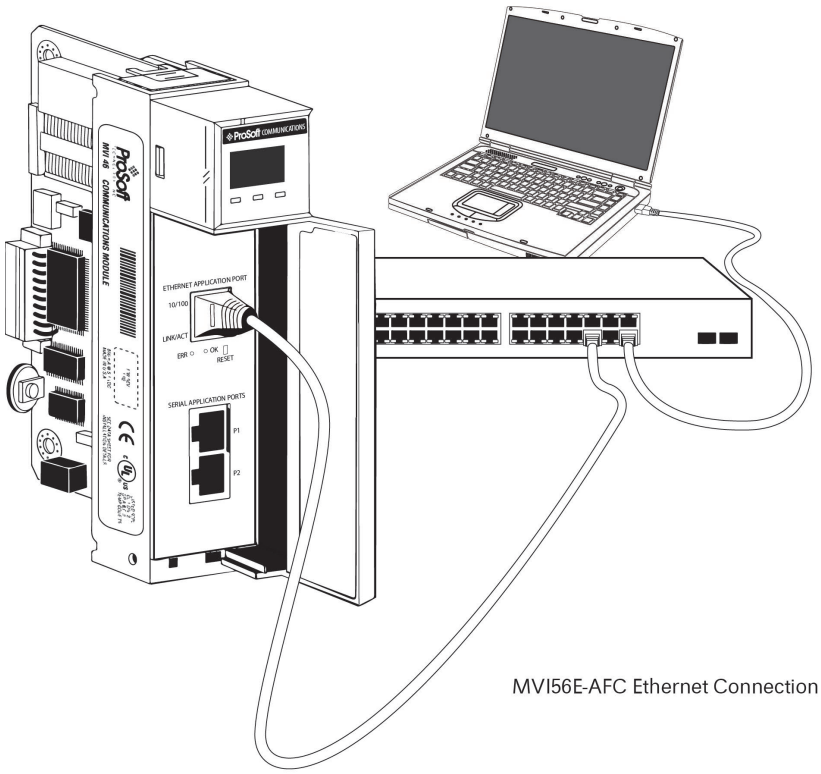
17 Connecting the AFC Module to EAFC Manager

Note: The following example shows the MVI56E-AFC module. Connecting the MVI69E-AFC module is done in a similar fashion.

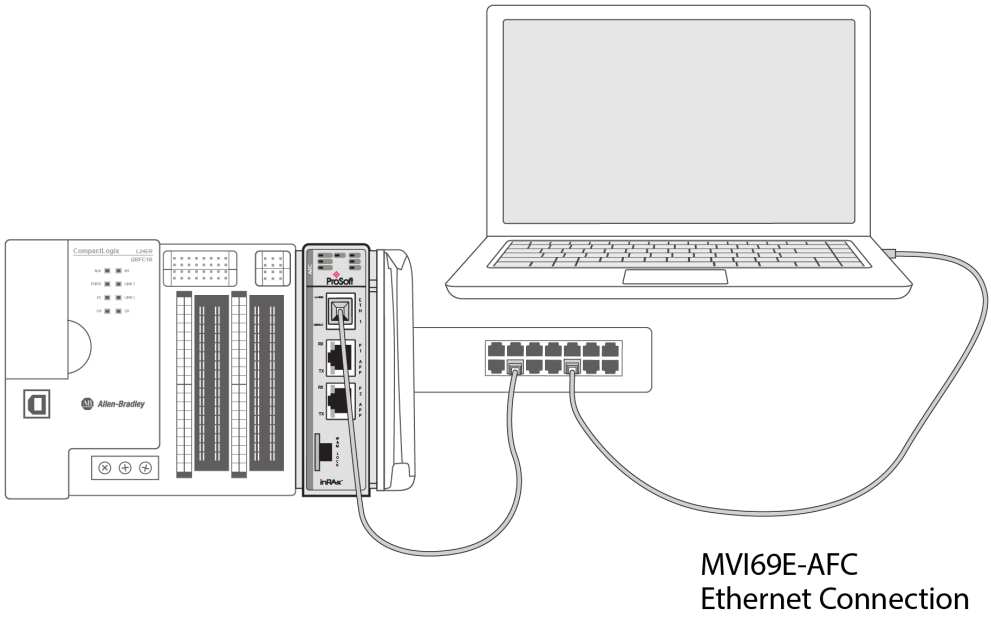
There are two ways to connect EAFC Manager (running on a PC) to the AFC Module, by Ethernet or Serial. The top port (eth0) is used to create Ethernet connections. Serial 1 and Serial 2 are both available for serial connections.

17.1 Ethernet Connection

Connect one end of an Ethernet cable to the Ethernet port on the module.



MVI56E-AFC Ethernet Connection



Connect the other end of the cable to the network. The PC running EAFC Manager must be on the same network.

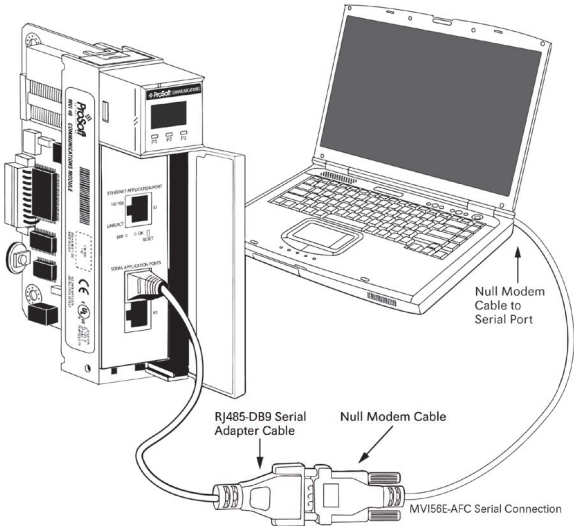
17.2 Serial Connection

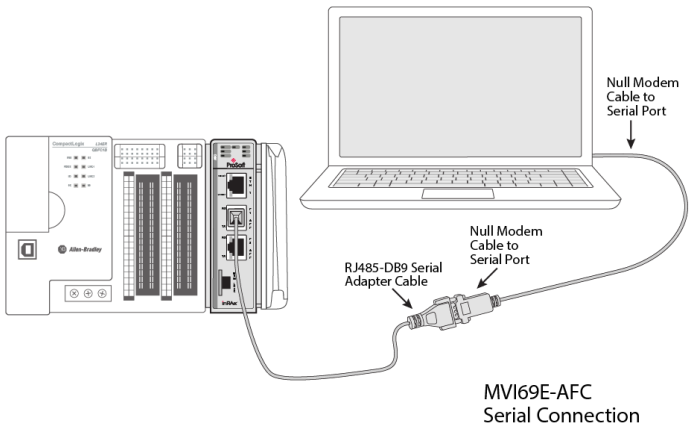
This section describes how to connect your PC to one of the serial ports on the module.

1 Connect the DB-9 adapter to a serial port of the AFC module (P1 or P2).

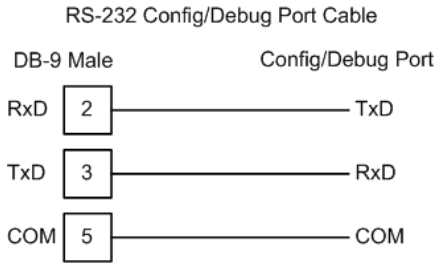
2 Connect the null-modem cable to the DB-9 adapter cable. Connect these to an available serial port on your PC.

Note: Some desktop and notebook computers are not equipped with a serial port. In this case, you may require a USB to Serial adapter cable, with drivers. Not all USB to Serial adapters will work correctly with this application. If you encounter problems, please contact ProSoft Technical Support for recommendations.

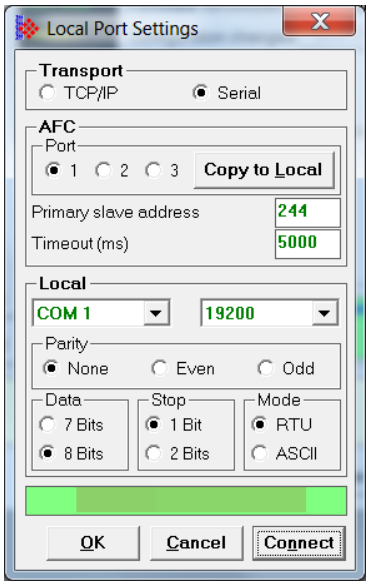




The null-modem cable that is supplied with the module uses the following cabling scheme:



3 Start EAFC Manager and select the port settings at **COMMUNICATIONS > LOCAL PORT SETTINGS**. The default serial communication settings are shown in the following illustration.



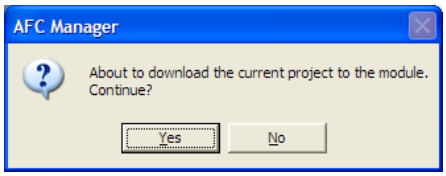
4 EAFC Manager will establish communications with the module. Open the *Project* menu and then select **SITE CONFIGURATION** to open the *Site Configuration* dialog box.

5 On the *Site Configuration* dialog box, click the **READ** button. You should see the word "Success" in the *Result* area of the dialog box.

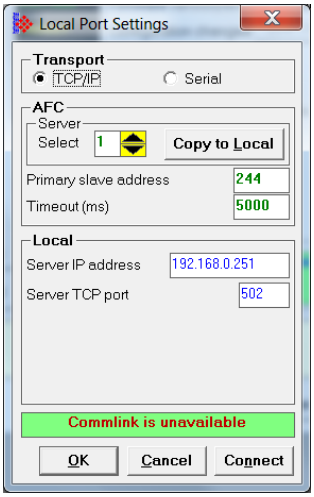
18 Downloading the Project to the Module

Note: This section use the MVI56E-AFC module as an example. The MVI69E-AFC download process is performed the same way.

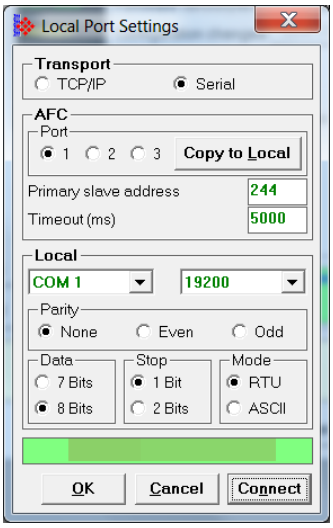
1 In EAFC Manager, select **PROJECT > DOWNLOAD PROJECT**.



This action opens the *Local Port Settings* window. If you are downloading via the network, click **TCP/IP**:

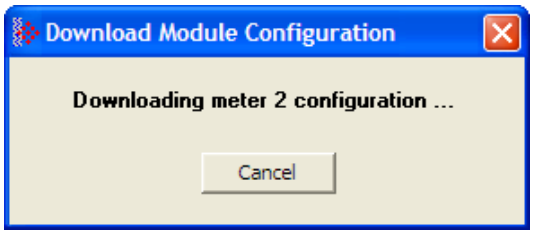


2 If you are downloading through one of the serial ports, click **SERIAL**.

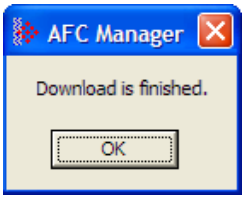


3 Enter the port parameters to use, and then click **DONE**.

4 During the download operation, the following progress window is displayed:



5 When the file transfer is complete, the following window is displayed:



Troubleshooting Tip: If EAFC Manager displays an "Illegal Data Value" message, it typically indicates an invalid meter type or product group configuration or the W&M switch on the front of the module is in the locked position. The module does not accept a configuration file that attempts to change a meter type or product group for a meter that is currently enabled. Disable all meters, change the meter types and product groups, and then enable the meters again.

19 Backplane Return

19.1 About Backplane Return

The backplane transfer protocol specifies that each function block output by the PLC to the module must elicit a corresponding input function block at the same location with the same size. This returned block typically contains no data (contents are all zero).

To increase efficiency of the system, the MVIxxE-AFC module is preconfigured to deliver data to the PLC via this otherwise empty function block. This is done by mapping slots in the input function block to points in the Modbus address space. This process is known as *backplane return*.

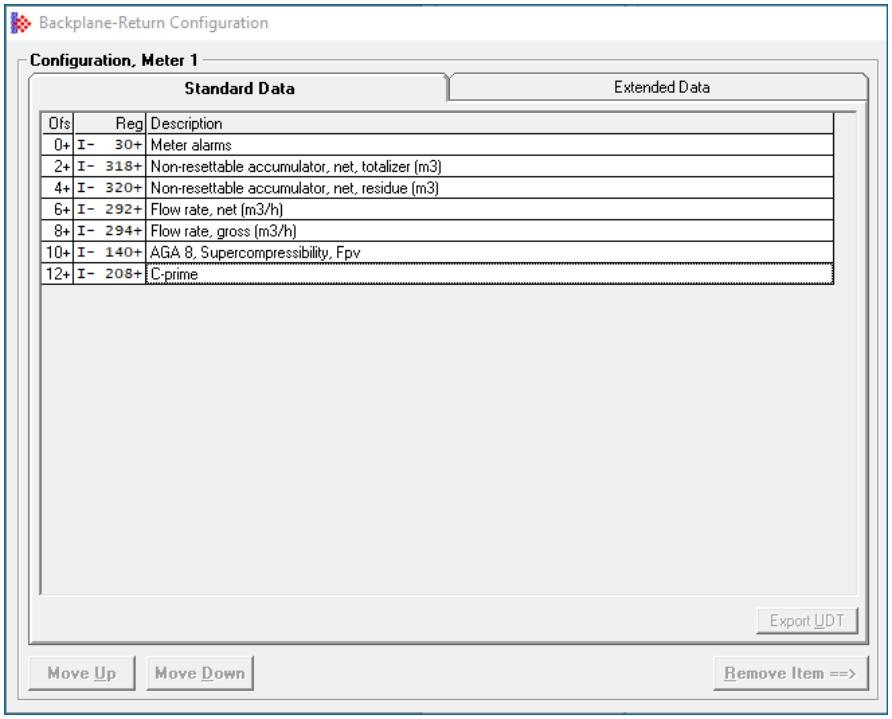
The module can deliver the following two types of data to the PLC via backplane return:

- Standard data
- Extended data

After configuring a backplane-return function block, you can export the data points as a UDT file that you can then import into RSLogix/Studio 5000 to allow for viewing the data via controller tags.

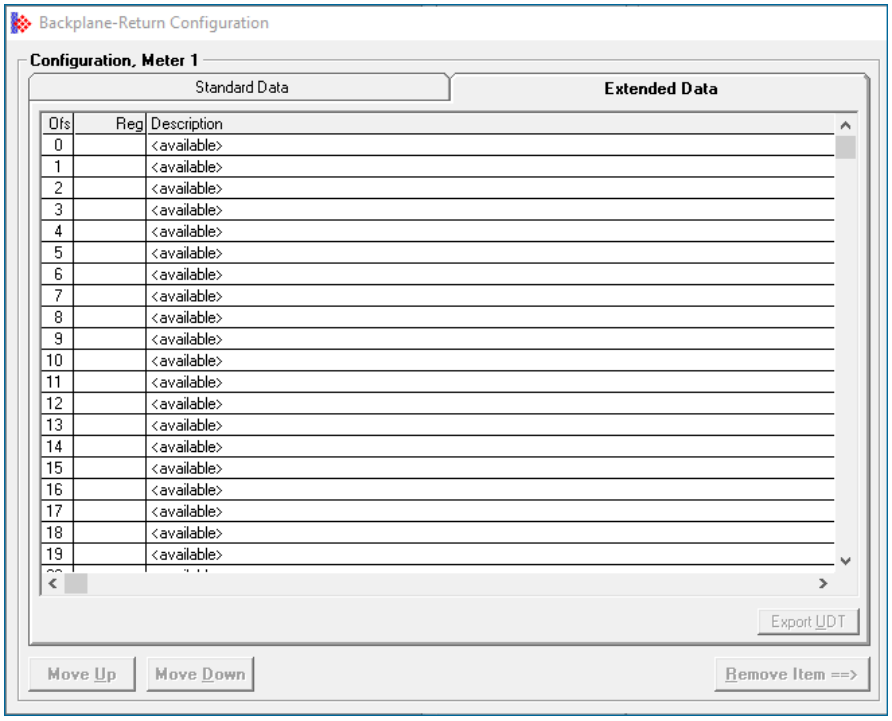
19.2 Standard Data Block

The *Standard Data* function block is configured by default to deliver process inputs used for measurement. These include values that would likely be required by the PLC program on a regular basis. This function block is delivered repeatedly and frequently from the module to the processor (PLC) without any additional configuration required. You do, however, have the option to customize the preconfigured data points using the *Backplane-Return Configuration* dialog.



