

Gas Flow Computer Library User Manual

Overview

The Beyond HMI Gas Flow Computer Library (BhiLibGasAGA3) for Wago e!COCKPIT provides natural gas flow computing features for Wago e!COCKPIT programs. The flow computer features conform to API 21.1 standards for electronic flow measurement. Data is transferred from the PLC using industry-standard CFX files. These files can be directly imported into hydrocarbon accounting systems.

Additionally, the library supports multi-access-level user authentication and authorization.

The library supports up to six AGA3 meters on up to six stations.

The BhiLibGasAGA3 library uses runtime licensing. A license is required for each PLC which executes the library code. The program will run for approximately 4 days in trial mode before a license is required. Licenses must be purchased from Beyond HMI, Inc.

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Configuring the Library

Configuration is usually performed via Codesys Visualizations included in the library. Your program's Visualizations must provide a link to the Gas Flow Computer Menu screen (see *Using BhiLibGasAGA3 in an e!COCKPIT Project* in this document for further details).

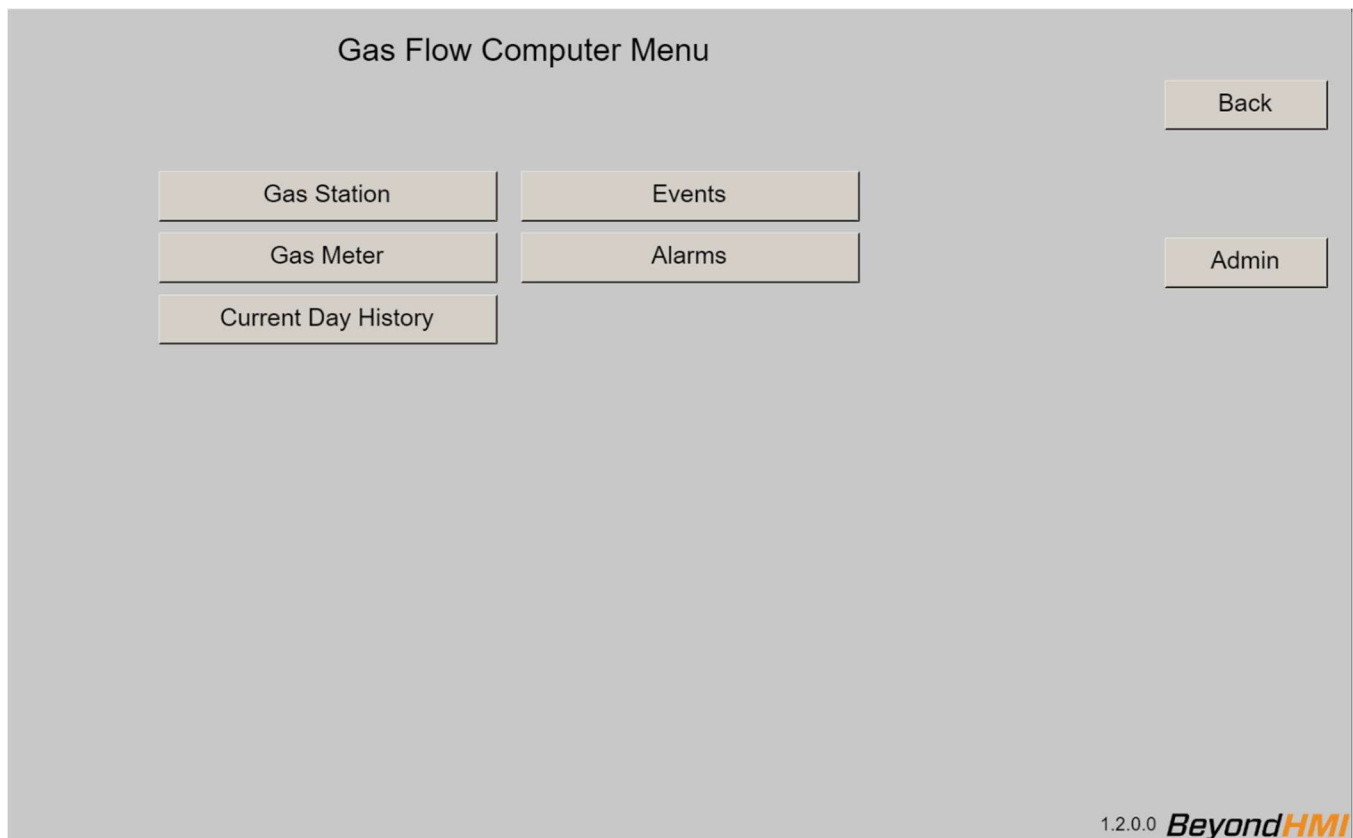
Formatting Note

The library allows input of two classes of parameters: parameters required for calculations and parameters captured for transmission to the hydrocarbon accounting system through .cfx files.

In the documentation sections below, parameters required for calculations are differentiated using an asterisk*. For the purposes of the library and its flow computer functions, entry of these parameters is mandatory. Parameters not marked with an asterisk* are not used by the library, but their values will be included in the .cfx files.

Main Menu

The main menu provides navigation to all of the features of the library.



Visualization Main Menu

Gas Stations

Calls the visualization for status and configuration of meter stations

Gas Meters

Calls the visualization for status and configuration of meters

Current Day History

Calls the visualization for reviewing periodic history for the current *day*. A *day* can contain up to 25 hours of data (during fall of the year when DST change occurs) or less – if a configuration change has been made.

Events

Calls the visualization for reviewing meter events

Alarms

Calls the visualization for reviewing meter alarms

Admin

Calls the visualization for viewing license status information and performing other administrative functions

Back

Returns to the visualization in your PLC program from which the gas flow computer memory was called

Station Screen - Values

Each meter must be assigned to a station. Stations house shared gas properties and contract conditions. If all of the meters are measuring the same gas (-i.e., only one sample is collected) and the same contract day and standard conditions, it may only be necessary to configure a single station.

The station screen contains several tabs. The **Values** tab displays live calculated results for the station. These values represent the accumulation of quantities from meters which are assigned to the station.

	Volume [MSCF/Day]	Energy [MMBTU/D]	Mass [M lb/Day]
Flow Rate	0.000	0.000	0.000
	[MSCF]	[MMBTU]	[M lb]
Current Hour	0.00	0.00	0.00
Last Hour	0.00	0.00	0.00
Today	2187.40	1916.16	123.94
Yesterday	7733.34	6774.41	438.18
Current Month	9920.7	8690.6	562.1
Previous Month	0.0	0.0	0.0
Total	9921	8691	562

Station Screen – Values Tab

Station Combo Box

This combo box is used to specify which station you wish to view.

Description Text Box

This text box is used to modify the common descriptive name of the currently-selected station.

Enabled

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

Volume

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Values in this column represent volumetric flow rates and accumulations. The screen displays the relevant units of measure.

Energy

Values in this column represent energy flow rates and accumulations. The screen displays the relevant units of measure.

Mass

Values in this column represent mass flow rates and accumulations. The screen displays the relevant units of measure.

Flow Rate

Values in this row represent instantaneous flow rates – as of the last successful calculation. The screen displays the relevant units of measure.

Current Hour

Values in this row represent the accumulated quantity for the current hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

Last Hour

Values in this row represent the accumulated quantity for the previous hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

Today

Values in this row represent the accumulated quantity for the current contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

Yesterday

Values in this row represent the accumulated quantity for the previous contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

Current Month

Values in this row represent the accumulated quantity for the current contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

Previous Month

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Values in this row represent the accumulated quantity for the previous contract month. The contract month changes on the first day of each calendar month - at the beginning of the configured contract hour. The screen displays the relevant units of measure.

Total

Values in this row represent the accumulated quantity for the lifetime of the flow computer installation. This value is not resettable by supported features. The screen displays the relevant units of measure.

Station Screen - Main

The station screen contains several tabs. The **Main** tab is used to adjust the main configuration parameters for the station.

