Linear Meter Flow Calculation Program
(For the FloBoss 107)

User Manual
(QER 08Q026)

Form A6261
October 2008

EMERSON
Process Management

Revision Tracking Sheet

October 2008

This manual may be revised periodically to incorporate new or updated information. The revision date of each page appears at the bottom of the page opposite the page number. A change in revision date to any page also changes the date of the manual that appears on the front cover. Listed below is the revision date of each page (if applicable):

Page	Revision
All pages	Oct-08
Initial release	Jul-08

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1 INTRODUCTION

1.1 Scope and Organization

This document serves as the user manual for the Linear Meter Flow Calculation User Program (QER 08Q026), which is intended for use in a FloBoss™ 107 (FB107). This manual describes how to download and configure this program (referred to as the "Linear Meter program" or "the program" throughout the rest of this manual). You access and configure this program using ROCLINK™ 800 Configuration Software (version 1.80 or greater) loaded on an IBM®-compatible personal computer (PC) running Windows® 2000 (with Service Pack 2), Windows XP, or Windows Vista.

The sections in this manual provide information in a sequence appropriate for first-time users. Once you become familiar with the procedures and the software running in a FB107, the manual becomes a reference tool.

This manual has the following major sections:

- *Section 1 – Introduction*
- *Section 2 – Installation*
- *Section 3 – Configuration*
- *Section 4 – Reference*

This manual assumes that you are familiar with the FB107 and its configuration. For more information, refer to the following manuals:

- *FloBoss 107 Flow Manager Instruction Manual (Form A6206)*
- *ROCLINK 800 Configuration Software User Manual (for FB107) (Form A6217)*

1.2 Product Overview

The Linear Meter program allows a FB107 to interface with meters whose flow input is proportional to either the mass flow or the uncorrected volumetric flow. Meter types with a flow input that is proportional to the uncorrected volumetric flow include turbine, vortex, ultrasonic, and positive displacement meters. Meter types with flow input that is proportional to the mass flow include Coriolis meters. Volume and mass flow rates and totals are calculated and stored for both volumetric and mass meters. The program uses the corresponding meter run point in the FB107's firmware to store Linear Meter calculated values and accumulations. Additional configuration parameters are located in the program's user-defined point types.

You enable the Linear Meter calculation for meter runs with Linear Meter hardware installed. With the calculation enabled, the FB107 bypasses the standard meter run flow calculations and performs the Linear Meter calculation instead. All standard meter run parameters, as well as the additional Linear Meter parameters, are available for assignment to Modbus registers, PID control loops, historical archiving, and FST functions.

The program is designed to calculate flows of natural gas and other related hydrocarbons, as defined in *AGA Report #8, 1992* edition and included in the FB107 firmware, or fluids whose properties are provided by a separate user program installed in the FB107. The only fluid properties used by the Linear Meter program are the flowing and base densities.

1.3 Program Requirements

You download the Linear Meter program to—and then run it from—the Flash and RAM memory on the FloBoss 107 with firmware version 1.10 (or greater). Download and configure the program using the ROCLINK 800 Configuration software version 1.80 (or greater).

The downloadable program is:

File Name	Target Unit/ Version	User Defined Point (UDP)	Flash Used (in bytes)	DRAM Used (in bytes)	ROCKLINK 800 Version	Display Number
LinearMeter_5.bin	1.10	31, 32	8,265	16,384	1.80	32, 33

Note: You must connect a PC to the FloBoss's LOI port **before** starting the download.

For information on viewing the memory allocation of user programs, refer to the *ROCLINK 800 Configuration Software User Manual (for FB107)* (Form A6217).

2 INSTALLATION

This section provides instructions for installing the Linear Meter program into the FB107. Read *Section 1.3* of this manual for program requirements.

2.1 Downloading the Program

This section provides instructions for installing the user program into FloBoss memory.

Note: Connect a PC to the FloBoss's LOI port **before** starting the download.

To download the user program:

1. Start and logon to ROCLINK 800.
2. Select **ROC** > **Direct Connect** to connect to the FloBoss unit.
3. Select **Utilities** > **User Program Administrator** from the ROCLINK menu bar. The User Program Administrator screen displays (see *Figure 1*):