19.3 Extended Data Function Block

In addition to the preconfigured *Standard Data* function block, you also have the option to configure a second backplane-return function block that can deliver additional measurement related data for a meter run over the backplane to the PLC. Unlike the *Standard Data* function block, the *Extended Data* function block is not delivered to the PLC by default. However, you can enable delivery of this function block by configuring it on the *Extended Data* tab of the *Backplane-Return Configuration* dialog and then triggering the request for this block using PLC ladder code.



19.4 Configuring the Backplane-Return Function Blocks

Following are instructions for configuring the *Standard Data* and *Extended Data* function blocks using the *Backplane-Return Configuration* dialog.

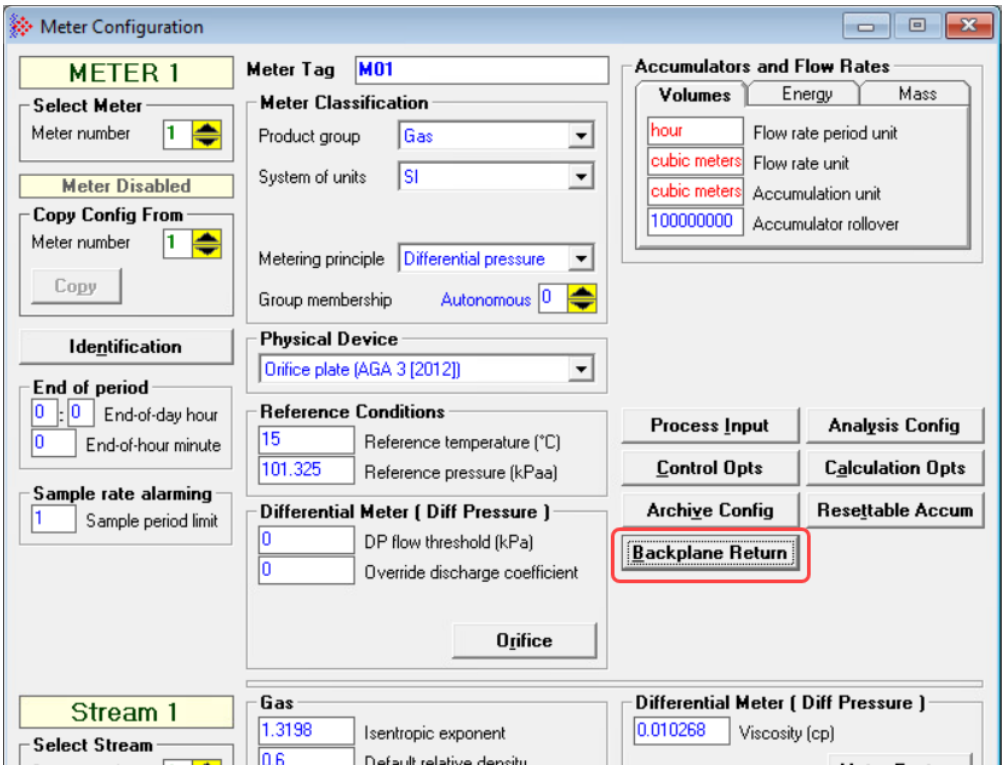
The default configuration in the *Backplane-Return Configuration* dialog shows the database points that were preselected for the *Standard Data* return and the empty mapping for the *Extended Data* return.

You can modify these by selecting desired values from the Modbus database. The module will deliver the selected items to the PLC automatically and on a regular basis without requiring you to create and issue a separate backplane transaction such as Modbus Gateway.

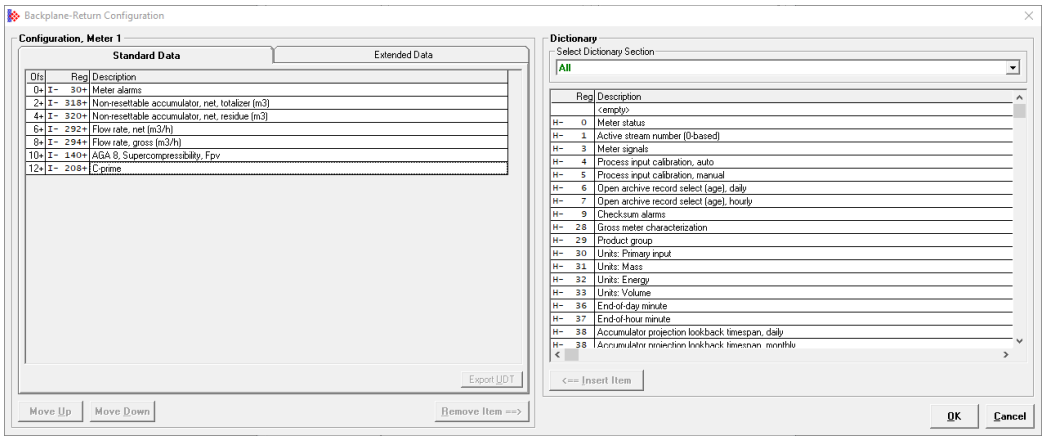
You have the responsibility to re-trigger the *Extended Data* function block when the previous one has completed. This makes the behavior semi-automatic (in contrast to *Standard Data* behavior, which is fully automatic).

To configure the *Standard Data* or *Extended Data* function block:

1 From the *Meter Configuration* dialog, select **BACKPLANE RETURN**.



The *Backplane-Return Configuration* dialog displays.



2 In the left side of the dialog, select the *Standard Data* tab or *Extended Data* tab.

3 From the *Dictionary* section, select the dictionary items you wish to include in the function block. This activates the **INSERT ITEM** button.

4 Click the **INSERT ITEM** button to add the items to the selected tab.

5 Use the **MOVE UP** and **MOVE DOWN** buttons to move items up or down in the list.

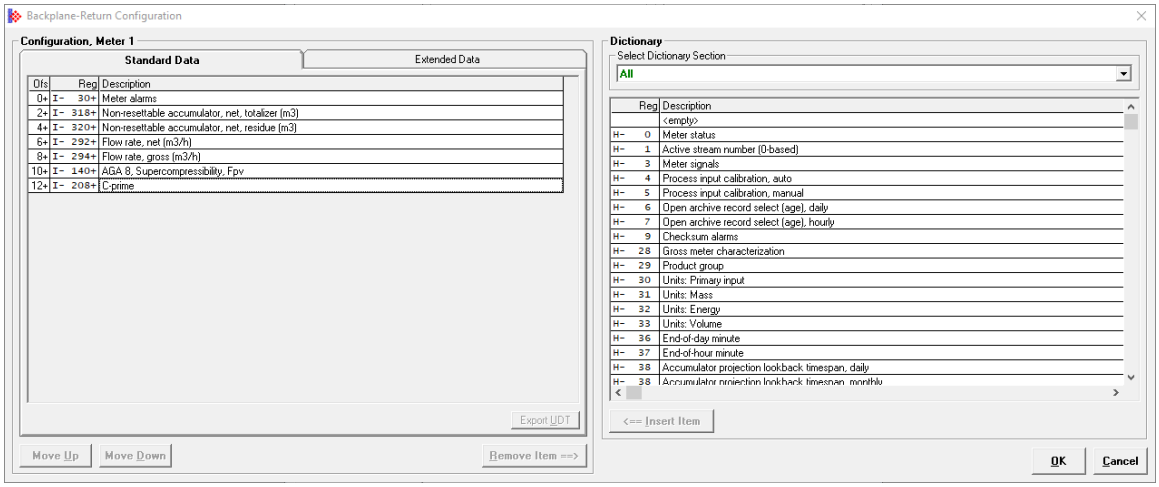
6 When you have finished adding dictionary items, click the **EXPORT UDT** button. The files are placed in a sub-directory of the directory that contains the project. The directory is named using the name of the project and extension **.PLC**. You can import this file into RSLogix/Studio 5000 by following the instructions in section 19.6, "Importing a Backplane-Return UDT," on page 113.

7 Click **OK**.

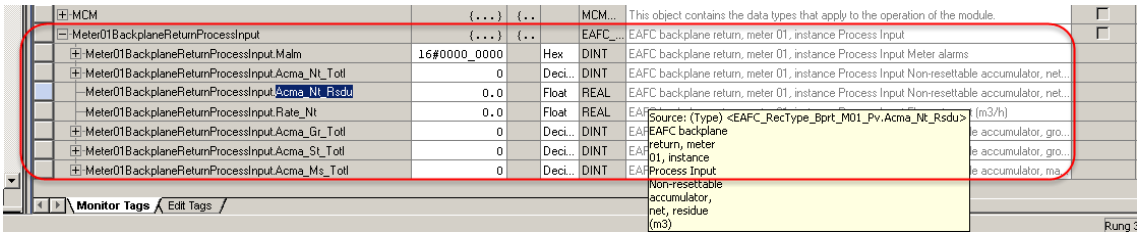
The backplane-return function block will be delivered to the PLC.

19.5 Backplane-Return Configuration

The following screen capture illustrates a *Backplane-Return Configuration* example configured within EAFC Manager:



This example shows data that can be obtained via the *BackPlaneReturn.ProcessInput* tags of a meter tag structure. Once imported, the same data can be accessible from the PLC as shown:

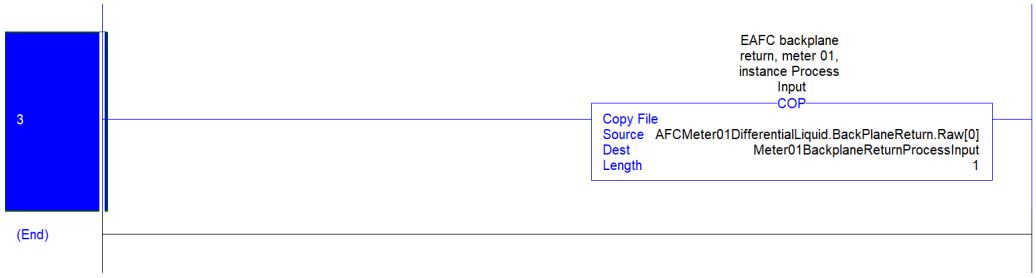


19.6 Importing a Backplane-Return UDT

The following procedure applies to *Standard Data* and *Extended Data* UDTs. When you configure a backplane-return function block, you can export its data tags as a UDT file, as explained in section 19.4, "Configuring the Backplane-Return Function Blocks," on page 110. Take the following steps to import the UDT file into RSLogix/Studio 5000.

1. From within RSLogix/Studio 5000 Controller Organizer, navigate to **DATA TYPES > USER-DEFINED**.
2. Right-click on **USER-DEFINED**.
3. Select **IMPORT DATA TYPE…**
4. In the *Import Data Type* window, select the UDT (.L5X file) to import.
5. Select **IMPORT...**
6. Click **OK** to import the UDT.

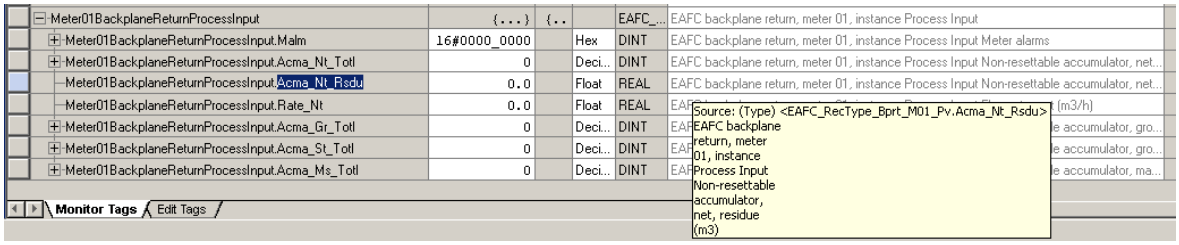
19.7 Copying the Backplane-Return Data



1. Create a unique tag of the imported data type.
2. Use a *COP* (Copy) instruction with the *Source* as the first element of the meter *BackplaneReturn* tag. The *Dest* (Destination) is a newly created tag of the imported data type. The length is 1. Make sure that the data type matches the data that you want to view.

19.8 Viewing Standard Data and Extended Data

You can view the data on the PLC as shown in the following example. Hover over the description field to get a full description of a selected type name.



Standard data is obtained when every function input block is sent to the AFC module. The extended data must be triggered in order to view it.

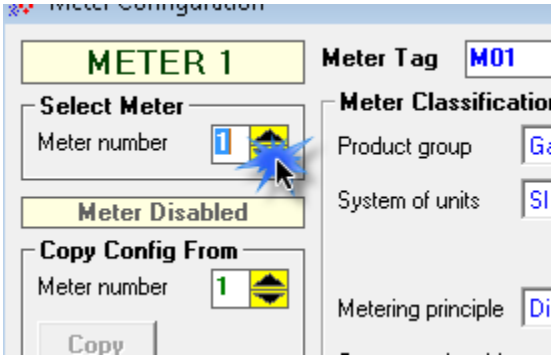
20 Archive Configuration

20.1 About the Archive Files

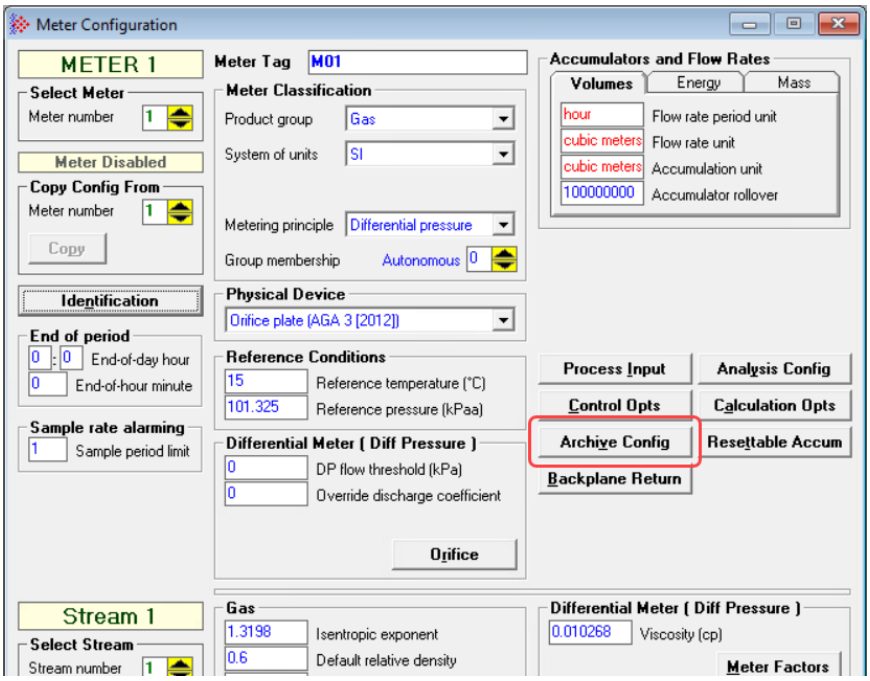
EAFC Manager archives selected meter data on a daily and hourly basis according to the *End-of-day hour* and *End-of-hour minute* settings. This chapter explains how to configure the layout of the archive files and export the data tags as a UDT file for use in RSLogix/Studio 5000.