Gas Meter Station Configuration

Station Gas Station 1 Description Gas Station 1 Enabled Back

Values Main Quality Diagnostic

Flow Computer ID FCID1111 Contract Hour 6 AM

Supercompressibility Standard AGA-8 GERG (2017)

Heating Value Basis dry Specific Gravity Basis dry

Atmospheric Pressure 14.4000 [psia] Gravitational Acceleration 0.0000 [Ft/sec²]

Contract Base Pressure 14.7300 [psia] Elevation 0.0 [Ft]

Contract Base Temperature 60.0000 [F] Latitude 0.0000 [degrees]

Power Source AC

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Station Screen – Main Tab

Station Combo Box*

This combo box is used to specify which station you wish to view/edit.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected station.

Enabled*

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

Flow Computer ID

Specify the Flow Computer ID to associate with this station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Contract Hour*

Specify the hour when the contract day changes. The contract day will change at the *beginning* of the configured hour.

Supercompressibility Standard

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The flow computer library only supports the AGA-8 GERG (2017) method.

Heating Value Basis

Specify the heating value basis – as provided on the gas sample analysis report. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Specific Gravity Basis

Specify the specific gravity (gas relative density) value basis – as provided on the gas sample analysis report. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Atmospheric Pressure*

Specify the atmospheric pressure to be used. If meters assigned to this station will use **Static Pressure Measurement Type** of *Absolute*, then this value will *not* be used by the flow computer library. If meters assigned to this station use **Static Pressure Measurement Type** of *Gauge*, then this value will be added to the live static pressure values before AGA-3 calculations are performed. In either case, this field is passed to FLOWCAL in the CFX file.

Contract Base Pressure*

Specify the contract base pressure. A common value for this quantity is 14.73.

Contract Base Temperature*

Specify the contract base temperature. A common value for this quantity is 60.0.

Power Source Combo Box

Use this combo box to specify the power source for the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Gravitational Acceleration

Specify the local acceleration of gravity for the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Elevation

Specify the elevation of the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Latitude

Specify the latitude of the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Station Screen - Quality

The station screen contains several tabs. The **Quality** tab is used to adjust the gas properties for the station.

Gas Meter Station Configuration

Station Gas Station 1 Description Gas Station 1 Enabled Back

Values | Main | **Quality** | Diagnostic

Sample Date 07 - 04 - 22 Sample Type spot

Heating Value 876.000 [BTU/Ft3] Specific Gravity 0.660000 Normalization Method adjust_methane

Composition		Adjustments	
% CO2	0.0000	% Octane (C8)	0.0000
% N2	0.0000	% Nonane (C9)	0.0000
% Methane (C1)	80.0000	% Decane (C10)	0.0000
% Ethane (C2)	9.0000	% Argon (Ar)	0.0000
% Propane (C3)	6.0000	% CO	0.0000
% iButane (iC4)	2.0000	% Hydrogen (H2)	0.0000
% nButane (nC4)	1.0000	% Oxygen (O2)	0.0000
% iPentane (iC5)	1.0000	% Helium (He)	0.0000
% nPentane (nC5)	1.0000	% Water (H2O)	0.0000
% Hexane (C6)	0.0000	% H2S	0.0000
% Heptane (C7)	0.0000	Total	100.0000

Heptanes+ (C6+) 0.0000

Apply 60% / 30% / 10% split

Normalize

Commit Needed
 Commit Changes

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Station Screen – Quality Tab

Station Combo Box*

This combo box is used to specify which station you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected station.

Enabled*

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

Sample Date

Use this control to specify the date on which the sample was captured. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Sample Type

Use this combo box to specify the sample type. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.


Heating Value*

Enter the heating value from the gas analysis report.

Specific Gravity*

Enter the gas specific gravity (relative density) from the gas analysis report.

Normalization Method

The functionality associated with this combo box is typically not used. If the gas compositional percentages add up to 100.0 percent, then normalization is not required. When gas compositions do not total to 100.0 percent, they can be normalized to 100 percent by specifying the normalization method here and selecting the  button.

The different normalization methods are described below.

- **adjust_methane**
The percentages of all other components will remain unchanged and the percentage of methane will be adjusted to cause the total to be 100.0 percent.
- **adjust_all**
The percentages of all of the components will be changed – proportionally – to bring the total to 100.0 percent.

to specify the sample type. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Normalize

The functionality associated with this button is typically not used. If the gas compositional percentages add up to 100.0 percent, then normalization is not required and pressing this button should have no impact. When gas compositions do not total to 100.0 percent, they can be normalized to 100 percent by specifying the **Normalization Method** and selecting this button.

Hexanes+ (C6+)

Typically, the gas analysis report will specify percentage for *Hexanes Plus* or *Hexanes+*. There are many regionally-accepted methods for dividing the *Hexanes Plus* percentage between Hexane, Heptane, and Nonane. The library provides this simple tool for performing a 60/30/10 split:

- Hexane % = 60% x *Hexanes Plus*%
- Heptane % = 30% x *Hexanes Plus*%
- Nonane % = 10% x *Hexanes Plus*%

To use this tool, enter the value from the analysis report into this box and check the **Apply 60% / 30% / 10% split** check box. The library will update the % **Hexane(C6)**, % **Heptane(C7)**, and % **Nonane(C8)** values and then uncheck the **Apply 60% / 30% / 10% split** check box.

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Note that this is just a utility feature. Its use is optional.

Apply 60% / 30% 10% split check box

See description of **Hexanes+ (C6+)**. Note that this is just a utility feature. Its use is optional.

Commit Needed check box

This read-only checkbox indicates that changes to the gas quality or standard conditions have been made and a Commit is necessary.

Commit Changes check box

When you have completed changes to the gas composition and the station base conditions, check this box to cause the library to begin using the new values. The library will uncheck this box and the **Commit Needed** checkbox when the commit is completed.

Note: committing changes is critical to accurate measurement. With other parameters in the visualizations, the new value of the parameter is used by the program immediately after a change. But with station gas properties and station base conditions, you must make changes and then Commit them as a set of changes.

Station Screen - Diagnostic

The station screen contains several tabs. The **Diagnostic** tab displays live diagnostic and internal calculation values from the library.

Gas Meter Station Configuration

Station Description Enabled

Values | Main | Quality | Diagnostic

@ 14.73 psia, 60 degrees F

Standard Density	<input type="text" value="0.0566610"/>	[lbm/CF]
Standard Z Factor	<input type="text" value="0.9962845"/>	
Gas Relative Density	<input type="text" value="0.7403875"/>	From Composition

@ Contract base conditions

Base Density	<input type="text" value="0.0566610"/>	[lbm/CF]
Base Z Factor	<input type="text" value="0.9962845"/>	

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Station Screen – Quality Tab

Station Combo Box*

This combo box is used to specify which station you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected station.

Enabled*

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

Standard Density

Displays the library-calculated density of the gas at *standard conditions* (14.73 psia, 60 degrees F).

Standard Z Factor

Displays the library-calculated Z factor of the gas at *standard conditions* (14.73 psia, 60 degrees F).

Gas Relative Density

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Displays the library-calculated gas gravity (relative density) of the gas at *standard conditions* (14.73 psia, 60 degrees F). This is calculated using gas compositional information. It may be different from the gas gravity you enter on the Station **Quality** tab.

Base Density

Displays the library-calculated density of the gas at the contract base temperature and pressure specified on the Station **Quality** tab.


Base Z Factor

Displays the library-calculated Z factor of the gas at the contract base temperature and pressure specified on the Station **Quality** tab.

Gas Meter Screen - Values

The gas meters screen contains several tabs. The **Values** tab displays live calculated results for the meter.

Gas Meter Configuration

Meter: Gas Meter 1 | Description: Gas Meter 1 | Enabled |  Back

Values | Main | Advanced | Ranges | Diagnostic | Cal Rpt Params | Calibration

	Volume [MSCF/Day]	Energy [MMBTU/Day]	Mass [M lb/Day]	Flow Seconds			
Flow Rate	3151.637	2760.834	178.575				
Current Hour	0.34	0.30	0.02	9			
Last Hour	0.00	0.00	0.00	0			
Today	0.3	0.3	0.0	9			
Yesterday	2187.4	1916.2	123.9	14588			
Current Month	9921	8691	562	66171			
Previous Month	0	0	0	0			
Total	9921	8691	562	66171			
Sp	155.70	Dp	23.40	Temperature	89.10	Pulses	0

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Gas Meter Screen – Values Tab

Meter Combo Box*

This combo box is used to specify which meter you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected meter.

Enabled*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

Volume

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Values in this column represent volumetric flow rates and accumulations. The screen displays the relevant units of measure.

Energy

Values in this column represent energy flow rates and accumulations. The screen displays the relevant units of measure.

Mass

Values in this column represent mass flow rates and accumulations. The screen displays the relevant units of measure.

Flow Rate

Values in this row represent instantaneous flow rate – as of the last successful calculation. The screen displays the relevant units of measure.

Current Hour

Values in this row represent the accumulated quantity for the current hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

Last Hour

Values in this row represent the accumulated quantity for the previous hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

Today

Values in this row represent the accumulated quantity for the current contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

Yesterday

Values in this row represent the accumulated quantity for the previous contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

Current Month

Values in this row represent the accumulated quantity for the current contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

Previous Month

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Values in this row represent the accumulated quantity for the previous contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

Total

Values in this row represent the accumulated quantity for the lifetime of the flow computer installation. This value is not resettable by supported features. The screen displays the relevant units of measure.

Sp

Displays the live static pressure being used by the library for gas flow calculations. If the static pressure is measured in psig, this value will reflect meter measured pressure plus station atmospheric pressure. The screen displays the relevant units of measure.

Dp

Displays the live differential pressure being used by the library for gas flow calculations. The screen displays the relevant units of measure.

Temperature

Displays the live temperature being used by the library for gas flow calculations. The screen displays the relevant units of measure.

Pulses

Displays the live accumulated pulse quantity used by the library for gas flow calculations. This value is only appropriate for linear meters. The current release of the library only supports orifice meters.

Gas Meter Screen - Main

The gas meters screen contains several tabs. The **Main** tab is used to configure most of the important meter parameters.

The screenshot displays the 'Gas Meter Configuration' interface. At the top, there's a title bar with 'Gas Meter Configuration'. Below it, a 'Meter' dropdown is set to 'Gas Meter 1', and a 'Description' text box contains 'Gas Meter 1'. To the right, there's an 'Enabled' checkbox which is checked, and a green status indicator. A 'Back' button is also present. Below these are several tabs: 'Values', 'Main', 'Advanced', 'Ranges', 'Diagnostic', 'Cal Rpt Params', and 'Calibration'. The 'Main' tab is selected. Under the 'Main' tab, there are fields for 'Meter Serial Nbr' (GASMETER1) and 'Station' (Gas Station 1). Below this is a 'Meter Type' section with 'Meter Type Orifice' selected, 'Static Pressure Measurement Type' set to 'absolute', 'Tap Type' set to 'Flange', 'Fitting Type' set to 'senior', and 'Static Pressure Tap Location' set to 'upstream'. The 'Meter Size' section includes 'Diameter [inch]' with 'Pipe' at 6.0000 and 'Orifice' at 3.0000, 'Material' with 'carbon_steel' and 'monel' options, and 'Reference Temperature [Deg F]' set to 68.0. The 'Meter Misc' section has several checkboxes: 'Meter Has RTD', 'RTD is In Use', 'Meter Temperature is Live', 'Meter is Pressure Compensated', and 'Meter is Temperature Compensated'. The BeyondHMI logo is in the bottom right corner.

Gas Meter Screen – Main Tab

Meter Combo Box*

This combo box is used to specify which meter you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected meter.

Enabled*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

Meter Serial Number*

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Use this field to specify the meter serial number. Meter serial numbers must be unique at each installation. Each meter on the PLC must have a unique serial number.

*Note: CFX files for the different meters are organized on the PLC file system by meter serial number. Therefore, it is important to configure this parameter correctly and – more importantly – to avoid changing it unless absolutely necessary. **Meter serial numbers should not contain spaces.***

First Delivery Date

Specify the first date of gas delivery through this meter. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Station Combo Box*

This combo box is used to specify the station to which the meter belongs. Each meter must be assigned to a meter.

Meter Type*

This version of the library only supports orifice meters.

Tap Type*

Applies to Orifice meters. The library only supports Flange taps.

Fitting Type

Specify the type of orifice fitting. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Static Pressure Measurement Type*

Specify whether static pressure values are reported to the library in **absolute** or **gauge** pressure. If the **gauge** option is selected, the library will add the associated station's **atmospheric pressure** to the static pressure values before performing calculations.

*Note: This value defaults to **gauge** for all meters. However, most modern multi-variable sensors report **absolute** pressure. Be sure to configure this parameter correctly.*

Static Pressure Tap Location*

This version of the library only supports static pressure measured at the upstream tap.

Pipe Diameter*

Specify the inside diameter of the meter tube. The screen displays the relevant units of measure.

Pipe Material*

Specify the type of material from which the meter tube was fabricated.

Pipe Reference Temperature*

Specify the reference temperature at which the meter tube measurement was made. The screen displays the relevant units of measure.

Orifice Diameter*

Specify the inside diameter of the orifice plate. The screen displays the relevant units of measure.

Plate Material*

Specify the type of material from which the orifice plate was fabricated.

Plate Reference Temperature*

Specify the reference temperature at which the orifice plate measurement was made. The screen displays the relevant units of measure.

Meter Has RTD check box

Indicates whether the meter is equipped with an RTD (usually true). This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

RTD in use

Indicates whether the meter RTD is being used to supply temperature values (usually true). This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Temperature is Live

Indicates whether the temperature values are live (usually true). It is not used by the flow computer library.

Meter is Pressure Compensated

Indicate whether the meter is pressure compensated. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

Meter is Temperature Compensated

Indicate whether the meter is temperature compensated. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

Gas Meter Screen - Advanced

The gas meters screen contains several tabs. The **Advanced** tab is used to configure additional meter parameters.

The screenshot shows the 'Gas Meter Configuration' screen with the 'Advanced' tab selected. At the top, there is a 'Meter' dropdown menu set to 'Gas Meter 1', a 'Description' text box containing 'Gas Meter 1', an 'Enabled' checkbox which is checked, and a green circular status indicator. Below this are several tabs: 'Values', 'Main', 'Advanced' (selected), 'Ranges', 'Diagnostic', 'Cal Rpt Params', and 'Calibration'. The main content area is divided into four sections:

- Meter Type:** Meter Factor (1.0000), K-Factor (1.0000), and Pulses_per_actual_Ft3 (dropdown menu).
- Gas:** Viscosity (0.00000689 [lbm/ft-sec]) and Ratio of Specific Heats (1.3).
- Setpoints:** Low Flow Cutoff Setpoint (0.10 [inch H2O]) and Backflow Cutoff Setpoint (0.00 [inch H2O]).
- Gas (continued):** [Linear Meters Only]: Input Pulse Count Rolls Over at (0), Max Data Retention (35 [Days]), and Force Day Rollover (checkbox).

The BeyondHMI logo is visible in the bottom right corner of the screenshot.

Gas Meter Screen – Advanced Tab

Meter Combo Box*

This combo box is used to specify which meter you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected meter.

Enabled*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

Meter Factor

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Indicate the meter factor derived from meter proving. Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

K-Factor

Indicate the factor used to convert linear meter pulses to velocity units. Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

K-Factor Units

Indicate the units of measure represented by the K-factor. Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

Low Flow Cutoff Setpoint*

Indicate the cutoff point to trigger no flow override. For orifice meters, this value pertains to differential pressure. If the differential pressure is below this value, then the meter is considered to be in *no flow* condition and the library will not accumulate volume, energy, or mass while the condition persists.

Backflow Cutoff Setpoint

Indicate the cutoff point to indicate backflow. The screen displays the relevant units of measure. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

Viscosity*

Indicate the gas viscosity to use in calculations. If this value is left at 0.0 for an enabled meter, the library will default it to 0.0000069. The screen displays the relevant units of measure.

Ratio of Specific Heats*

Indicate the ratio of specific heats for the gas to use in calculations. If this value is left at 0.0 for an enabled meter, the library will default it to 1.3.

Input Pulse Count Rolls Over At

Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

Max Data Retention*

Indicate the number of days of data to save in the PLC file system. If this value is left less than 35 days for an enabled meter, the library will change it to 35. The value can be set larger than 35 days.

Force Day Rollover

Check this box to trigger an immediate “rollover” of data for the current day into a CFX file. Should be used sparingly.

Gas Meter Screen - Ranges

The gas meters screen contains several tabs. The **Ranges** tab is used configure parameters related to sensor ranges and alarm levels.