20.2 Configuring the Archive Files

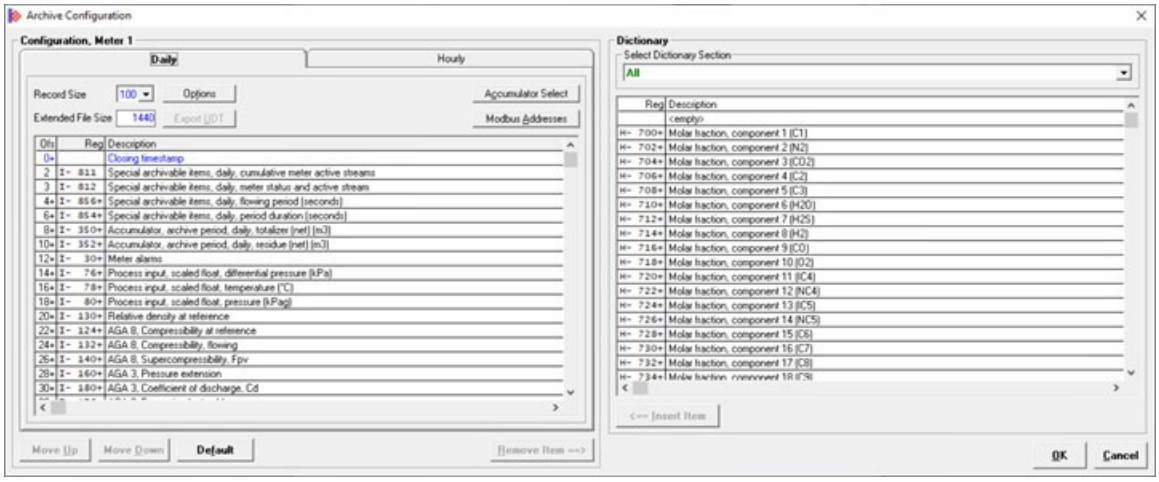
1 From the *Meter Configuration* dialog box, select the meter number.



2 Click on the **ARCHIVE CONFIG** button.



This opens the *Archive Configuration* dialog.



3 In the left side of the dialog, select the *Daily* or *Hourly* tab.

4 From the *Dictionary* section, select the dictionary items you wish to include in the archive file. This activates the **INSERT ITEM** button.

5 Click the **INSERT ITEM** button to add the items to the selected tab (*Daily* or *Hourly*).

6 Use the **MOVE UP** and **MOVE DOWN** buttons to move items up or down in the list.

7 When you have finished adding dictionary items, click the **EXPORT UDT** button. The files are placed in a sub-directory of the directory that contains the project. The directory is named using the name of the project and extension **.PLC**. You can import this file into RSLogix/Studio 5000 by following the instructions in section 20.3, "Importing an Archive Configuration UDT," on page 116.

20.3 Importing an Archive Configuration UDT

The following procedure imports an Archive Configuration UDT. It applies to *Daily* and *Hourly* Archive UDTs.

1 From within RSLogix/Studio 5000 Controller Organizer, navigate to **DATA TYPES > USER-DEFINED**.

2 Right-click on **USER-DEFINED**.

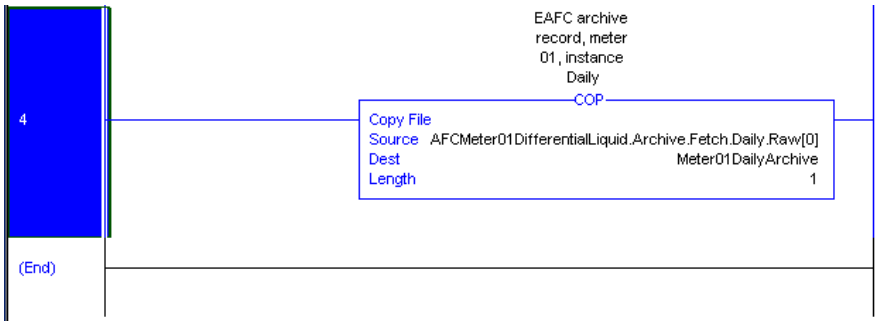
3 Select **IMPORT DATA TYPE…**

4 In the *Import Data Type* window, select the UDT (.L5X file) to import.

5 Select Import...

6 Click **OK** to import the UDT.

20.4 Copying the Archive Data



1 Create a unique tag of the imported data type.

2 Use a **COP** (Copy) instruction with the *Source* as the first element of the meter *Archive.Fetch.xxx.Raw* data. The *Dest* (Destination) is a newly created tag of the imported data type. The *Length* is 1.

3 Make sure that the data type you are using matches the data that you want to view. For example, if you want process data, ensure that the imported data is actually process data.

20.5 Viewing Archive Data

Navigate to the newly-created tag array to view the data.

Name	Value	For	Style	Data Ty	Description
Meter01DailyArchive	{...}	{..		EAFC_...	EAFC archive record, meter 01, instance Daily
Meter01DailyArchive.Tstp	0		Deci...	DINT	EAFC archive record, meter 01, instance Daily Special archivable items, closing timestamp
Meter01DailyArchive.RkvS_Dy_Rkvl_AcSm	2#0000_00...		Binary	INT	EAFC archive record, meter 01, instance Daily Special archivable items, daily, cumulative
Meter01DailyArchive.RkvS_Dy_Rkvl_StSm	2#0000_00...		Binary	INT	EAFC archive record, meter 01, instance Daily Special archivable items, daily, meter status
Meter01DailyArchive.RkvS_Dy_Rkvl_Flsc	0		Deci...	DINT	EAFC archive record, meter 01, instance Daily Special archivable items, daily, flowing peri
Meter01DailyArchive.RkvS_Dy_Rkvl_Durn	0		Deci...	DINT	EAFC archive record, meter 01, instance Daily Special archivable items, daily, period durati
Meter01DailyArchive.AcmK_Dy_Totl	0		Deci...	DINT	EAFC archive record, meter 01, instance Daily Accumulator, archive period, daily, totalizer
Meter01DailyArchive.AcmK_Dy_Rsdu	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Accumulator, archive period, daily, residue
Meter01DailyArchive.Malm	16#0000_0000		Hex	DINT	EAFC archive record, meter 01, instance Daily Meter alarms
Meter01DailyArchive.InSc_DifP	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Process input, scaled float, differential pres
Meter01DailyArchive.InSc_Temp	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Process input, scaled float, temperature (°C)
Meter01DailyArchive.InSc_Pres	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Process input, scaled float, pressure (kPag)
Meter01DailyArchive.Gref	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Relative density at reference
Meter01DailyArchive.Zref	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily AGA 8, Compressibility at reference
Meter01DailyArchive.Zflw	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily AGA 8, Compressibility, flowing
Meter01DailyArchive.Ifpv	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily AGA 8, Supercompressibility, Fpv
Meter01DailyArchive.Ixtf	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily AGA 3, Pressure extension
Meter01DailyArchive.I3cd	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily AGA 3, Coefficient of discharge, Cd
Meter01DailyArchive.I3yy	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily AGA 3, Expansion factor, Y
Meter01DailyArchive.Cprm	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily C-prime
Meter01DailyArchive.FpAc_Ms	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, curren
Meter01DailyArchive.RkvS_Dy_Rkvl_FpAO_Ms	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, daily,
Meter01DailyArchive.FpAc_Eg	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, curren
Meter01DailyArchive.RkvS_Dy_Rkvl_FpAO_Eg	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, daily,
Meter01DailyArchive.FpAc_Nt	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, curren
Meter01DailyArchive.RkvS_Dy_Rkvl_FpAO_Nt	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, daily,
Meter01DailyArchive.FpAc_Gr	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, curren
Meter01DailyArchive.RkvS_Dy_Rkvl_FpAO_Gr	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Special-archivable NR accumulator, daily,
Meter01DailyArchive.Molf_00	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Molar fraction, component 1 (C1)
Meter01DailyArchive.Molf_01	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Molar fraction, component 2 (N2)
Meter01DailyArchive.Molf_02	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Molar fraction, component 3 (CO2)
Meter01DailyArchive.Molf_03	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Molar fraction, component 4 (C2)
Meter01DailyArchive.Molf_04	0.0		Float	REAL	EAFC archive record, meter 01, instance Daily Molar fraction, component 5 (C3)

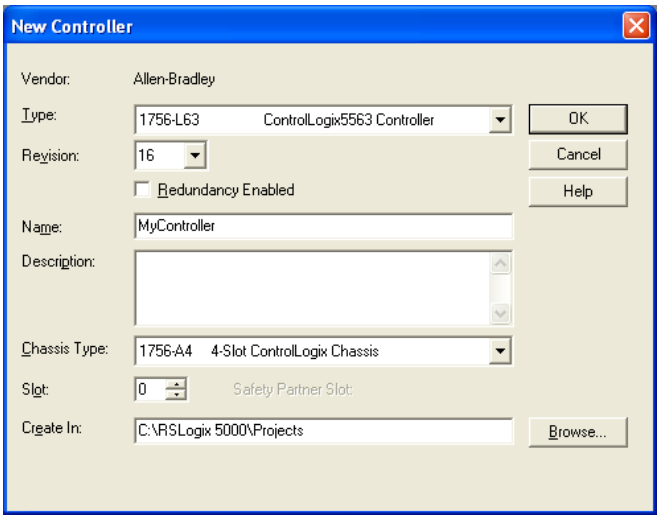
Archive data must be triggered with the desired age in order to view it. For more information on viewing archive data, see the ProSoft Technical Note titled “How to Fetch Daily and Hourly Archives,” available at www.prosoft-technology.com.

21 Creating an RSLogix/Studio 5000 Project and Importing an AOI

Note: This section use the MVI56E-AFC module for examples. The MVI69E-AFC module is configured like the MVI56E-AFC.

21.1 Creating an MVI56E-AFC RSLogix/Studio 5000 Project

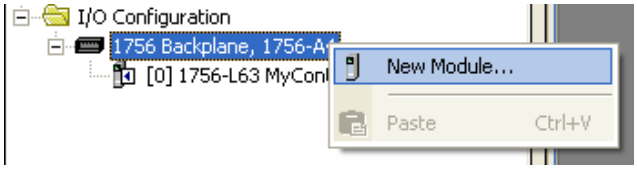
1 Create a new RSLogix/Studio 5000 project.



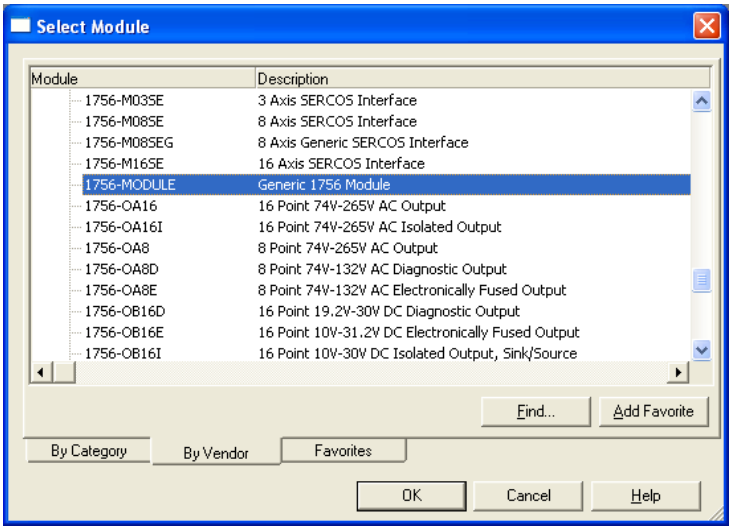
2 In the Controller Organization window, expand the I/O Configuration folder.

3 Select **1756 Backplane**, and then click the right mouse button to open a shortcut menu.

4 On the shortcut menu, choose **NEW MODULE...**

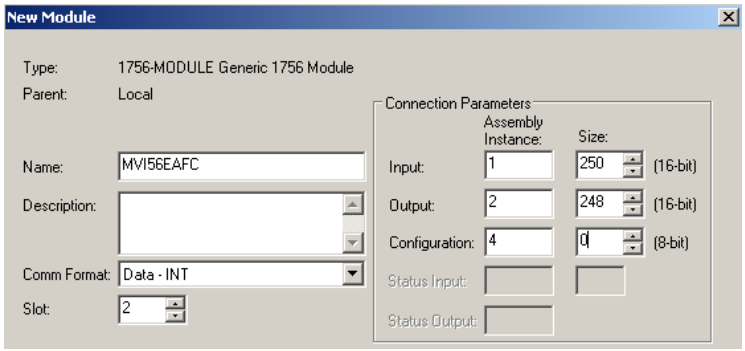


5 On the *Select Module* dialog box, select **1756-MODULE**.

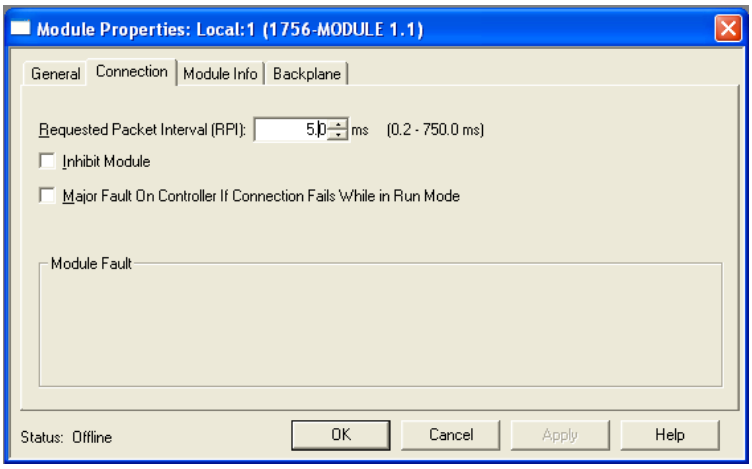


6 Create a new **1756-MODULE** (I/O Configuration) with the following settings:

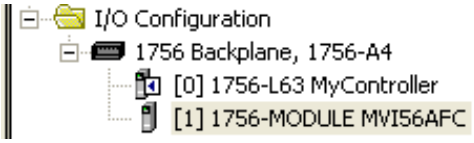
Name	= MVI56EAFC
Comm Format	= Data-INT
Input Assembly Instance	= 1
Input Assembly Size	= 250
Output Assembly Instance	= 2
Output Assembly Size	= 248
Configuration Assembly Instance	= 4



7 Adjust the *Slot* and *RPI* settings for your application. 5ms is the recommended default RPI time, do not use an RPI setting below 5ms. Click **OK** to confirm.