The screenshot shows the 'Gas Meter Configuration' interface. At the top, there is a 'Meter' dropdown menu set to 'Gas Meter 1', a 'Description' text box containing 'Gas Meter 1', an 'Enabled' checkbox which is checked, and a green status indicator. Below this is a navigation bar with tabs: Values, Main, Advanced, Ranges (selected), Diagnostic, Cal Rpt Params, and Calibration. The main content area is divided into two sections: 'Ranges' and 'Alarms'. Each section contains a table with 'Low' and 'High' columns and units.

Ranges	
	Low High
DP Calibration	0.0000 0.0 [inch]
DP Xducer	0.0000 0.0 [inch]
SP Calibration	0.0000 0.0 [psia]
SP Xducer	0.0000 0.0 [psia]
Temperature Calibration	0.0000 0.0 [DegF]
Temperature Xducer	0.0000 0.0 [DegF]

Alarms	
	Low High
DP	0.0000 0.0 [inch]
SP	0.0000 0.0 [psi]
Temperature	0.0000 0.0 [F]

Gas Meter Screen – Ranges Tab

Meter Combo Box*

This combo box is used to specify which meter you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected meter.

Enabled*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

DP Calibrated Range

Enter the low and high ranges for calibration of the meter's differential pressure signal - if applicable. Applies to orifice and cone meters. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

DP Xducer Range

Enter the low and high ranges for absolute ranges of the meter's differential pressure sensor - if applicable. Applies to orifice and cone meters. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

SP Calibrated Range

Enter the low and high ranges for calibration of the meter's static pressure signal – if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

SP Xducer Range

Enter the low and high ranges for absolute ranges of the meter's static pressure sensor - if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Temperature Calibrated Range

Enter the low and high ranges for calibration of the meter's temperature signal – if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

Temperature Xducer Range

Enter the low and high ranges for absolute ranges of the meter's temperature sensor - if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

DP Alarm*

Enter the low and high alarm levels for the differential pressure signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs.

SP Alarm*

Enter the low and high alarm levels for the static pressure signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs. The static pressure alarm uses the calculation static pressure [in psia] as the basis for triggering alarms. If the meter's **Static Pressure Measurement Type** is set to **gauge**, then the static pressure alarm logic will reference the static pressure value provided by the PLC program *plus* atmospheric pressure.

Temperature Alarm*

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Enter the low and high alarm levels for the temperature signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs.

Gas Meter Screen - Diagnostic

The gas meters screen contains several tabs. The **Diagnostic** tab displays live diagnostic and internal calculation values from the library.

Gas	
Static Pressure	155.70 [psia]
Flowing Density	0.5843709 [lbm/CF]
Flowing Z Factor	0.9669461

Gas	
Reynolds Number	762678
Cd	0.603597
Ev	1.032801
Y1	0.998441
Fpv	1.015057
C Prime	52.213638

Errors	
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR

Gas Meter Screen – Diagnostic Tab

Meter Combo Box*

This combo box is used to specify which meter you wish to view.

Description Text Box*

This text box is used to modify the common descriptive name of the currently-selected meter.

Enabled*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

Static Pressure

Displays the static pressure value being used by the library for gas flow calculations.

Flowing Density

Displays the library-calculated density of the gas at flowing temperature and pressure.

Flowing Z Factor

Displays the library-calculated Z factor of the gas at flowing temperature and pressure.

Orifice Diameter

Displays the library-calculated, temperature corrected orifice size.

Pipe Diameter

Displays the library-calculated, temperature corrected meter tube size.

Beta Ratio

Displays the library-calculated beta ratio - using temperature corrected orifice and pipe sizes.

Reynolds Number

Displays the library-calculated Reynolds number for the instantaneous meter flow.

Cd Number

Displays the library-calculated Coefficient of Discharge (C_d) for the instantaneous meter flow.

Ev Number

Displays the library-calculated Velocity of Approach Factor (E_v) for the meter flow.

Y1 Number

Displays the library-calculated Expansion Factor (Y_1) for the meter flow.

Fpv

Displays the library-calculated Supercompressibility Factor (F_{pv}) for the flowing gas. This value is not used by the library's AGA-3 (2013) calculation, but it is a common factor used in other AGA-3 calculations.

C Prime

Displays the library-calculated CPrime from an orifice flow calculation. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library's AGA-3 (2013) calculation.

Error Codes and Messages

BeyondHMI

The library reports up to five Errors/Warnings for each meter. If more than five Errors/Warnings exist, only five will be displayed. Each Error/Warning is represented by a code number and a short text message. The table below provides further details for each Error/Warning. Note that Errors must be corrected before calculations can resume for the meter, whereas Warnings are only for informational purposes.

Code	Text	Error or Warning	Description and Suggestions
0	NO ERROR		Meter is functioning without errors or warnings
1	W:BAD COMPN %	Warning	The gas compositional information for the associated station does not sum to 100%. Correct the station gas composition information or normalize the composition percentages, then commit changes to the station's gas composition.
2	W:STAT PRS GAGE	Warning	The meter's Static Pressure Measurement Type is set to gauge . Modify this configuration parameter if it is not correct. Most modern multivariable sensors report static pressure in psia
3	BAD HEAT VALUE	Warning	The gas heating value for the associated station is out of normal range. Correct this value in the station configuration.
1002	BAD ORIFICE SIZ	Error	The orifice size parameter has an unrealistic value. Correct the orifice size parameter for the meter.
1003	BAD PIPE SIZE	Error	The pipe size parameter has an unrealistic value. Correct the orifice size parameter for the meter.
1004	BAD LIVE TMPR	Error	The live temperature value is unrealistic.
1005	LOW CALCd Re	Error	The calculated Reynolds number is too low for AGA-3 calculations. This is caused by a combination of very low flow and the meter's Low Flow Cutoff Setpoint being set too low. When this error is displayed, the meter will not measure flow or accumulate volume (it is basically in "no flow override" mode). When flow goes above the critical level, the meter will start measuring flow again and this error will disappear.
1006	BAD ORF REF T	Error	The meter's Plate Reference Temperature value is unrealistic
1007	BAD PIPE REF T	Error	The meter's Pipe Reference Temperature value is unrealistic
1008	BAD MTR TYP	Error	The meter type parameter is wrong. This error should not be observed with this version of the library. Contact Beyond HMI, Inc. for help if this error is seen.
1009	INVALID STATN	Error	The meter is assigned to an invalid station number. Correct the meter's configuration so that its Station parameter is realistic.
1010	STATN DISABLED	Error	The station to which this meter is assigned is disabled. Enable the station or disable the meter.
1012	BAD BETA RATIO	Error	The calculated Beta ratio is unrealistic. It is unlikely that this error will ever be displayed. More likely, you will see either error 1002 or 1003 – or both.

1013	DENSITY FN ERR	Error	This indicates an internal error in the AGA-8 calculation code. Contact Beyond HMI, Inc. for help if this error is seen.
1014	BAD RE INPUTS	Error	The meter's viscosity parameter might be set to a number very close to zero. If the viscosity is set to exactly 0.0(repeating zeros) then the library will default the viscosity to a realistic value. If this message is displayed, check the meter's viscosity parameter.
1016	QUALITY COMMIT	Error	Changes have been made to critical gas property information on the associated station but those changes have not been committed. Go to the associated station's Quality configuration tab and trigger a Commit. The program should perform an automatic commit after about 5 minutes. This may result in a different error, so it is best to reconcile this error manually
1017	SERNBR 2 SHORT	Error	The meter's serial number is too short (or may not have been configured). The Meter Serial Number parameter for the meter must be at least 4 characters in length. Meter serial numbers are used to organize .cfx files in the PLC file system. It is important to use a correct (and unique) serial number for each meter.
1018	BAD BASE PRS	Error	The base pressure parameter on the associated station is unrealistic. Correct the base pressure parameter in the station configuration.
1019	BAD BASE TMPR	Error	The base temperature parameter on the associated station is unrealistic. Correct the base temperature parameter in the station configuration.
1020	MTR SN DUPLICT	Error	The meter Serial Number for this meter is the same as at least one other meter. Meter serial numbers must be unique – on any specific PLC.