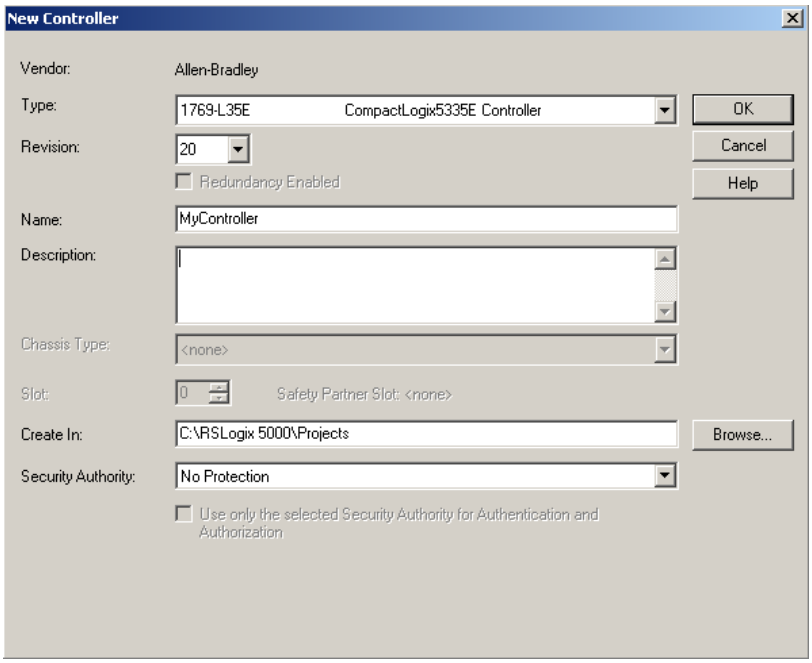


8 The MVI56E-AFC module is now visible in the I/O Configuration folder.



21.2 Creating an MVI69E-AFC RSLogix/Studio 5000 Project

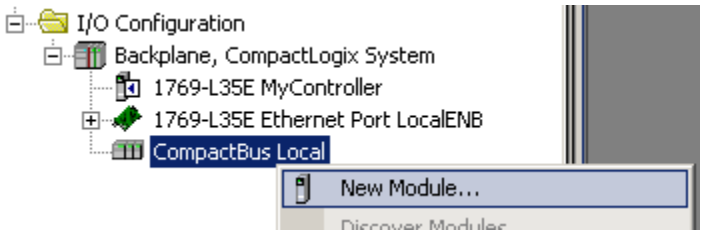
1 Create a new RSLogix/Studio 5000 project.



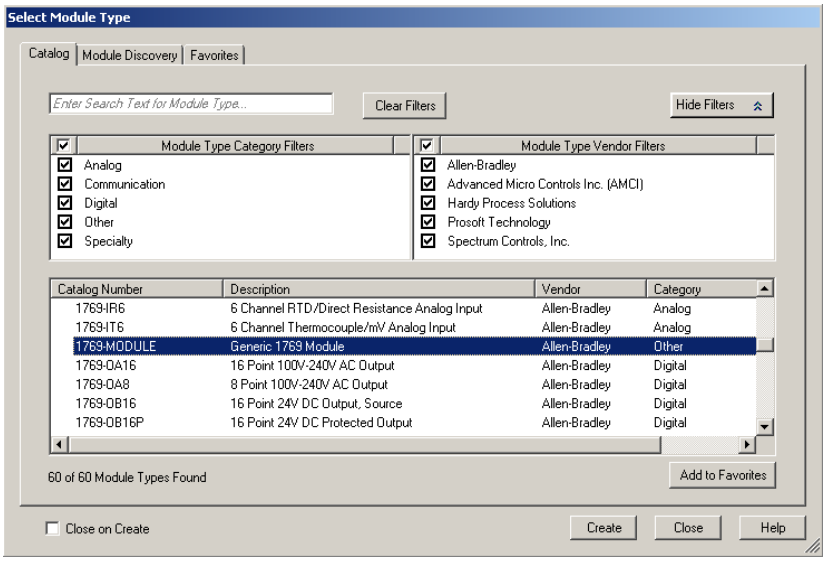
2 In the Controller Organization window, expand the I/O Configuration folder.

3 Right-click on the **CompactBus Local** icon to open a shortcut menu.

4 On the shortcut menu, choose **NEW MODULE…**

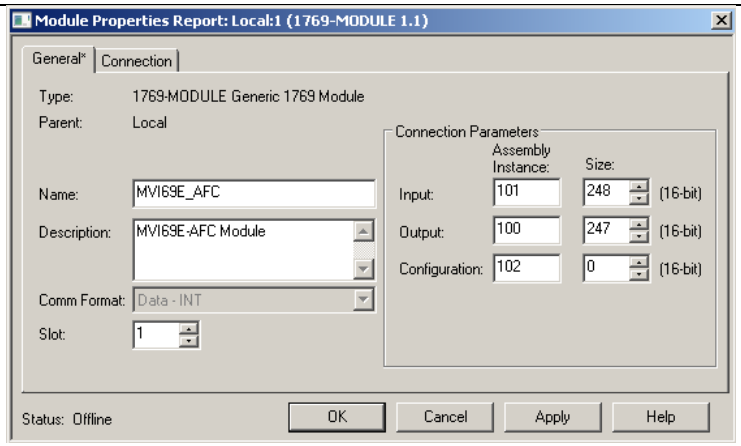


5 In the *Select Module Type* dialog box, select **1769-MODULE**. Click the **CREATE** button.

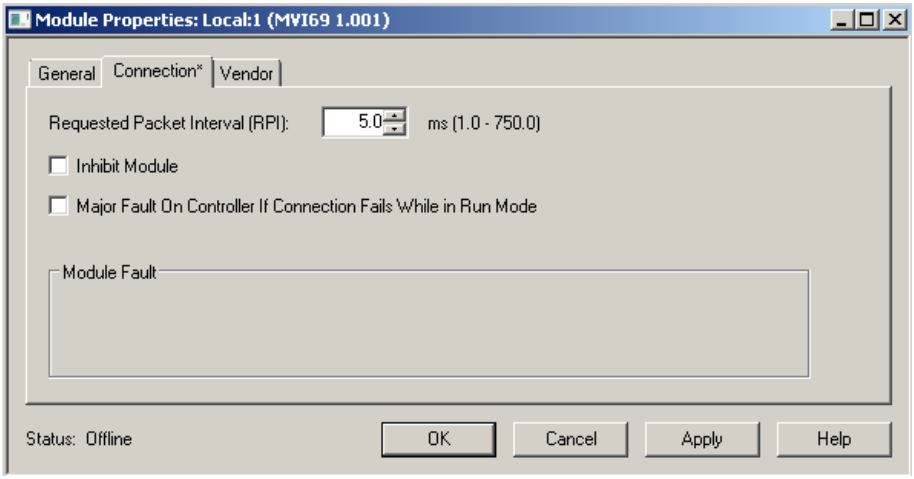


6 Enter the *Name* and select the *Slot* location of the module. In addition, enter the following values:

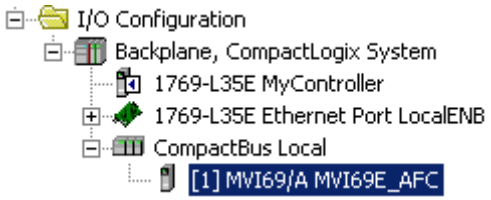
Parameter	Value
Name	MVI69E_AFC
Comm Format	Data-INT
Input Assembly Instance	101
Input Size	248
Output Assembly Instance	100
Output Size	247
Configuration Assembly Instance	102
Configuration Size	0



7 Click on the *Connection* tab to adjust the *Requested Packet Interval (RPI)* setting for your application. 5ms is the recommended default RPI time, do not use an RPI setting below 5ms. Click **OK**.



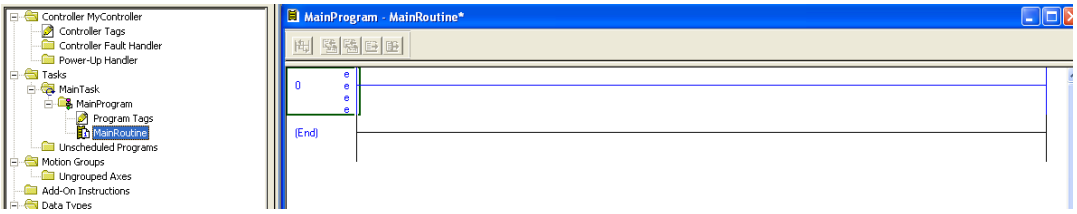
8 The MVI69E-AFC module is now visible in the I/O Configuration folder.



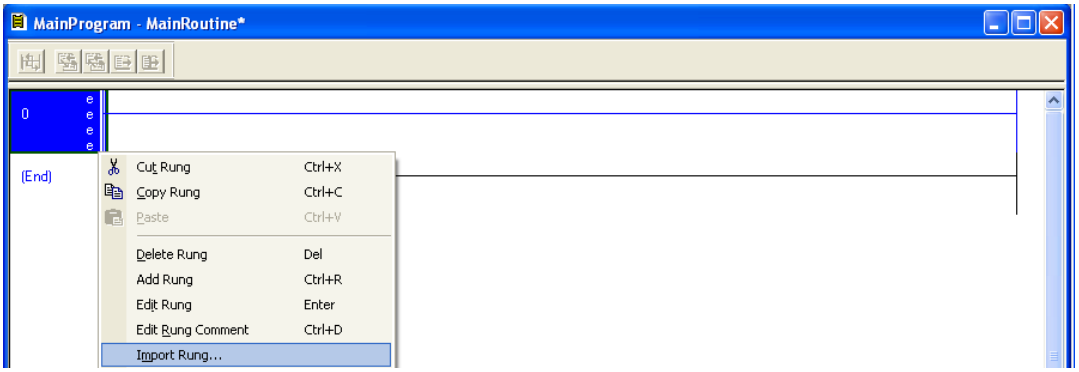
21.3 Importing the AOI Rungs

All meter-specific Add-On rungs must precede the Main AOI56EAFC instruction. The meter-specific AOIs can all be on a single rung, but the main AOI instruction must be on a separate rung. See the sample .ACD file for an example of this.

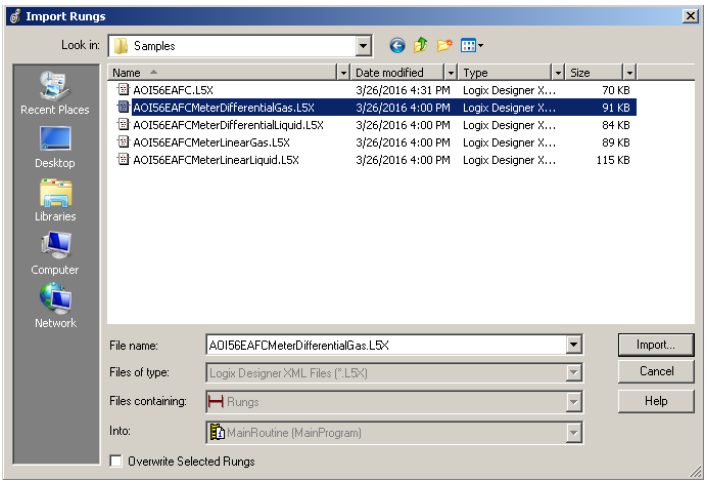
1 Expand the *Tasks* folder, and then select **MAINPROGRAM**.



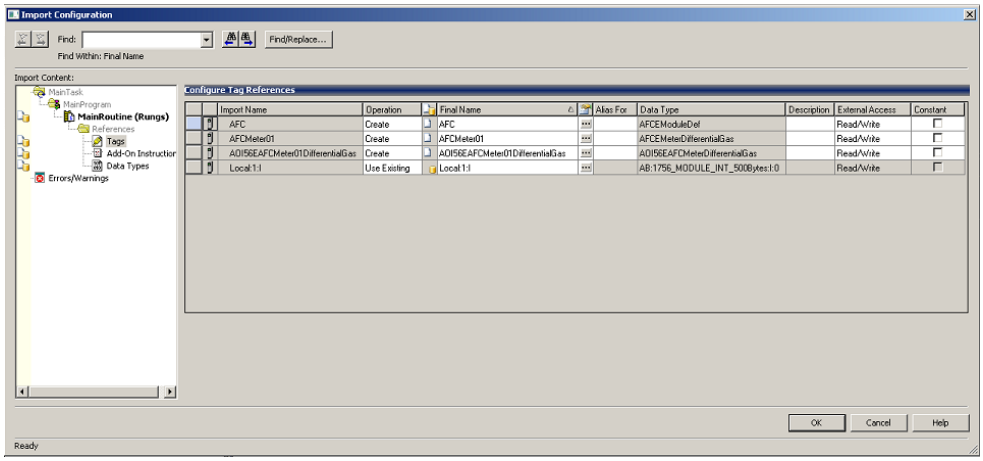
2 Click the right mouse button to open a shortcut menu, and then choose **IMPORT RUNG**. This action opens the *Import Rung* dialog box.



3 In the *Import Rung* dialog box, select the meter type specific rung that you will want to use in your project, and then click **IMPORT**. The meter-specific AOI must be imported before the Main AOI.



4 When the following window opens, select the *Tags* section as shown below:



5 Edit the default AOI rung. The 4 tags are as follows:

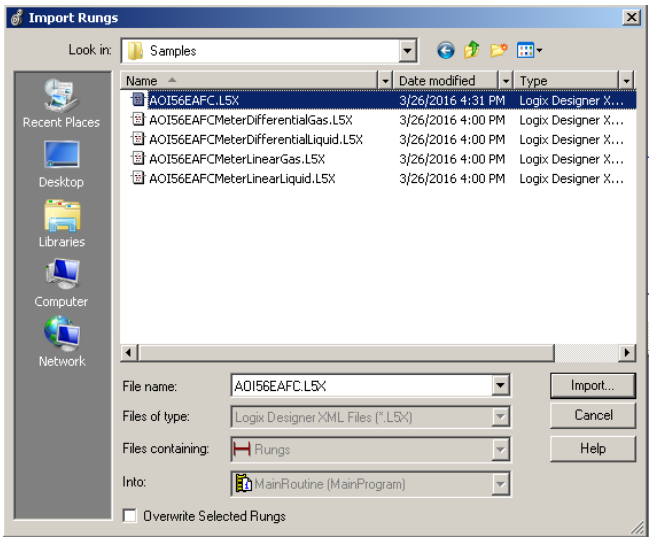
- **AFC** – This tag must match the tag of the MAIN AOI that you will import last. This is the main tag for all of the functions of the module. This will have a Data Type of EAFCModuleDef, and will import all of the User Defined Data Types required for the communication between the module and the ControlLogix process.
- **AFCMeterX** – This is the tag that contains all information pertaining to a particular meter run. The User Defined Data Type is dependent on the type of meter you are importing (shown above is differential gas).
- **AOI56EAFCMeterX…** – This is a unique tag for each meter run in your project. It is required for the operation of the AOI, and contains the enabled in, enabled out, and meter number parameters.

  Or

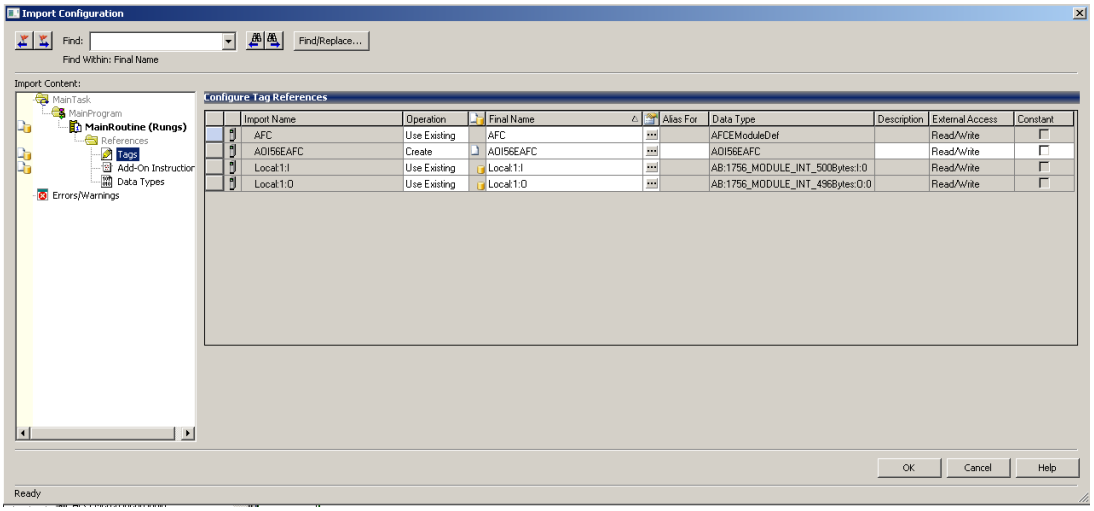
  AOI69EAFCMeterX… – This is a unique tag for each meter run in your project. It is required for the operation of the AOI, and contains the enabled in, enabled out, and meter number parameters
- **Local:1:I** – This tag will reflect the slot number that the module resides in your ControlLogix rack (in this sample slot 1). If your module is in slot 4 instead, you will change this tag to Local:4:I.