No Flow Indicated

Error Codes and Messages

0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR

No Flow Indicated

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When the input value for the meter is below no flow cutoff threshold, this text will appear – as a warning/notification. Volume does not accumulate and input value averaging is suppressed during *no flow*.

Gas Meter Screen – Cal Rpt Params

The gas meters screen contains several tabs. The **Cal Rpt Params** tab displays a set of static parameters which will be saved with a calibration or verification report. These fields are for documentation purposes only. They are not used for library calculations or CFX reporting. They are only used when a calibration or verification report is committed to memory.

Entry of these values is optional. However, if you wish to configure these values for a calibration report, you must Commit the changes using the checkbox described below. If changes are not Committed, they will be lost when the PLC loses power.

The screenshot shows the 'Gas Meter Configuration' window with the 'Cal Rpt Params' tab selected. At the top, there is a 'Meter' dropdown menu set to 'Gas Meter 1', a 'Description' field containing 'Gas Meter 1', an 'Enabled' checkbox which is checked, and a green status indicator. A 'Back' button is located to the right. Below this is a tabbed interface with 'Cal Rpt Params' highlighted. The main area is titled 'Meter Calibration Parameters' and contains several text input fields: 'Producer Name', 'Purchaser Name', 'Lease Name', 'Well / Facility Name', 'Well / Facility Number', 'DP Transducer Make/Model', 'SP Transducer Make/Model', and 'Tmptr Transducer Make/Model'. At the bottom of this section are two checkboxes: 'Commit Changes' and 'Cancel / Refresh', both of which are currently unchecked. The 'BeyondHMI' logo is visible in the bottom right corner of the window.

Gas Meter Screen – Cal Rpt Params Tab

Commit Changes

After making changes on this screen, check this box to signal the library to save your changes to persistent memory. ***If changes are not committed, they will be lost when the PLC is power-cycled.*** When the library has finished saving the changes, this box will be un-checked.

Cancel / Refresh

If you wish to cancel changes that you have made, check this box to signal the library to reload values from persistent memory. When the library has finished reloading the screen, this box will be un-checked.

Gas Meter Screen - Calibration

The gas meters screen contains several tabs. The **Calibration** tab is used to initiate a calibration or a verification of one of the analog input signals.

By default, all input signals are directly translated to process variables. If calibration is performed in the sensor and a digital interface is used to obtain values from the sensor, it is not necessary to calibrate signals in the BHI library. If calibration is performed in the BHI library, a transfer function will be applied to that signal until another calibration is performed on that signal.

The screenshot displays the 'Gas Meter Configuration' interface. At the top, the 'Meter' dropdown is set to 'Gas Meter 1', and the 'Description' is 'Gas Meter 1'. A green checkmark indicates the meter is 'Enabled', and a green circle is visible. A 'Back' button is in the top right. Below this is a navigation bar with tabs: 'Values', 'Main', 'Advanced', 'Ranges', 'Diagnostic', 'Cal Rpt Params', and 'Calibration'. The 'Calibration' tab is selected. The main area is titled 'Sensor Verification and Calibration' and contains a 'Freeze Values' checkbox. Below this are three columns, each representing a different sensor type: 'Differential Pressure', 'Differential Pressure', and 'Differential Pressure'. Each column has a 'Frozen' value displayed in a black box: 'Frozen Dp' (23.40), 'Frozen Static' (155.70), and 'Frozen Temperature' (89.10). Below each value are 'Verify' and 'Calibrate' buttons. The 'BeyondHMI' logo is in the bottom right corner.

Gas Meter Screen – Calibration Tab

Freeze Values Checkbox*

Before calibrating or verifying, check this box to freeze all input signals. After calibration/verification, uncheck this box so the library uses live input values for flow calculations.

Frozen Dp

This text box displays the frozen differential pressure value being used by the flow calculations.

Frozen Static

This text box displays the frozen static pressure value being used by the flow calculations.

Frozen Tmpr

This text box displays the frozen temperature value being used by the flow calculations.

Verify Dp Button

Use this button to initiate a verification of the differential pressure signal.

Verify Static Button

Use this button to initiate a verification of the static pressure signal.

Verify Tmpr Button

Use this button to initiate a verification of the temperature signal.

Calibrate Dp Button

Use this button to initiate a calibration of the differential pressure signal.

Calibrate Static Button

Use this button to initiate a calibration of the static pressure signal.

Calibrate Tmpr Button

Use this button to initiate a calibration of the temperature signal.

Meter Verification Screen

The **Meter Verification** screen is displayed after you select one of the **Verify...** buttons from the **Calibration Tab** of the **Meter** screen. The screen supports up to 6 verification points.

Meter signals should be set to the Frozen state before performing verifications.

The screenshot shows the 'Meter Verification' screen. At the top, there is a table with 6 rows and 5 columns: Action, Actual, Expected, Deviation, and Deviation %. All values in the table are 0.00. Below the table, there are input fields for 'Normal Value' (0.00), 'Tester Value' (0.00), 'Live Reading' (0.00), and 'Deviation' (0.00, 0.000 [%]). A red warning message 'Meter Values Not Frozen' is displayed. At the bottom, there are three buttons: 'Log Verify', 'Complete Verification', and 'Cancel Verification'.

Action	Actual	Expected	Deviation	Deviation %
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00

Normal Value: 0.00

Tester Value: 0.00

Live Reading: 0.00

Deviation: 0.00, 0.000 [%]

Meter Values Not Frozen

Log Verify | Complete Verification | Cancel Verification

Meter Verification Screen

Normal Value

This is a “memo only” field for BLM calibration/verification reports. It is not used by the library – except to display on the verification report.

Tester Value*

Enter the reference value being applied to the signal.

Log Verify Button*

Use this button to signal that the verification point is ready to be saved for the verification report.

Complete Verification Button*

Use this button to signal that you have logged all verification points and you are ready to commit the verification to the database.

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You must proceed through the Completion process to get the verification points saved to persistent memory – where they will be available for generating a verification report.

Cancel Verification Button

Use this button to cancel a verification.

If you cancel a verification, all data related to that verification will be lost.

Meter Values Not Frozen message

This message will appear if you have not frozen the meter signals prior to attempting a verification. If you see this message, cancel the verification, freeze meter signals, and restart the verification process.

Meter Serial Number Not Set message

This message will appear if you have not configured the meter serial number on the meter screen – main tab. If you see this message, cancel the verification, properly configure the meter, and restart the verification process.

Meter Calibration Screen

The **Meter Calibration** screen is displayed after you select one of the **Calibrate...** buttons from the **Calibration Tab** of the **Meter** screen. The screen supports up to 6 verification points.

Meter signals should be set to the Frozen state before performing calibrations.

Meter Verification

	Action	Actual	Expected	Deviation	Deviation %
1		0.00	0.00	0.00	0.00
2		0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	0.00
4		0.00	0.00	0.00	0.00
5		0.00	0.00	0.00	0.00
6		0.00	0.00	0.00	0.00

Normal Value **0.00**

Tester Value **0.00**

Live Reading **0.00**

Deviation **0.00** **0.000** [%]

Meter Values Not Frozen

BeyondHMI

Meter Calibration Screen

Normal Value

This is a “memo only” field for BLM calibration/verification reports. It is not used by the library – except to display on the calibration report.

Tester Value*

Enter the reference value being applied to the signal.

Set Zero Button*

Use this button to signal that the current live reading and tester values are to be used as the low range calibration point.

Set Span Button*

Use this button to signal that the current live reading and tester values are to be used as the high range calibration point.

Set Mid Button*

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Use this button to signal that the current live reading and tester values are to be used as reference mid-points for the calibration.

Complete Calibration Button*

Use this button to signal that you have logged all calibration points and you are ready to commit the calibration to the database.

You must proceed through the Completion process to get the calibration points saved to persistent memory – where they will be used by the BHI library to scale input values and will be available for generating a calibration report.

Cancel Calibration Button

Use this button to cancel a calibration.

If you cancel a calibration, all data related to that calibration will be lost.

Meter Values Not Frozen message

This message will appear if you have not frozen the meter signals prior to attempting a calibration. If you see this message, cancel the calibration, freeze meter signals, and restart the calibration process.

Meter Serial Number Not Set message

This message will appear if you have not configured the meter serial number on the meter screen – main tab. If you see this message, cancel the calibration, properly configure the meter, and restart the calibration process.

Verification and Calibration Report Description Screen

The **Verification and Calibration Report Description** screen is displayed after you select one of the **Complete...** buttons on either the **Meter Verification** or the **Meter Calibration** screens. The screen supports up to 6 verification points.

*The information entered on this screen is optional. However, you **MUST** select the **Commit button** to save your verification or calibration data to the database*

Verification and Calibration Report Description

Tester

Affiliation [Redacted]
Remarks [Redacted]

Witness

Affiliation [Redacted]
Remarks [Redacted]

Validation Equipment

Range [Redacted]
Last Calibration Date [Redacted]

Prior Inspection Date/Time [Redacted]
Prior Inspection Condition [Redacted]
Prior Verification Date/Time [Redacted] Prior Calibration Date/Time [Redacted]

Commit Verification/Calibration Cancel Verification/Calibration

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Meter Calibration Screen

Commit Verification/Calibration Button*

Use this button to signal that you are ready to commit the data to the database.

You must proceed through the Completion process and Commit changes (even if you do not enter any data on this screen) to get the verification or calibration points saved to persistent memory.

Cancel Verification/Calibration Button

Use this button to cancel a verification or calibration.

If you cancel a verification or calibration, all related data will be discarded.

Event Screen

The event screen can be used to review API 21.1 events for a meter.

Meter Events

Meter Gas Meter 1 Back

Show Most Recent Events

Index of First Event to Display 23 Index of Next Event that program will Populate 32

Event Index	Timestamp	Table	Item	Old Value	New Value
23	07/03/2022 15:37:04	1	8	0.0	6.60000026
24	07/03/2022 15:38:38	0	16	G	A
25	07/03/2022 15:38:43	0	10	0.0	6.0
26	07/03/2022 15:38:45	0	8	0.0	3.0
27	07/03/2022 15:38:47	0	22	C	M
28	07/03/2022 15:38:51	0	11	0.0	68.0
29	07/03/2022 15:38:52	0	9	0.0	68.0
30	07/03/2022 15:39:00	1	9	0.0	6.89999978
31	07/03/2022 15:39:00	1	10	0.0	1.29999995

BeyondHMI

Events Screen

The library maintains a circular buffer 256 events for each meter. The first event is stored at event index zero. Subsequent events are stored at indices with increasing numbers. When event 255 has been populated and another event needs to be logged, event index zero is overwritten.

For long term data retention, events are copied to the .cfx files each time a .cfx file is created. This file creation occurs at least once per day (after contract day change), or when a major configuration change is made to the meter or its station.

The event screen can be used to view portions of the event log for a meter. Ten events are displayed at one time. The user can navigate through the entire 256 event log using this screen – viewing 10 events at one time. The user can change position in the event log by changing the **Index of First Event to Display** parameter on the screen. In the example above, the **Index of First Event to Display** parameter is set to zero. As a result, events zero through 9 are displayed. If the **Index of First Event to Display** parameter were changed to 55, for example, the screen would refresh – showing events 55 through 64.

The logic behind this screen can handle “rollover”. For example, if the **Index of First Event to Display** parameter were changed to 250, the screen would refresh and events 250 through 255 followed by events zero through 3 would be displayed.

If you wish to view the 10 most recent events, check the **Show Most Recent Events** check box and the screen will refresh – displaying the 10 most recent events (the single most recent event will be at the bottom of the list).

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The **Index of Next Event that program will Populate** parameter reveals the current position of the Event logic – within the circular buffer.

Meter Combo Box

This combo box is used to specify which meter you wish to view.

Show Most Recent Events check box

Check this box to force the screen to refresh – showing the most recent events in the log.

Index of First Event to Display

Enter a number in this box (0 through 255) to cause the screen to update – showing events at a specific location within the circular buffer. The refreshed list will start with the event number you enter.

Index of Next Event that program will Populate

This read-only field displays the position where the next event will be logged.

Event Index

Displays the event index number (0-255).

Timestamp

Displays the local timestamp at which the event was recorded.

Table and Item

The combination of Table and Item represent a specific parameter. This combination indicates which parameter was changed. The Table/Item combinations are defined by Quorum Software and are part of the CFX file specification. This specification is subject to a Nondisclosure Agreement. Therefore, it cannot be reproduced here. For more information, contact Quorum Software.

Old Value and New Value

These represent the *Before* and *After* values of the parameter which was changed.

Alarms Screen

The alarms screen can be used to review API 21.1 alarms for a meter.

The screenshot shows the 'Meter Alarms' interface. At the top, there is a dropdown menu for 'Meter' set to 'Gas Meter 1' and a 'Back' button. Below this, there is a checkbox for 'Show Most Recent Alarms' which is unchecked. Two input fields are present: 'Index of First Alarm to Display' with the value '3' and 'Index of Next Alarm that program will Populate' with the value '14'. The main part of the screen is a table with 12 rows of alarm data. The columns are 'Alarm Index', 'Timestamp', 'AlarmCode', 'New State', and 'Value'. The data is as follows:

Alarm Index	Timestamp	AlarmCode	New State	Value
3	07/03/2022 15:40:25	Diff Prs	High	123.0
4	07/03/2022 15:40:25	Low Flow	Off	123.0
5	07/04/2022 10:03:19	Low Flow	On	0.0
6	07/04/2022 10:41:12	Low Flow	On	0.0
7	07/04/2022 10:52:39	Diff Prs	High	23.4
8	07/04/2022 10:52:39	Low Flow	Off	23.4
9	07/04/2022 10:52:44	Static Prs	High	155.7
10	07/04/2022 10:52:47	Tempr	High	89.1
11	07/04/2022 11:03:49	Low Flow	On	0.0
12	07/04/2022 11:05:57	Low Flow	On	0.0

The 'BeyondHMI' logo is visible in the bottom right corner of the screenshot.

Alarms Screen

The library maintains a circular buffer 64 alarms for each meter. The first alarm is stored at alarm index zero. Subsequent alarms are stored at indices with increasing numbers. When event 63 has been populated and another alarm needs to be logged, alarm index zero is overwritten.

For long term data retention, alarms are copied to the .cfx files each time a .cfx file is created. This file creation occurs at least once per day (after contract day change), or when a major configuration change is made to the meter or its station.

The alarm screen can be used to view portions of the alarm log for a meter. Ten alarms are displayed at one time. The user can navigate through the entire 64 alarm log using this screen – viewing 10 alarms at one time. The user can change position in the alarm log by changing the **Index of First Alarm to Display** parameter on the screen. In the example above, the **Index of First Alarm to Display** parameter is set to zero. As a result, alarms zero through 9 are displayed. If the **Index of First Alarm to Display** parameter were changed to 25, for example, the screen would refresh – showing alarms 25 through 34.

The logic behind this screen can handle “rollover”. For example, if the **Index of First Alarm to Display** parameter were changed to 60, the screen would refresh and alarms 60 through 63 followed by alarms zero through 5 would be displayed.

BeyondHMI

If you wish to view the 10 most recent alarms, check the **Show Most Recent Alarms** check box and the screen will refresh – displaying the 10 most recent alarms (the single most recent alarm will be at the bottom of the list).

The **Index of Next Alarm that program will Populate** parameter reveals the current position of the Alarm logic – within the circular buffer.

Meter Combo Box

This combo box is used to specify which meter you wish to view.

Show Most Recent Alarm check box

Check this box to force the screen to refresh – showing the most recent alarms in the log.

Index of First Alarm to Display

Enter a number in this box (0 through 63) to cause the screen to update – showing alarms at a specific location within the circular buffer. The refreshed list will start with the alarm number you enter.

Index of Next Alarm that program will Populate

This read-only field displays the position where the next alarm will be logged.

Alarm Index

Displays the alarm index number (0-63).

Timestamp

Displays the local timestamp at which the alarm was set or cleared.

Alarm Code

Indicates which alarm is involved:

- Diff Prs
- Static Prs
- Tempr
- Low Flow
- Back Flow
- Low Btry

New State

Indicates the state change which triggered the alarm:

- Off
- On
- High
- Low

Value

Indicates the value of the relevant parameter at the time of the state change.

Current Day Periodic History Screen

The current day periodic history screen can be used to review API 21.1 periodic history for a meter for the current day.