6 Once the meter AOI is imported, you must update the *Meter Number* parameter which can only be done after the AOI is imported. Each meter must have unique meter numbers.

7 When finished importing all of the meter type specific rungs that you need for the project, import the **MAIN Add-On Instruction** for your module type



8 Select the *Tags* section to display the following menu:



The tags shown here are as follows:

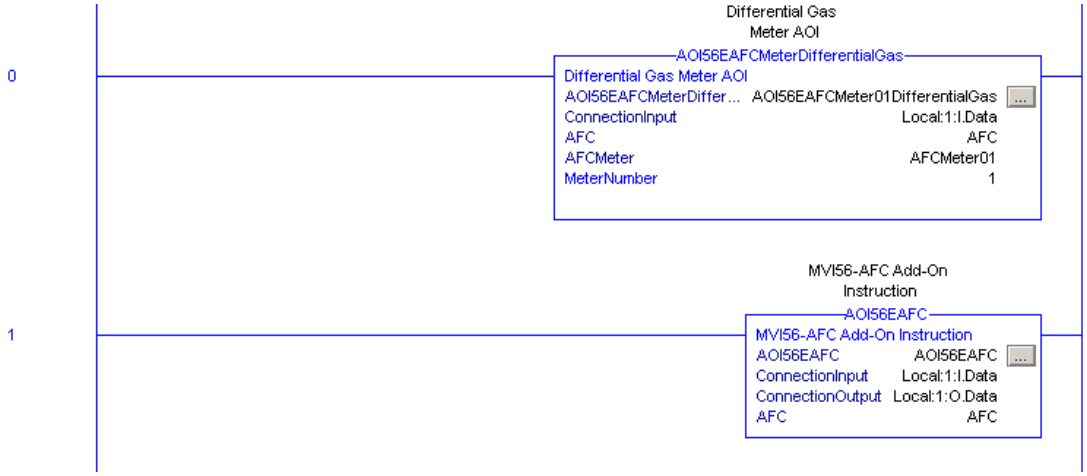
- **AFC** – This should match the tag name used when importing the meter specific Add-On Instructions. It will be of data type EAFCModuleDef.
- **AOI56EAFC** – This tag contains the enable in and enable out bits needed for the main Add-On Instruction.

or

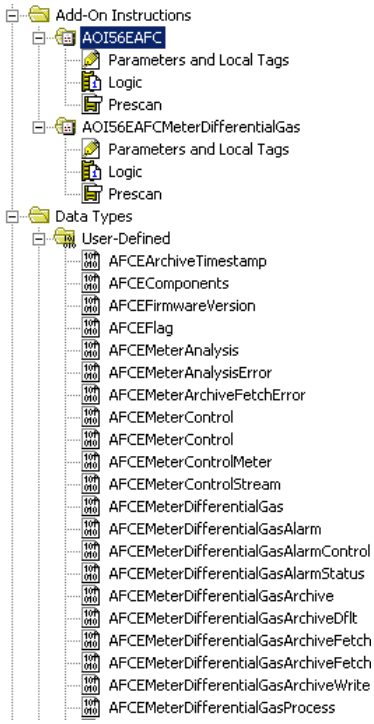
AOI69EAFC – This tag contains the enable in and enable out bits needed for the main Add-On Instruction.

- **Local:1:I** – This will represent the slot of the module (in this case slot 1). If your module is located in another slot in the ControlLogix chassis, edit in the Final Name column to reflect your application.
- **Local:1:O** – Again slot dependent. Edit to reflect the location of the module in your ControlLogix application.

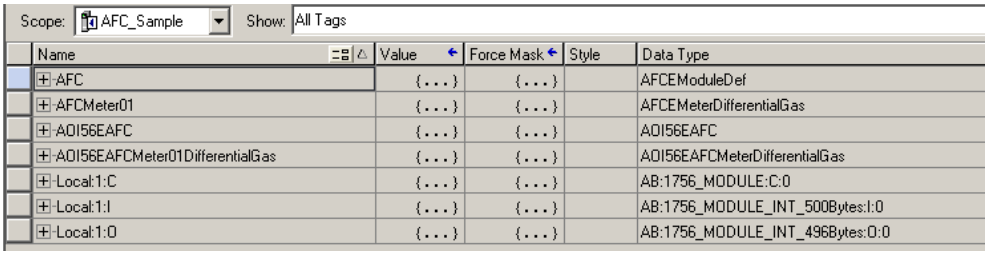
9 When the import is completed, the Add-On Instructions appear similar to the following example:



The procedure has imported User-Defined data types that will be used by the sample program.



The procedure has imported controller tags that will be used by the sample program.



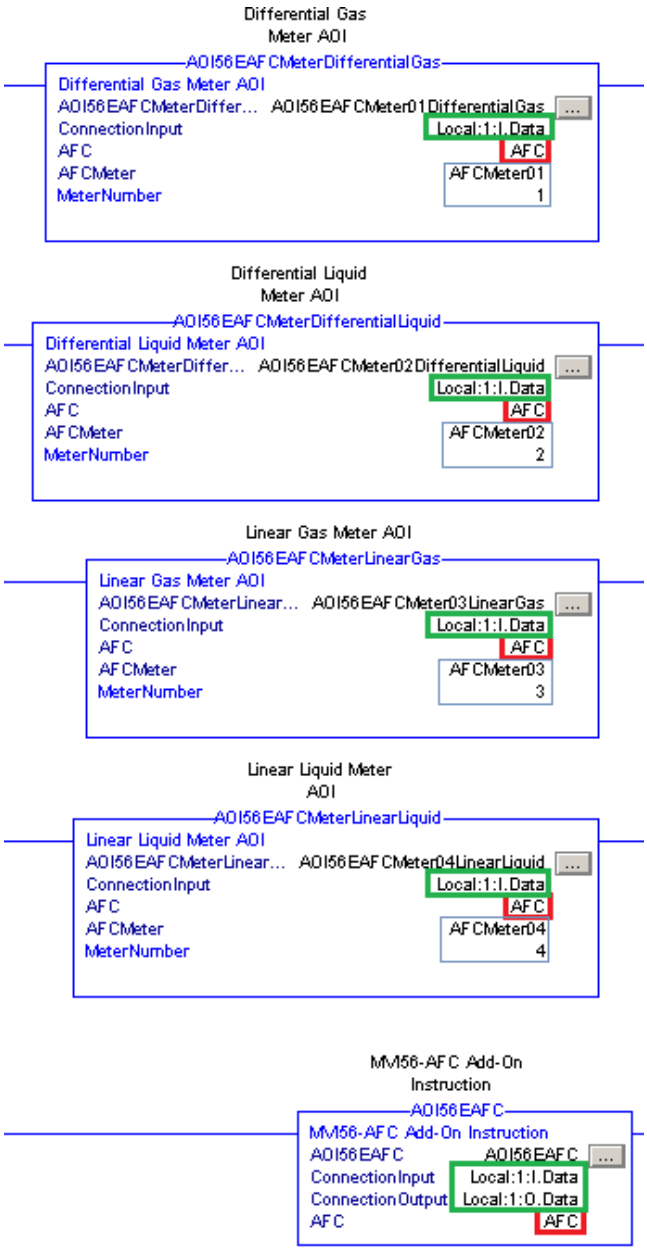
10 The import procedure is now complete. Save your project and continue configuring the AOI's section.

Note: An example for all 16 (56E) meter runs and all 4 meter types is provided as a .ACD file that can be used. This utilizes additional processor memory when not using all 4 meter types, so while it is not recommended to use this as a base, it is available as a sample from our website.

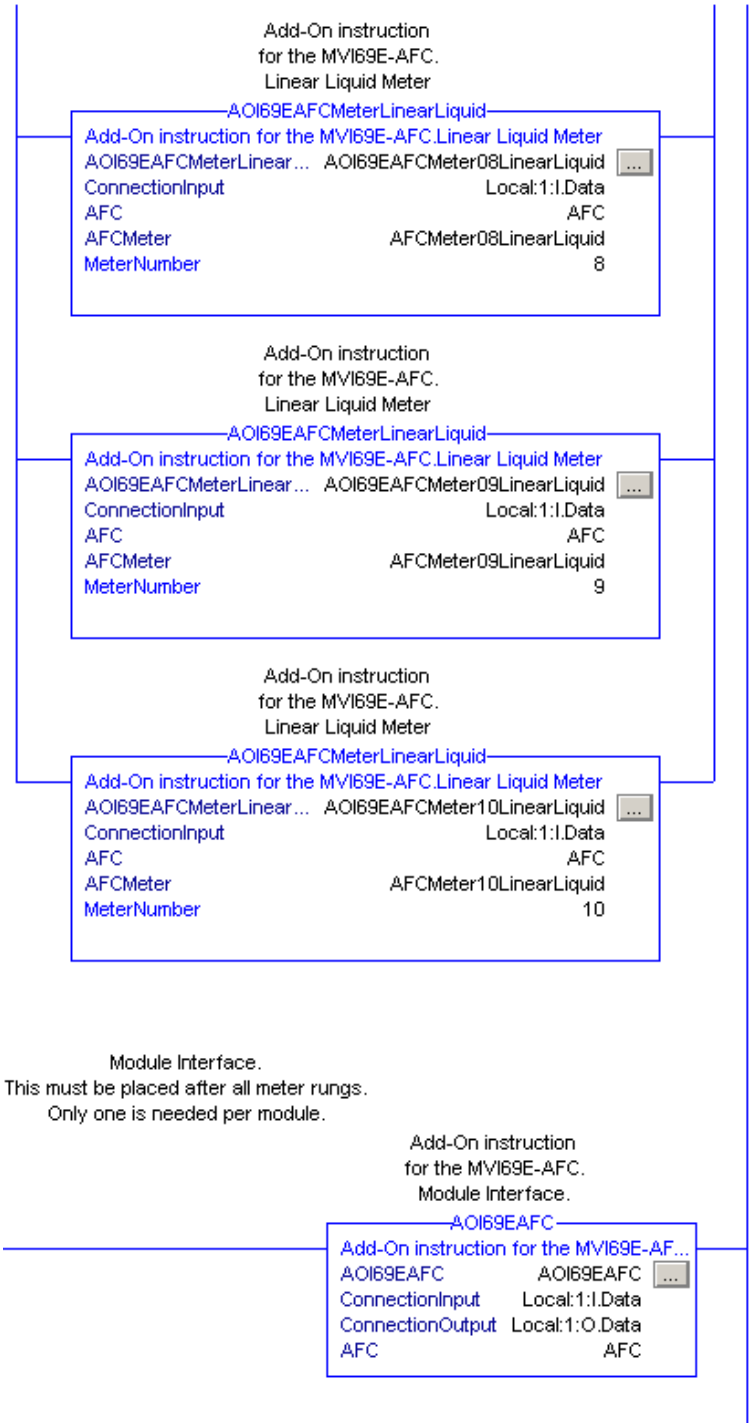
21.4 Configuring the AOIs

Now that all of the AOI's are in the project you may now configure the ladder for the rest of your application. Below is the sample .ACD file available from the website:

21.4.1 MVI56E-AFC



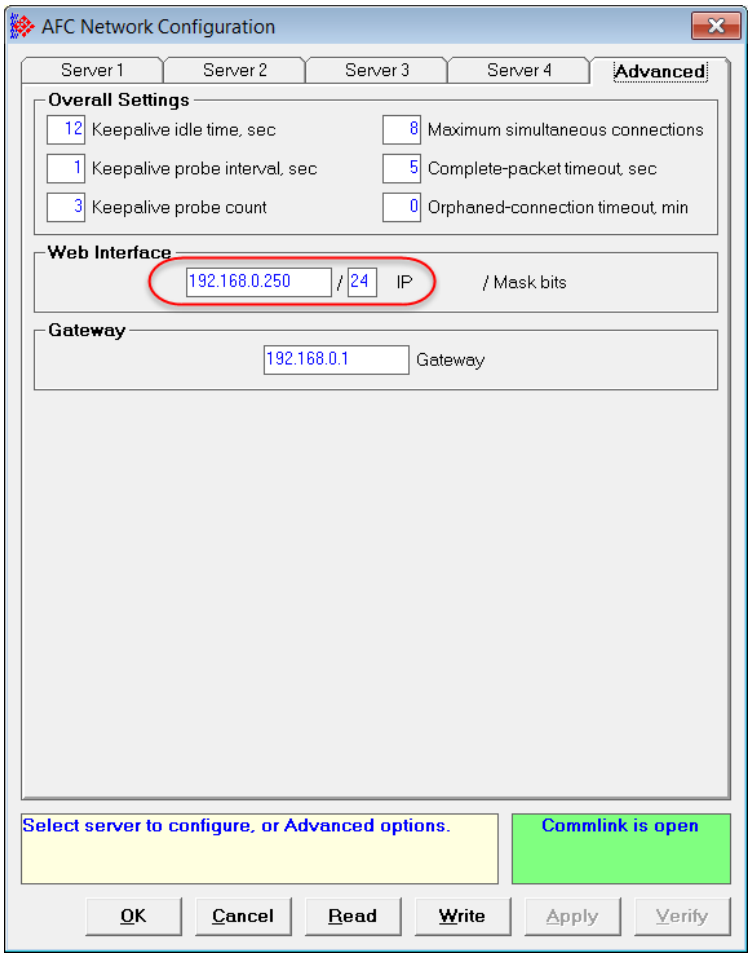
21.4.2 MVI69E-AFC



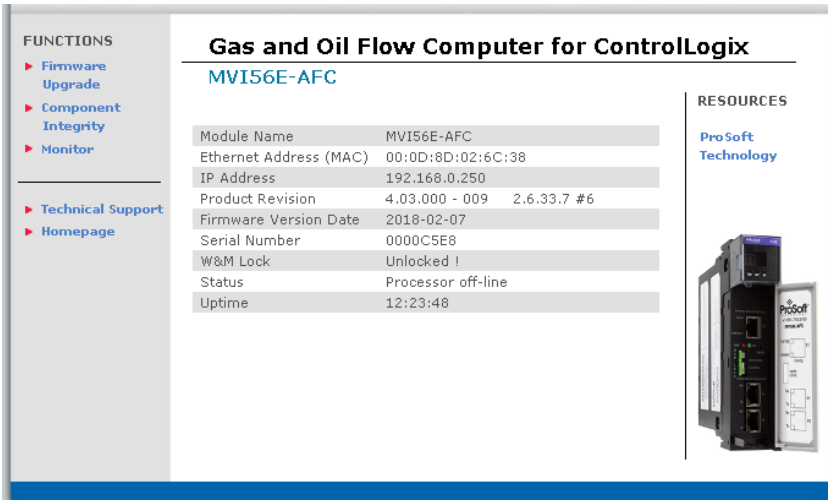
22 Using the AFC Module Web Pages

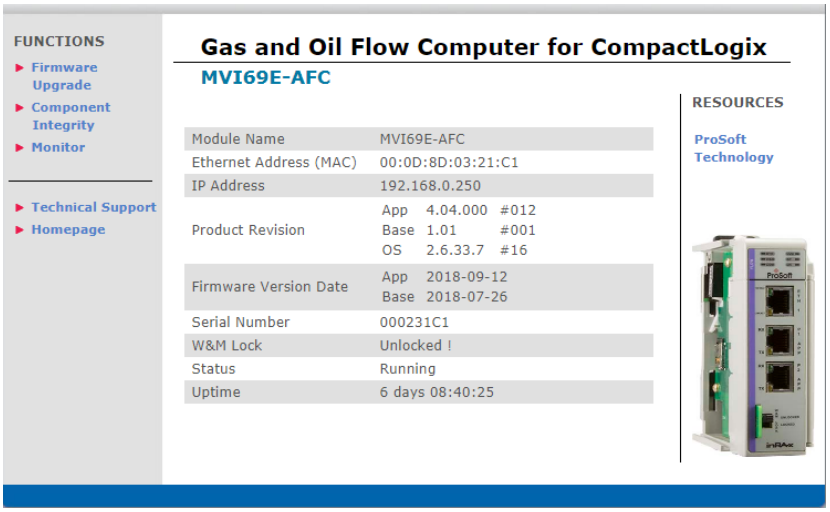
The AFC module web pages are accessible through a browser by entering the module's IP address. From this page, you can view general information about the module as well as upgrade the firmware.