Periodic Index	Start Timestamp	End Timestamp	Duration [sec]	Flow [sec]	DP/pulses	Static Prs	Tmpr	Extensn/Raw vol	CPPrime	Volume	Energy	Mass
0	07/04/2022 11:08:14	07/04/2022 11:10:11	117	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
1	07/04/2022 11:05:56	07/04/2022 11:08:14	127	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
2	07/04/2022 11:00:00	07/04/2022 11:03:48	219	219	23.40	155.70	89.10	60.36	52.21	8.0	7.0	0.5
3	07/04/2022 09:00:00	07/04/2022 10:00:00	3600	3600	123.00	456.00	78.00	236.83	54.70	539.8	472.9	30.6

Current Day Periodic History Screen

The library maintains a buffer 25 periodic history records for each meter. Each periodic history record is meant to contain up to one hour of flow data. However, these history records are broken/changed any time a significant parameter change is made. So, the periodic history log may contain records including less than one hour of data.

The first periodic record for the meter is stored at periodic index zero. Subsequent periods are stored at indices with increasing numbers. The periodic history is not a circular buffer. This data is not overwritten until the previous days' worth of data has been archived to a cfx file.

For long term data retention, periodic history is copied to the .cfx files. A new cfx file is created at least once per day (after contract day change), or when a major configuration change is made to the meter or its station. Once periodic data is archived to a cfx file, the PLC program has no facilities for displaying that data.

The current day periodic history screen can be used to view portions of the current day's periodic history for a meter. Four records are displayed at one time. The user can navigate through the entire 25 record log using this screen – viewing 4 records at one time. The user can change position in the periodic history log by changing the **Index of First Record to Display** parameter on the screen. In the example above, the **Index of First Record to Display** parameter is set to zero. As a result, alarms zero through 3 are displayed. If the **Index of First Record to Display** parameter were changed to 5, for example, the screen would refresh – showing records 5, 6, and 7.

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The logic behind this screen can handle “rollover”. For example, if the **Index of First Record to Display** parameter were changed to 23, the screen would refresh and records 23, 24, 25, and zero would be displayed.

If you wish to view the 4 most recent periods, check the **Show Most Recent Periodic History** check box and the screen will refresh – displaying the 4 most recent records (the single most recent record will be at the bottom of the list).

The **Index of Record that program is currently populating** parameter reveals the current position of the periodic history logic – within the buffer.

Meter Combo Box

This combo box is used to specify which meter you wish to view.

Show Most Recent Periodic History check box

Check this box to force the screen to refresh – showing the most recent periodic history records in the log.

Index of First Record to Display

Enter a number in this box (0 through 25) to cause the screen to update – showing periodic history records at a specific location within the buffer. The refreshed list will start with the periodic history record number you enter.

Index of Record that program is currently populating

This read-only field displays the position where the library is currently accumulating flow information.

Periodic Index

Displays the periodic index number (0-25).

Start Timestamp

Displays the local timestamp at which the period began.

End Timestamp

Displays the local timestamp at which the period ended.

Duration

Displays the elapsed time between Start Timestamp and End Timestamp.

Flow Time

Displays the amount of flowing time accumulated during the period.

DP/Pulses

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For Orifice and cone meters, this field displays the flow time weighted average of the differential pressure during the period. For linear meters, this field displays the number of pulses accumulated during the period.

Static Pressure

This field displays the flow time weighted average of the static pressure during the period.

Temperature

This field displays the flow time weighted average of the temperature during the period.

Extensn/Raw Volume

For Orifice and cone meters, this field displays the flow time weighted average of the calculation extension during the period. For linear meters, this field displays the raw volume accumulated during the period.

CPrime

For Orifice and cone meters, this field displays the flow time weighted average CPrime during the period.

Volume

This field displays the accumulated volume during the period.

Energy

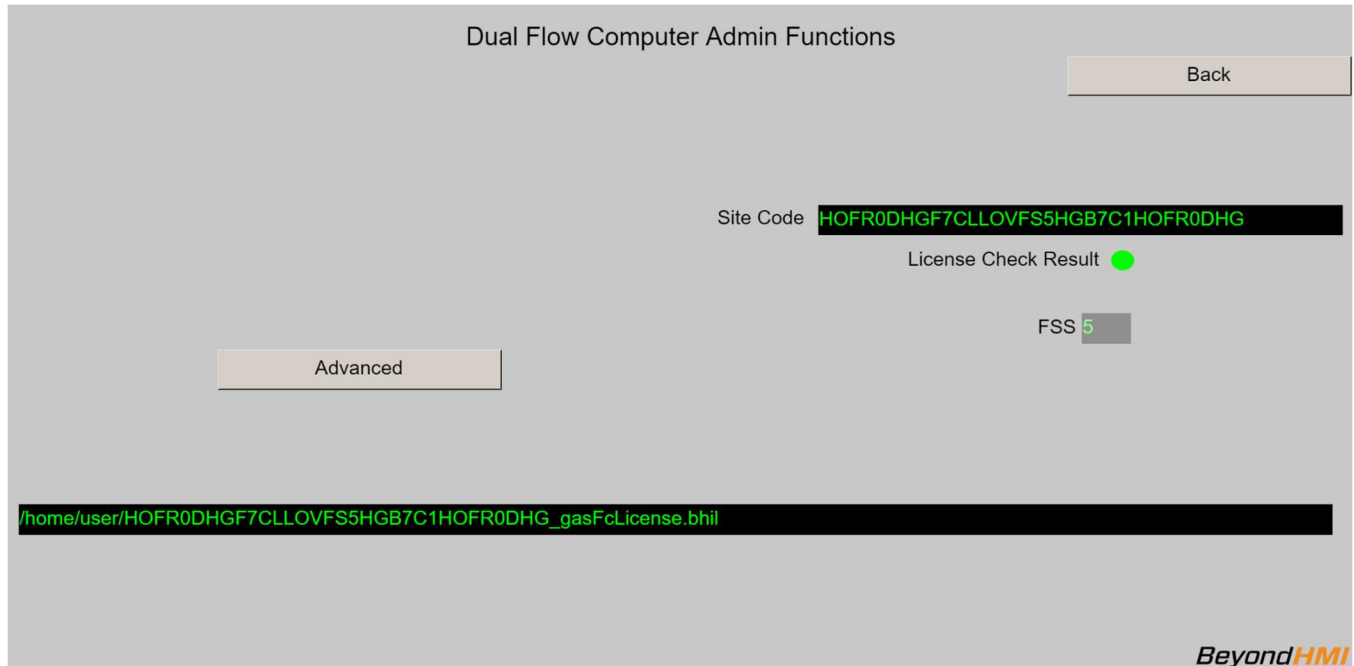
This field displays the accumulated energy during the period.

Mass

This field displays the accumulated mass during the period.

Admin Screen

The admin screen exposes features related to runtime licensing of the BhiLibGasAGA3 library.



Admin Screen

Note: The BhiLibGasAGA3 library utilizes runtime licensing. It must be licensed on every PLC where it runs. Licenses are obtained from beyond HMI, Inc.

The library reads parameters from the PLC which are unique to each PLC specimen. From these parameters, the library generates a Site Code. This represents a unique identifier for the PLC. The license key is unique to the PLC processor. It is not influenced by installed I/O modules or firmware version.

Site Code

A unique identifier for the PLC specimen. Use this to request a runtime license.