To access this web page, ensure that you use the **Web Interface** IP address configured under **SITE CONFIGURATION > NETWORK > ADVANCED**.



The web page opens in your browser.



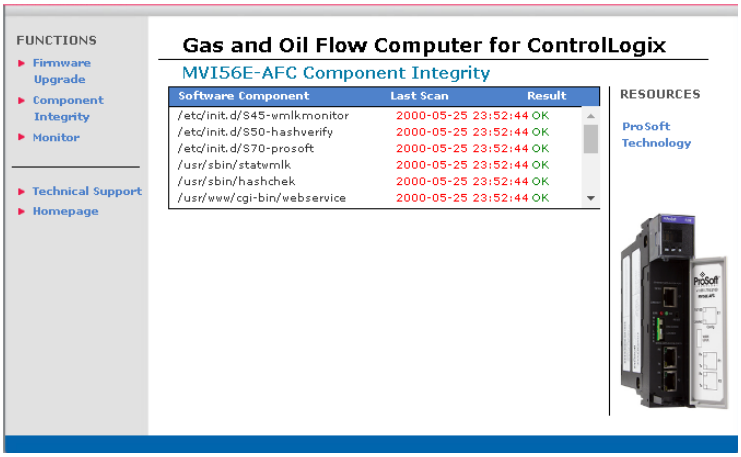


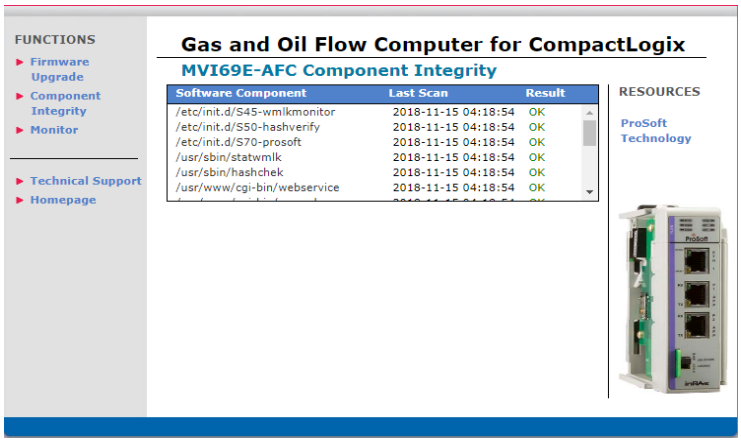
22.1 Firmware Upgrade Link

Click on the **FIRMWARE UPGRADE** link to upgrade the module's firmware if instructed to do so from the support group.

22.2 Component Integrity Link

Click on the **COMPONENT INTEGRITY** link to display software competency, its last scan, and results.



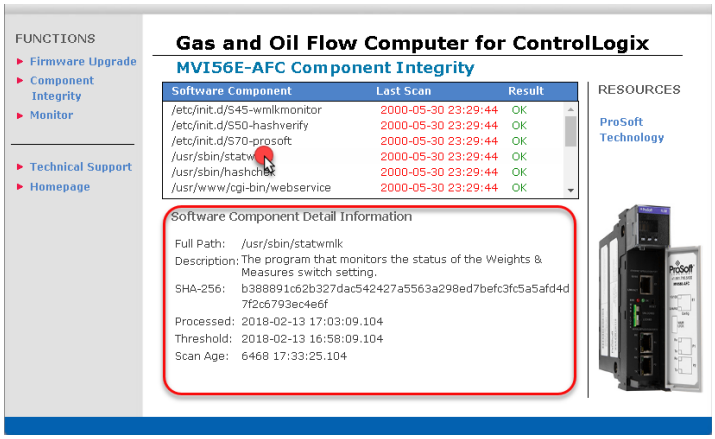


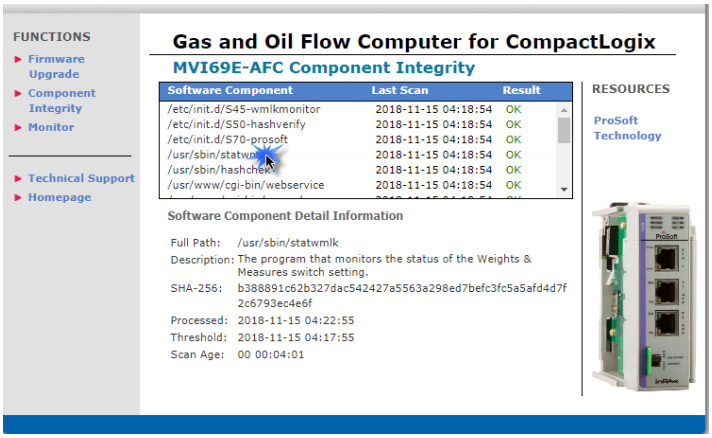
The software component integrity table information provides the following information:

- **Software Component** – The Software Component column displays the list of legally relevant software identifiers. On the right side of the table, a vertical scroll is provided to scan this listing.
- **Last Scan** – The Last Scan column displays the timestamp (UTC) of the last scan of the software component by the hash checking process.
- **Result** – The Result column displays the outcome of the last scan of the software component by the hash checking process.

22.2.1 Software Component Detail Information

Mouse hover or click on the legally relevant software component identifier in the table, the software component detail information is displayed below the table.





The software component detail information displays the following information.

Parameter	Description
Full Path	The complete legally relevant software component identifier.
Description	The legal description of the software component identifier.
SHA-256	The SHA-256 hash code of the legally relevant software as calculated during the firmware-image build process..
Processed	The operating system timestamp (UTC) when the hash code results were processed. The processed timestamp is based upon the viewing device date and time running the web browser software.
Threshold	The page processed timestamp minus 5 minutes.
Age	The page processed timestamp minus the last scan timestamp.

22.2.2 Component Integrity Page Operation

The AFC module hash checking is performed by an internal process which scans each legally relevant software component once every 4 minutes and 30 seconds. The outcome of this scan is stored in a result file. The hash checking process runs continuously and is independent of all other processes that run on the module.

Each minute, or on manual refresh, the component integrity web page performs a web service transaction which reads the result from the internal hash checking process.

The AFC module legally relevant software identifiers are unique for each legally relevant software component. The table however, is limited in width. When the legally relevant software identifier is too long to display in the software component column, the legally relevant software identifier in the table is shortened to fit the table column width. When this occurs, the legally relevant software component identifier is displayed with ".." characters. The full legally relevant software component identifier is always displayed in the detail information section.

On each process interval, if the age of the software component last scan timestamp is older than 5 minutes, the last scan timestamp is displayed in red.

The following table details the displayed software component scan result codes:

Result Code	Description
OK	The software component was successfully processed by the internal hash checking process, and the calculated hash code by the hash checking process matched the calculated hash code during the firmware-image build process.
Mismatch	The software component was successfully processed by the internal hash checking process, but the calculated hash code by the hash checking process did not match the calculated hash code during the firmware-image build process.
Missing	The software component was not found and therefore could not be scanned.
Err<nn>	An error occurred when the internal hash checking process attempted to scan the software component, so the hash code could not be calculated. <nn> is the error code reported by the operating system function call that failed for use by ProSoft Technical Support.

22.2.3 Verification

The AFC Enhanced Liquid & Gas Flow Computers for ControlLogix® and CompactLogix modules consists of two firmware images; the “base” firmware-image which supplies an environment and component files that have more general utility that what is needed for measurement and flow computation, and the “application” firmware-image that adjusts/enhances the “base” environment and components the directly implement the measurement and flow computation. Both firmware images are required for full implementation of the AFC Enhanced Liquid & Gas Flow Computer for ControlLogix® and CompactLogix modules. Both firmware images contain legally relevant software components.

The AFC Enhanced Liquid & Gas Flow Computer for ControlLogix® and CompactLogix modules legally relevant software documentation contains the following information for each legally relevant software component within each firmware-image:

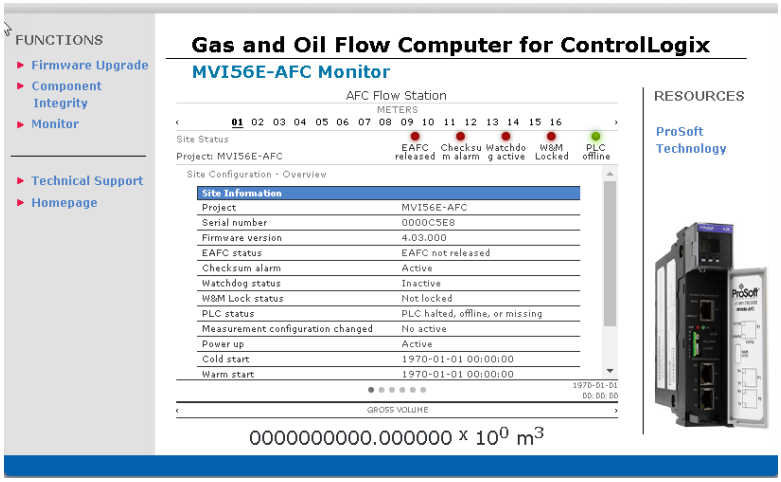
- Legally relevant software component identifier
- Legal description
- Calculated SHA-256 hash code during the firmware-image build process

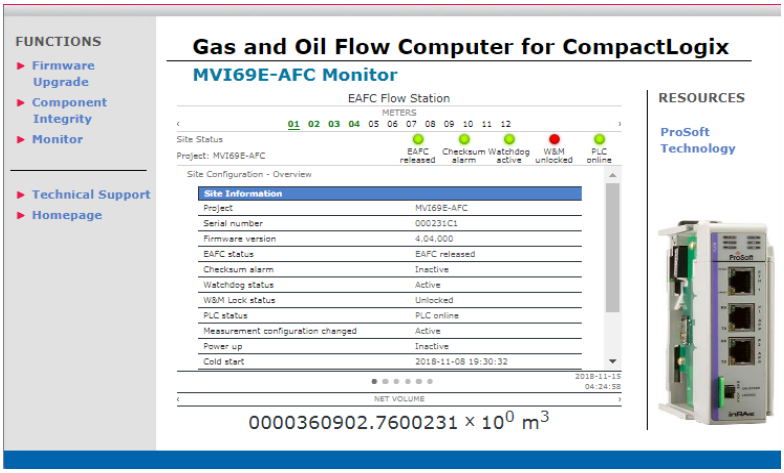
The AFC Enhanced Liquid & Gas Flow Computer for ControlLogix® and CompactLogix® modules legally relevant software documentation is provided for full manual verification of all legally relevant software components.

22.3 Monitor

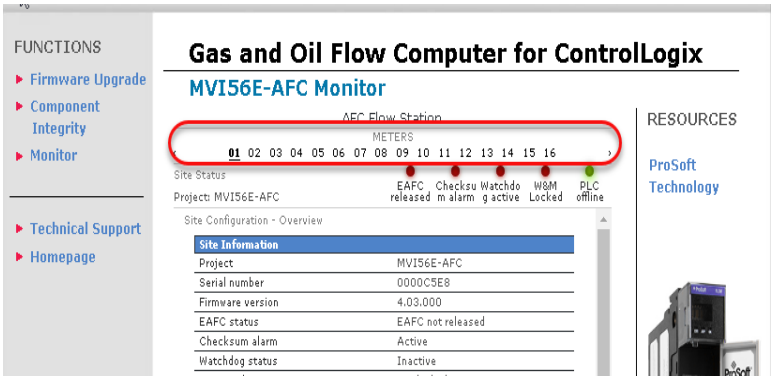
Click on the **Monitor** link from the module's web page to display information about what is going on inside the module.

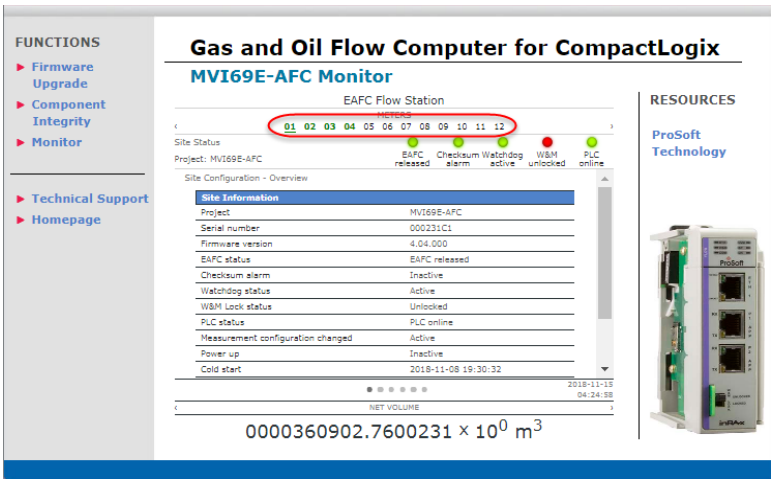
The following two screen captures show the *Meter Monitor* dialog box for the MVI56E-AFC and the MVI69E-AFC.





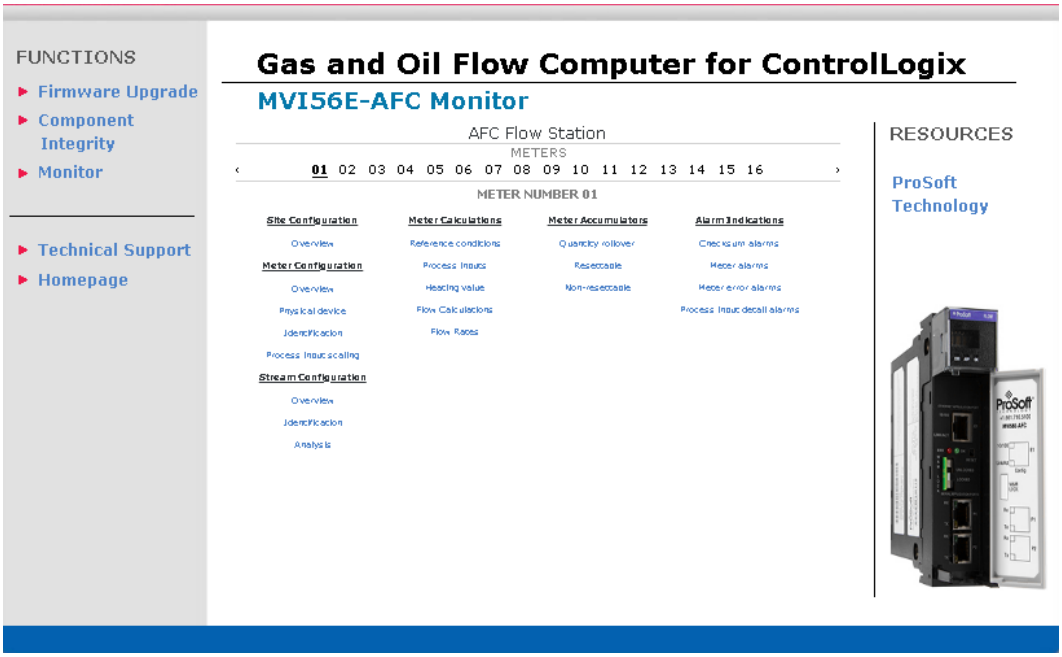
Information is viewable for each of the 16 available meters. Click on the appropriate meter for data that pertains to that meter.





If you hover or click over a meter, links appear under the appropriate headings.

Note: The following are examples for the MVI56E-AFC. However the functionality is the same for the MVI69-AFC. It is important to note that the MVI56E-AFC supports 16 meters, versus the MVI69E supports 12.

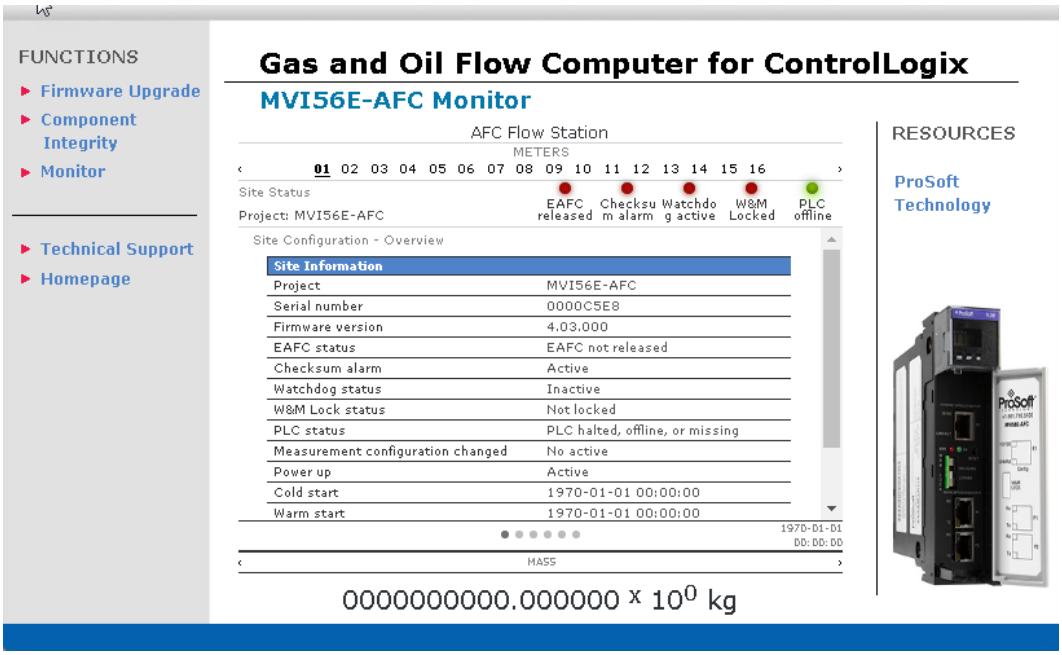


Click on any of the links under the appropriate heading.

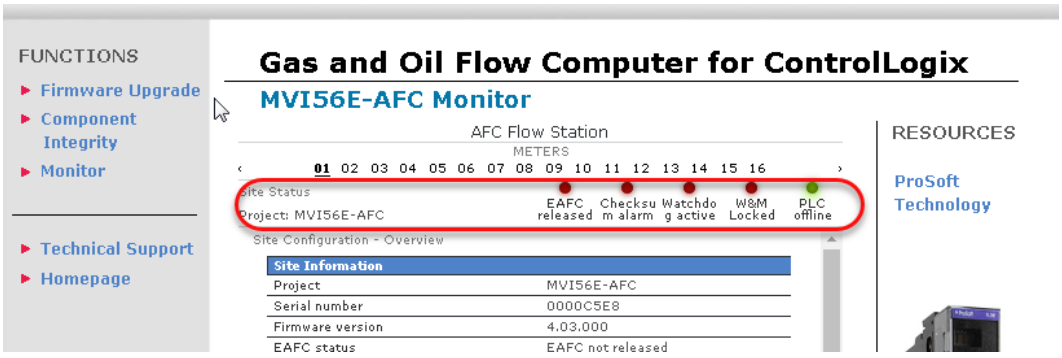
22.3.1 Site Configuration

Site Configuration Overview

Click on the **OVERVIEW** link to display the following information:



Site status LED indicators are displayed just under the meter selection links.



These alarms are displayed on the Site Header, Meter Header, and alarm indication sections.

Site Header LEDs

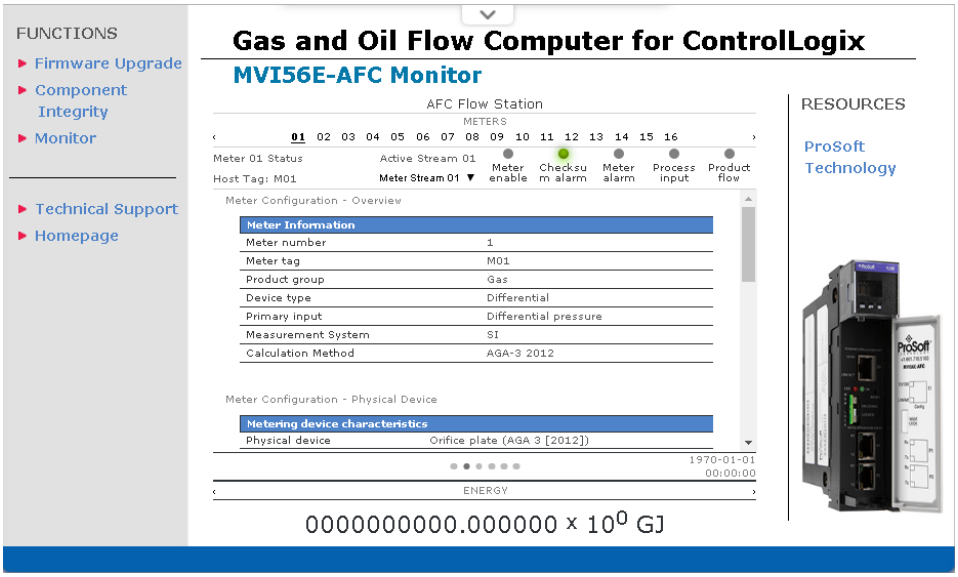
Site Header	Value	Text	LED Color
EAFC Released	False	EAFC released	Red
	True		Green
	Error		Black
Checksum Alarm	False	Checksum alarm	Green
	True		Red
	Error		Black
Watchdog Active	False	Watchdog inactive	Red
	True	Watchdog active	Green
	Error	Watchdog status	Black
W&M Lock	False	W&M unlocked	Red
	True	W&M locked	Green
	Error	W&M status	Black
PLC Offline	False	PLC online	Green
	True	PLC offline	Red
	Error	PLC status	Black

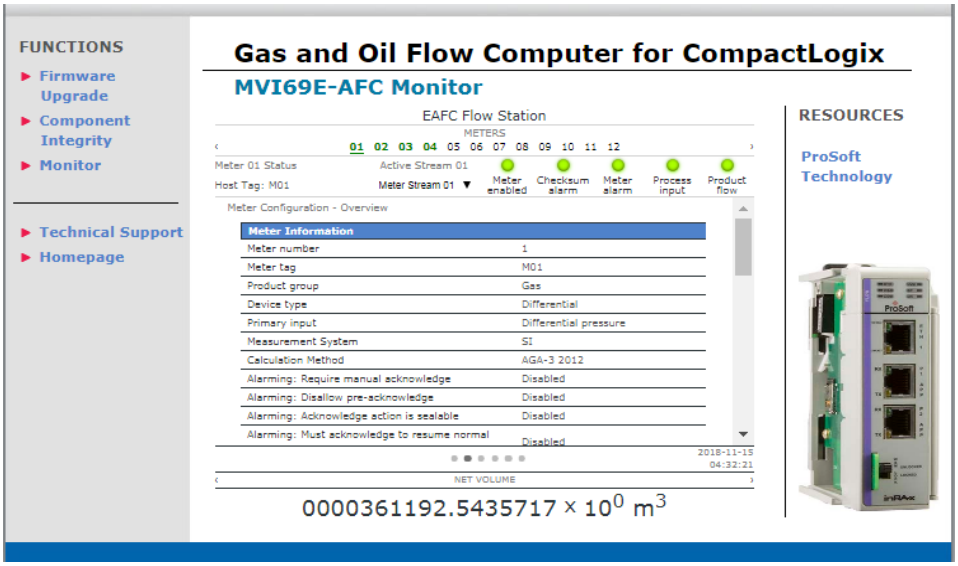
Site Information is located directly below the Site Status LEDs:

Parameter	Description
Project	Displays the current project name.
Serial Number	Displays the serial number of the device.
Firmware version	Displays the current firmware version on the module.
EAFC status	Displays the EAFC released status.
Checksum alarm	Displays active or inactive.
Watchdog status	Displays the watchdog status.
W&M Lock status	Displays the weights & measures lock switch status.
PLC Status	Indicates the module communications state with the PLC controller.
Measurement configuration changed	Indicates whether or not the measurement configuration has occurred for any meter.
Power Up	Indicates whether or not the most recent software reset was due to applying power to the module.
Cold Start	Display the timestamp of the most recent cold start.
Warm Start	Display the timestamp of the most recent warm start.
Accuracy class	C
Climatic and Mechanical class	I

22.3.2 Meter Configuration

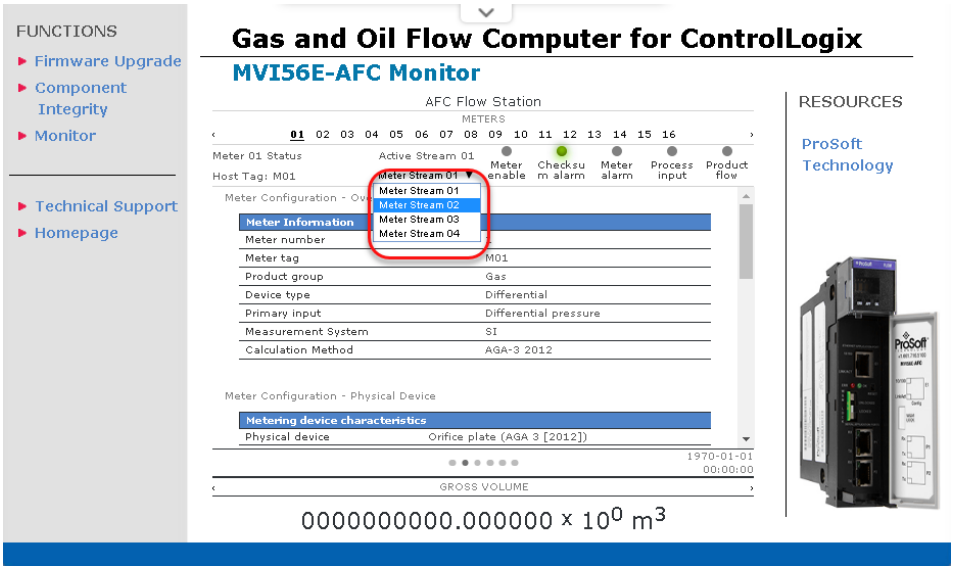
Below are examples of the current configuration.





Selecting Meter Streams

You can select specific streams per meter from any of the meter pages. Simply select the appropriate meter stream from the dropdown list as shown below:



Meter Configuration Links

Meter Configuration contains the following links:

- Overview
- Physical Device
- Identification
- Process Input Scaling

Overview

The Meter Configuration page displays the following information:

Meter Configuration - Overview

Meter Information	
Meter number	1
Meter tag	M01
Product group	Gas
Device type	Differential
Primary input	Differential pressure
Measurement System	SI
Calculation Method	AGA-3 2012

Physical Device

The Physical Device page displays the following information:

Meter Configuration - Physical Device

Metering device characteristics		
Physical device	Orifice plate (AGA 3 [2012])	
Orifice plate diameter	0 mm	
Orifice plate temperature	20 °C	293.1500 °K
Orifice plate material	0.0000167000 /°C	[Stainless Steel]
Meter tube diameter	0 mm	
Meter tube temperature	20 °C	293.1500 °K
Meter tube material	0.0000112000 /°C	[Carbon Steel]
Low flow threshold	0 kPa	

Identification

The Identification page displays the following data:

Meter Configuration - Identification

Meter nameplate information
Meter general type
Meter manufacturer
Meter model
Meter serial number
Meter size
Nominal K-factor

Process Input Scaling

The Process Input Scaling page displays the following data:

Meter Configuration - Process Input Scaling

Process Input	Transmitter Minimum	Transmitter Maximum	Calibration Low	Calibration High	Alarm Low Limit	Alarm High Limit
Diff press (kPa)	0	0	0	0	0	0
Temperature (°C)	15	15	15	15	15	15
Temperature (°K)	288.1500	288.1500	288.1500	288.1500	288.1500	288.1500
Pressure (kPag)	0	0	0	0	0	0
Pressure (barg)	1.0132	1.0132	1.0132	1.0132	1.0132	1.0132

22.3.3 Stream Configuration

Stream Configuration contains the following links:

- Overview
- Identification
- Analysis

Overview

Meter Stream Configuration - Overview

Meter stream 1 characteristics		
Meter active stream number	1	(Site stream number 1)
Meter displayed stream number	1	(Site stream number 1)
Isentropic exponent	1.3198	
Default relative density	0.60000002	
Default heating value	0 MJ/kg	
Default Fpv	1	
Viscosity	0.010268 centipoise	

Identification

Meter Stream Configuration - Identification

Meter stream 1 nameplate information
Product description

Analysis

Meter Stream Configuration - Analysis

Meter stream 1 component analysis					
C1	0.65691	CO	0	C8	0
N_2	0.00447	O_2	0	C9	0
CO_2	0.01164	i-C4	0.01228	C10	0
C2	0.16971999	n-C4	0.03156	He	0
C3	0.094679996	i-C5	0.0064900001	Ar	0
H_2O	0	n-C5	0.0068899998	neo-C5	
H_2S	0	C6	0.0053599998	U_x	
H_2	0	C7	0	U_y	

22.3.4 Meter Calculations

Meter Calculations provide the following data:

- Reference Conditions
- Process Inputs
- Heating value
- Flow Calculations
- Flow Rates

Reference Conditions

Meter Calculations - Reference conditions

Reference Conditions	
Reference temperature	15 °C
	288.1500 °K
Reference pressure	101.325 kPaa
	2.0265 barg
Barometric pressure	101.325 kPaa
	1.0132 bara

Process Inputs

Meter Calculations - Process Inputs

Process Input	Last Raw	Scaled Average
Differential pressure	0	0 kPa
Temperature	0	0 °C
		273.1500 °K
Pressure (downstream)	0	0 kPag
		1.0132 barg

Heating Value

Meter Calculations - Heating Value

Analysis Characterization - Heating Value	
Meter active stream number	1 (Site stream number 1)
Relative density calculation method	AGA-8 / ISO 12213
Relative density @ reference	0.60000002
Gas density @ reference	0.73524779
Default relative density @ reference	0.60000002
Heating value calculation method	AGA-8 / ISO 12213
Default heating value	0 MJ/kg
Molar heating value	0 MJ/kmol
Mass heating value	0 MJ/kg
Volumetric heating value	0 MJ/m^3
Wobbe index	0