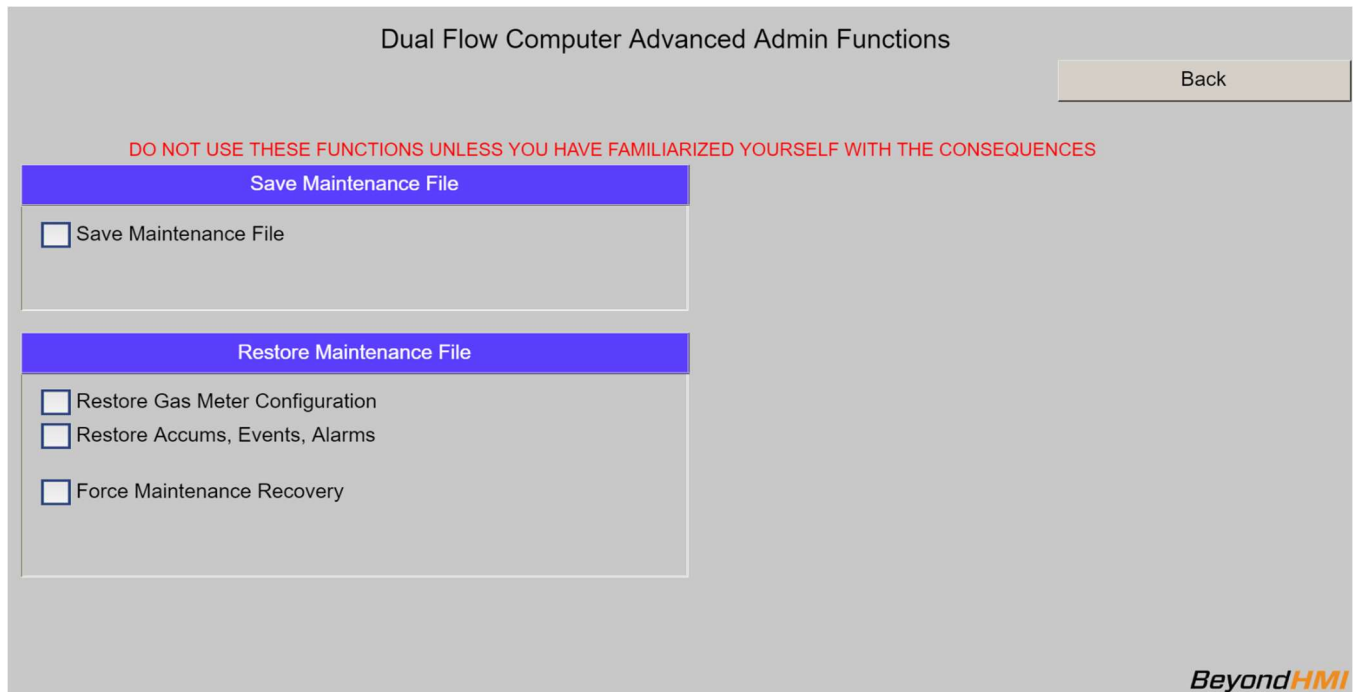
License Check Result

If this indicator is green, then a valid license has been detected. If not green, then the program is either running in *trial* mode or is disabled – awaiting a license.

For more information about runtime licensing of the BhiLibGasAGA3 library, see the *Licensing* section of this document.

Advanced Admin Screen

The Advanced Admin screen exposes functions for PLC program maintenance. Please use caution when using the functions on this screen.



Save Configuration Screen

When the Host PLC program needs to be changed, there is potential for loss of accumulator data that the Flow computer library uses. To prevent this loss, a special sequence of events must be followed when changing the host PLC program. The procedure is as follows:

Note: The following steps must be executed in order. Please read and study the entire procedure list before beginning PLC program maintenance.

Stop physical flow

In order to prevent loss of accumulated flow, all processes for all meters must be shut-in to prevent flow while the PLC program is being maintained.

Failure to follow this step may result in lost flow accumulation.

Save the library configuration to file

Using Admin features, save the configuration to file. Make note of the file name you use when saving.

Save a maintenance file

Check the **Save Maintenance File** checkbox on the Advanced Admin screen. Wait for the checkbox to be unchecked. This indicates that a maintenance file has been saved to the PLC file system.

Perform PLC program maintenance

At this point, you are free to make changes to the PLC program and load those changes onto the PLC.

Restore Library configuration

Using Admin features, load the configuration file that you previously saved.

Force Maintenance Recovery

Check the **Force Maintenance Recovery** checkbox on the Advanced Admin screen. Wait for the checkbox to be unchecked. This indicates that meter accumulators have been recovered from the maintenance file.

Resume physical flow

At this point, process flow can be resumed without loss of accumulated volume.

Licensing

The BhiLibGasAGA3 library utilizes runtime licensing. Each PLC upon which it runs must have a license. Licenses are obtained from Beyond HMI, Inc.

Trial Mode

Upon startup, the library will run in trial mode for approximately 4 days. While in trial mode, the library is fully functional. After the 4 day period passes – and if no license is installed - the library will stop calculating flow.

If the PLC program is stopped and restarted, the 4 day trial period begins again. Therefore, PLC program developers should be able to develop and test programs without needing a license for their development PLCs.

Steps to Obtain a Runtime License

To fully license the BhiLibDualFc library on a PLC, the following steps must be executed:

- Include library features in a PLC program (*reference other instructions in the DFC_DG_yyyy_mm_dd document available from Beyond HMI*)
- Install the PLC program on the target PLC specimen
- Open the library's Admin screen and capture the Site Code
- Transmit the site code to Beyond HMI, Inc. and provide payment information
 - Please use info@beyond-hmi.com to initiate contact with us.
- Wait for Beyond HMI, Inc. to return a license file
- Use the free BLT software to log into the PLC as 'root' and install the license file
- Open the library's Admin screen and confirm that the license check result is green

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Licenses are perpetual. No maintenance fee is required. Licenses are keyed to a site code and are not portable between PLCs. Please contact Beyond HMI if you need to move a license to another PLC.

Collecting CFX Files from the PLC

The CFX files generated by the BhiLibGasAGA3 library are saved into meter-specific directories underneath the PLC's /home/user/ directory. Each meter is given its own directory. The name of the directory is taken from the **Meter Serial Number** parameter for that meter.

For example, if two meters are configured at a certain PLC installation and one meter is given **Meter Serial Number** 'METER_1' and the other is given **Meter Serial Number** 'METER_2', then the following directories will be created:

- /home/user/METER_1
- /home/user/METER_2

And the CFX files for each meter will be stored within their respective directories.

The CFX files in these directories will be named using format YYYYMMDDQQ.CFX

Where:

- YYYYMMDD is the year, month, and day of the *gas day* for which the data applies.
- QQ is a sequence number generated by the program/library – beginning with 00.

Any person or local/remote process with the password for the 'user' profile on the PLC should be able to read/copy CFX files from these sub-directories to another computer.

The free BLT software can be used to transfer CFX files from the PLC onto your PC.

For a WINDOWS-like interface to the PLC directory system, products like WinSCP can be easily configured to use Secure FTP to interact with the PLC file system. The PLC must be configured to support whichever file transfer protocol you intend to permit field measurement technicians to use.

Deleting CFX Files From the PLC

There should be no reason to manually delete CFX files from the PLC directories. Files can be copied from the PLC file system to another computer but should not be 'cut' or deleted from the PLC directories. Normally, only a user with access to the 'root' profile would have the ability to delete these files.

The library contains logic to prune the files in the meter subdirectories. By setting the **Max Data Retention** parameter for the meter, you can control this pruning. In order to enforce API 21.1 standards, the **Max Data Retention** parameter cannot be set below 35 days. If you set the parameter to a lower value, it will be overridden later. Data pruning typically occurs once per day – at about 8 minutes after the contract hour.

FAQ

Why don't station hourly and daily quantities (Station screen – Values Tab) always show the sum of the same quantities from the Meters Screen – Values Tab)?

Throughout an hour and a day, values for the *station* are accumulated from the *meters* associated with that station. During the hour or day, the hourly and daily accumulations for the *meters* may be reset if a configuration change is made, but the *station* hourly and daily accumulations are not reset. Therefore, the *station* quantities can be larger than the sum of *meter* quantities – if a configuration change has been made during the clock hour or contract day. This is not a concern for the API 21.1 data retention because API 21.1 data is only stored by *meter*.

Will the library calculate and accumulate flow in the reverse direction for orifice meters?

No. The library will calculate flow rate and accumulate volume as long as the differential pressure is greater than or equal to the **Low Flow Cutoff Setpoint**. When the differential pressure falls below this threshold, the library will still calculate flow *rate* down to a differential pressure of zero. In the range between zero and **Low Flow Cutoff Setpoint** no volume, mass or energy accumulation occurs. At differential pressure of zero and lower, the library stops calculating rate.

The User manual says that if I set the *Max Data Retention* days to a value of less than 35, the library will change it to 35. But I don't see that happening. Why Not?

The data retention logic only runs once per calendar day. Before checking to see whether CFX files need to be deleted from the archive, the library validates the **Max Data Retention** days. This validation logic will change the **Max Data Retention** days – if necessary, but this process only occurs once per calendar day.