Flow Calculations

Meter Calculations - Flow Calculations

Flow Calculations	
Meter active stream number	1 (Site stream number 1)
Temperature, absolute	0 °C
	273.1500 °K
Pressure, absolute	0 kPaa
	0.0000 bara
Compressibility @ reference	1
Molar density @ reference	0
Compressibility, flowing	0
Molar density, flowing	0
Supercompressibility	0
Extension	0
Beta ratio	0

Flow Rates

Meter Calculations - Flow Rates

Quantity	Flow Rate - Meter is currently disabled
Gross volume flow rate	-1 m^3/h
Net volume flow rate	-1 m^3/h
Energy flow rate	-1 GJ/h
Mass flow rate	-1 kg/h

22.3.5 Meter Accumulators

Meter Accumulators provide the following data:

- Quantity Rollover
- Resettable
- Non-Resettable

Quantity Rollover

Meter Accumulators - Rollover

Quantity Type	Accumulator Rollover
Volume	100000000 × 10^{0} m^3
Energy	100000000 × 10^{0} GJ
Mass	100000000 × 10^{0} kg

Resettable

Meter Accumulators - Resettable

Quantity	Accumulator	Reset Options
[1]Net Volume	0000000000.000000 × 10^{0} m^3	END OF DAY END OF HOUR UPON EVENT
[2]Gross Volume	0000000000.000000 × 10^{0} m^3	END OF DAY END OF HOUR UPON EVENT
[3]Gross Standard Volume		
[4]Mass	0000000000.000000 × 10^{0} kg	END OF DAY END OF HOUR UPON EVENT

Contract Period	Contract Period End	Time Remaining
Hour	1970-01-01 00:00:00	00:00:00
Day	1970-01-01 00:00:00	00:00:00

Non-Resettable

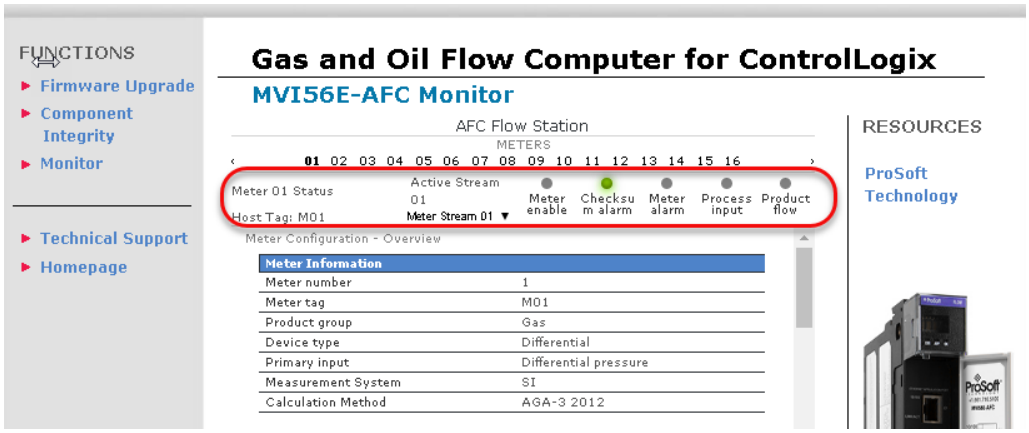
Meter Non-Resettable Accumulators

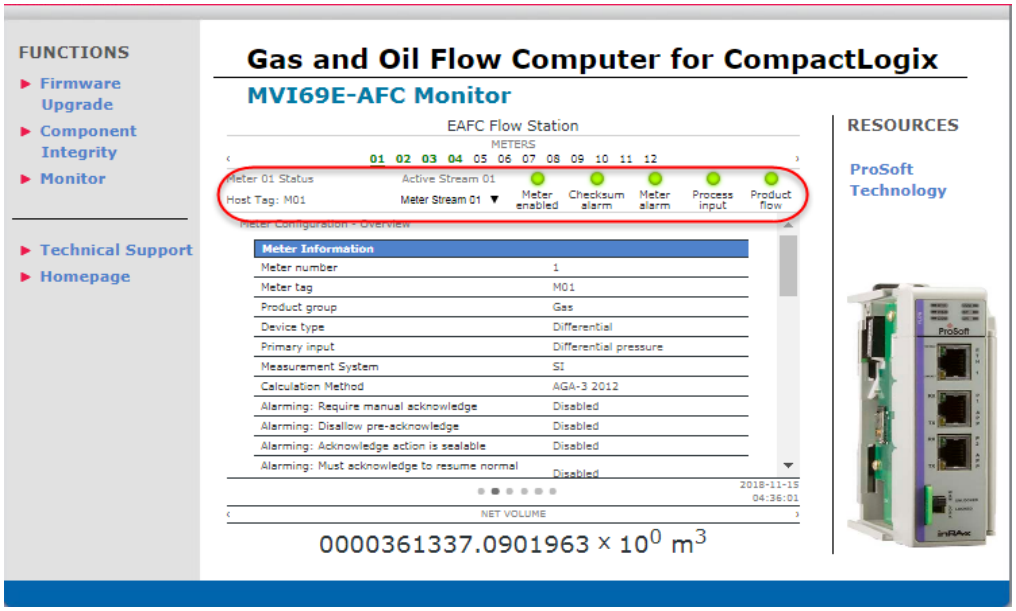
Quantity	Accumulator
	0000000000.000000 × 10^{0} m^3
Net Volume	0000000000.000000 × 10^{0} m^3
Energy	0000000000.000000 × 10^{0} GJ
Mass	0000000000.000000 × 10^{0} kg

Quantity	✗ (In Error) Alarm Accumulator
Gross Volume	0000000000.0000000 × 10^{0} m^3

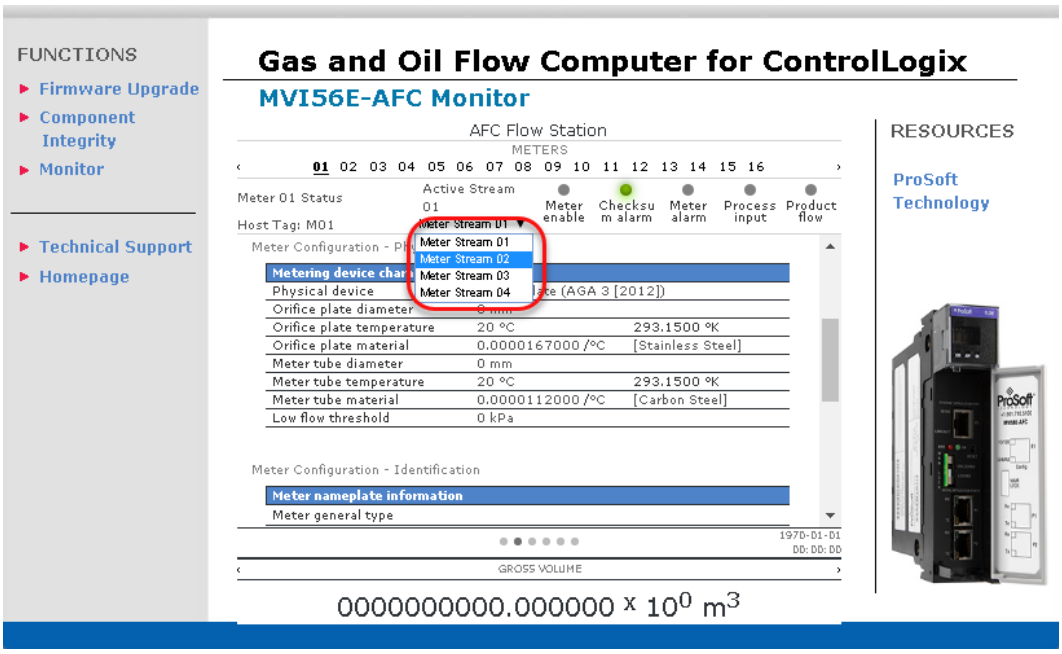
22.3.6 Meter Status

The meter status area provides alarm information for the selected meter and stream.





In this example, the Active Stream indicates the active stream for Meter 1. You can change the meter stream by selecting the requested stream from the Meter Stream dropdown.



Meter enable

Displays meter enable/disable state.

Checksum Alarms

Click to display details on the following:

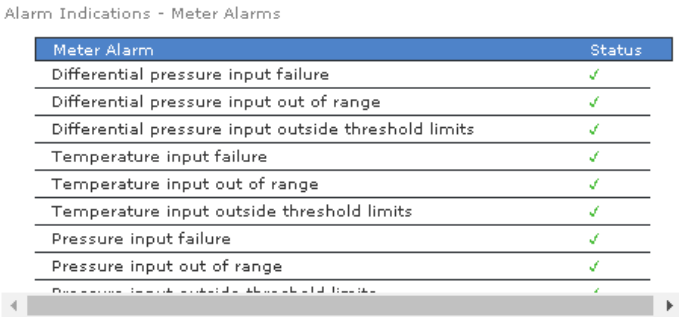
- Alarm Indicators – Checksum Alarms

Alarm Indications - Checksum Alarms

Checksum Alarm	Status
Meter configuration	✓
Meter accumulators	✓
Meter previous prove summary	✓
Meter user-specified archivables	✓
Meter archive accumulators	✓
Meter archive status	✓
Meter archive detail (daily)	✓
Meter archive detail (hourly)	✓

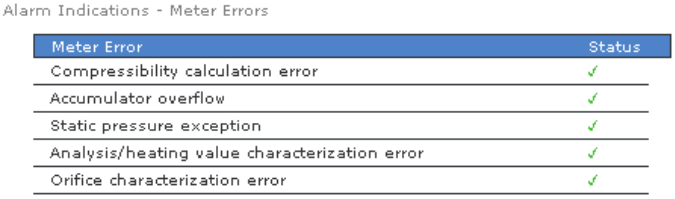
Meter alarm

- Alarm Indicators – Meter Alarms


Alarm Indications - Meter Alarms

Meter Alarm	Status
Differential pressure input failure	✓
Differential pressure input out of range	✓
Differential pressure input outside threshold limits	✓
Temperature input failure	✓
Temperature input out of range	✓
Temperature input outside threshold limits	✓
Pressure input failure	✓
Pressure input out of range	✓

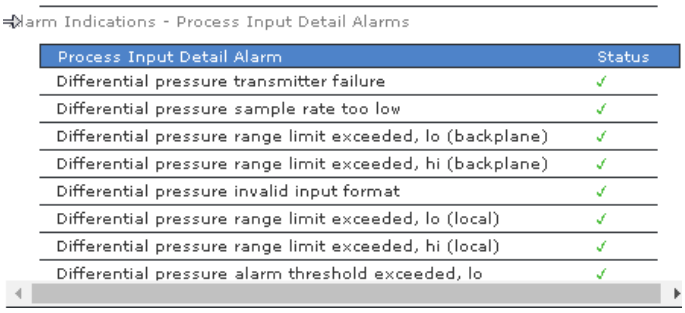
- Alarm Indicators – Meter Errors


Alarm Indications - Meter Errors

Meter Error	Status
Compressibility calculation error	✓
Accumulator overflow	✓
Static pressure exception	✓
Analysis/heating value characterization error	✓
Orifice characterization error	✓

Process Input

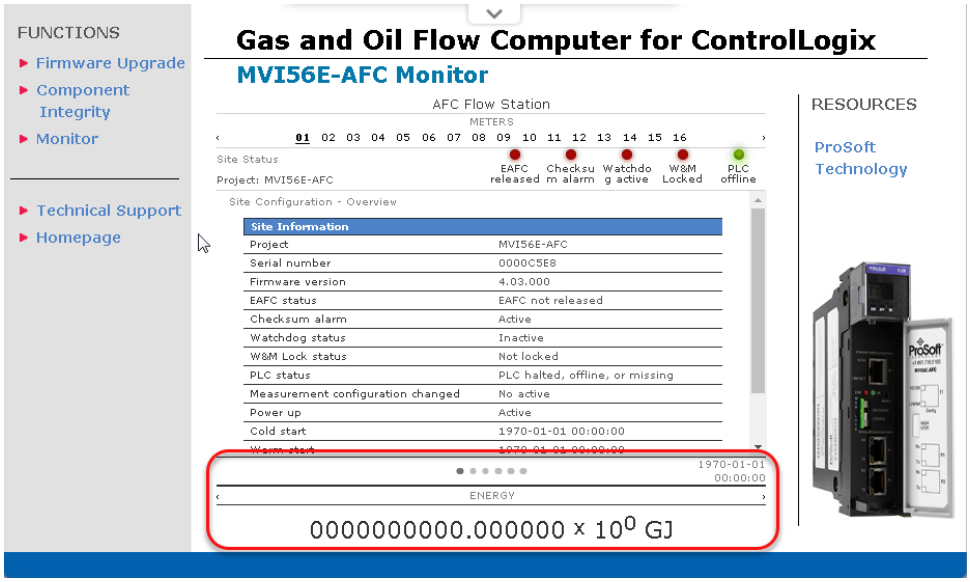
- Alarm Indicators – Process Input Detail Alarms


Alarm Indications - Process Input Detail Alarms

Process Input Detail Alarm	Status
Differential pressure transmitter failure	✓
Differential pressure sample rate too low	✓
Differential pressure range limit exceeded, lo (backplane)	✓
Differential pressure range limit exceeded, hi (backplane)	✓
Differential pressure invalid input format	✓
Differential pressure range limit exceeded, lo (local)	✓
Differential pressure range limit exceeded, hi (local)	✓
Differential pressure alarm threshold exceeded, lo	✓

22.3.7 Data Displays

In addition to the information provided above, the web page displays current data along the bottom of the page.



This information displayed automatically changes every few seconds and displays:

- Gross Volume
- Net Volume
- Energy
- Mass

23 What's Next?

Congratulations! Your module is now configured and running. There are a number of features and customizations that you can set up and use. The *AFC Reference Guide* contains a wealth of information that will help you get the most out of your module.

The *AFC Reference Guide* contains information on how to:

- Configure primary and virtual Modbus slave addresses
- Disable pass-thru mode
- Configure whitelist options
- Access data
- Read site configuration status
- Configure parameters common to all modules
- Use the Modbus Dictionary
- Configure archives
- Set up and view events
- Set up and view alarms
- Perform transmitter calibrations and view results
- Perform diagnostics and troubleshooting
- Perform meter proving

In addition, the *AFC Reference Guide* provides further information on:

- Modbus communication
- Modbus database information
- Modbus communication parameters
- Modbus transaction sequencing and constraints
- Product groups
- Calculation results
- Molar Analysis
- Measurement standards
- Metering according to meter type
- Enron Modbus Implementation
- Function Block Interface
- Cable connections

24 Support, Service and Warranty

24.1 Contacting Technical Support

ProSoft Technology, Inc. is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1. Product Version Number
2. System architecture
3. Network details

If the issue is hardware related, we will also need information regarding:

1. Module configuration and associated ladder files, if any
2. Module operation and any unusual behavior
3. Configuration/Debug status information
4. LED patterns
5. Details about the interfaced serial, Ethernet or Fieldbus devices

Note: *For technical support calls within the United States, ProSoft's 24/7 after-hours phone support is available for urgent plant-down issues.*

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For additional ProSoft Technology contacts in your area, please visit:
https://www.prosoft-technology.com/About-Us/Contact-Us.

24.2 Warranty Information

For complete details regarding ProSoft Technology's TERMS & CONDITIONS OF SALE, WARRANTY, SUPPORT, SERVICE AND RETURN MATERIAL AUTHORIZATION INSTRUCTIONS, please see the documents at:
www.prosoft-technology/legal