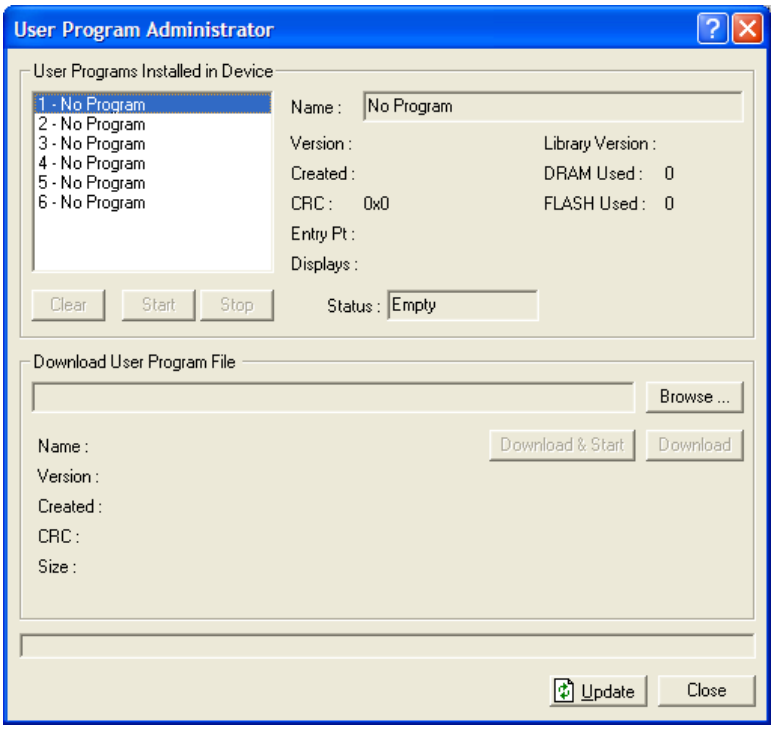

Figure 1. User Program Administrator

4. Click **Browse** in the Download User Program File frame. The Select User Program File screen displays (see *Figure 2*).
5. Select the path and user program file to download from the CD-ROM. (Program files are typically located in the Program Files folder on the CD-ROM). As *Figure 2* shows, the screen lists all valid user program files with the .BIN extension:

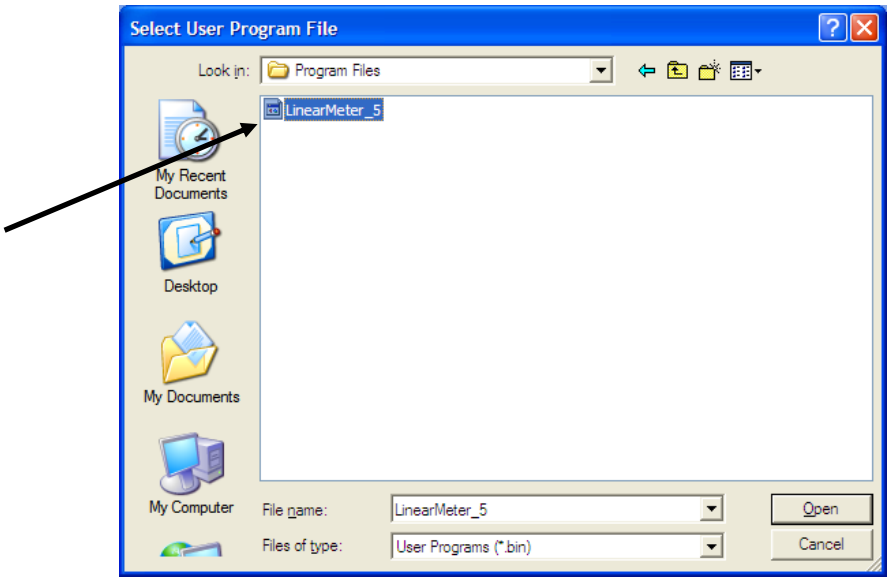

Figure 2. Select User Program File

6. Click **Open** to select the program file. The User Program Administrator screen displays. As shown in *Figure 3*, note that the Download User Program File frame identifies the selected program and that the **Download & Start** button is active:

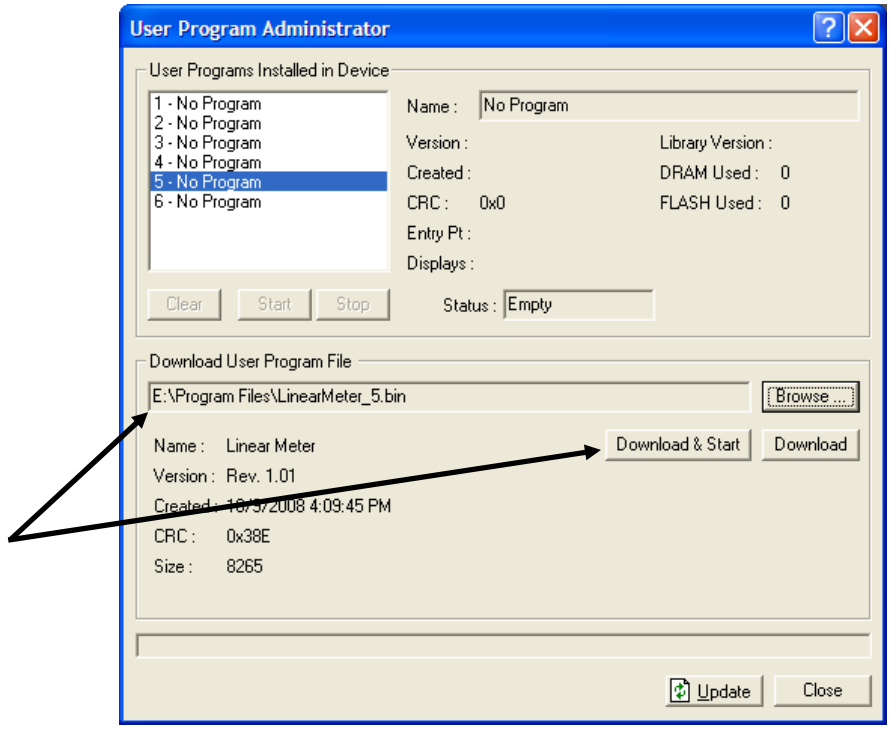

Figure 3. User Program Administrator

7. Click **Download & Start** to begin loading the selected programs. The following message displays:

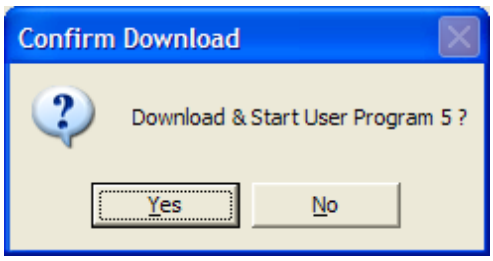

Figure 4. Confirm Download

Note: For the FB107, ROCLINK800 assigns program positions based on memory allocations. For this reason, the Linear Meter program automatically installs as program 5.

8. Click **Yes** to begin the download. During the download, the program performs a warm start, creates an event in the event log, and—when the download completes—displays the following message:

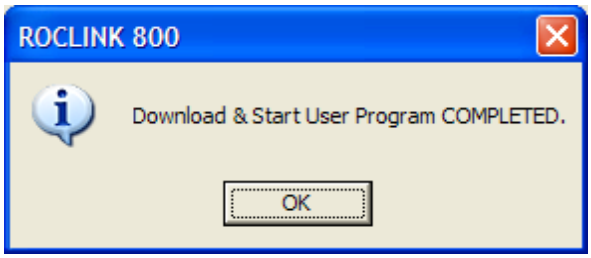

Figure 5. ROCLINK 800 Download Confirmation

9. Click **OK**. The User Program Administrator screen displays (see *Figure 6*). Note that:
   - The User Programs Installed in Device frame identifies the loaded program.
   - The Status field indicates that the program is running.

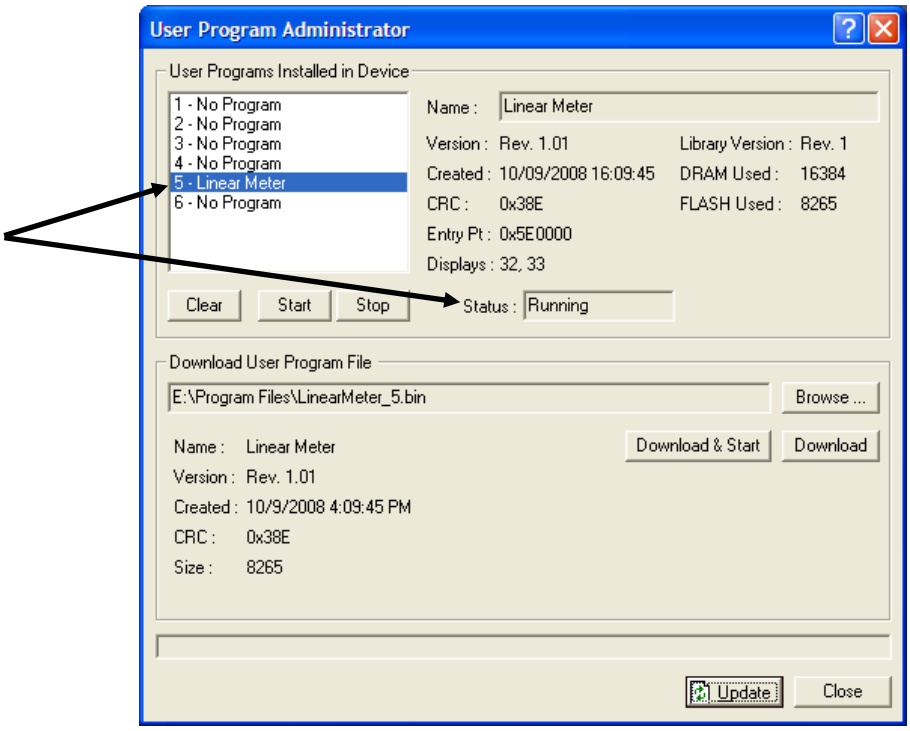

Figure 6. User Program Administrator

10. Click **Close** and proceed to *Section 3* to configure the program.

3 CONFIGURATION

After you have downloaded and started the Linear Meter program, you configure the program and view calculation results using the ROCLINK 800 software. To do this, you use two program-specific screens (Linear Meter Setup and Linear Meter Values):

- Use the Linear Meter Setup screen to set the parameters for the meter run.
- Use the Linear Meter Values screen to view results from the Linear Meter calculations.

Note: Configure history points after you configure the Linear Meter program. To configure history points, refer to *Table 7-2. EFM History Points (AGA 7)* in *Section 10.2* of the *ROCLINK800 Configuration Software User Manual (for FloBoss 107), Form A6217*.

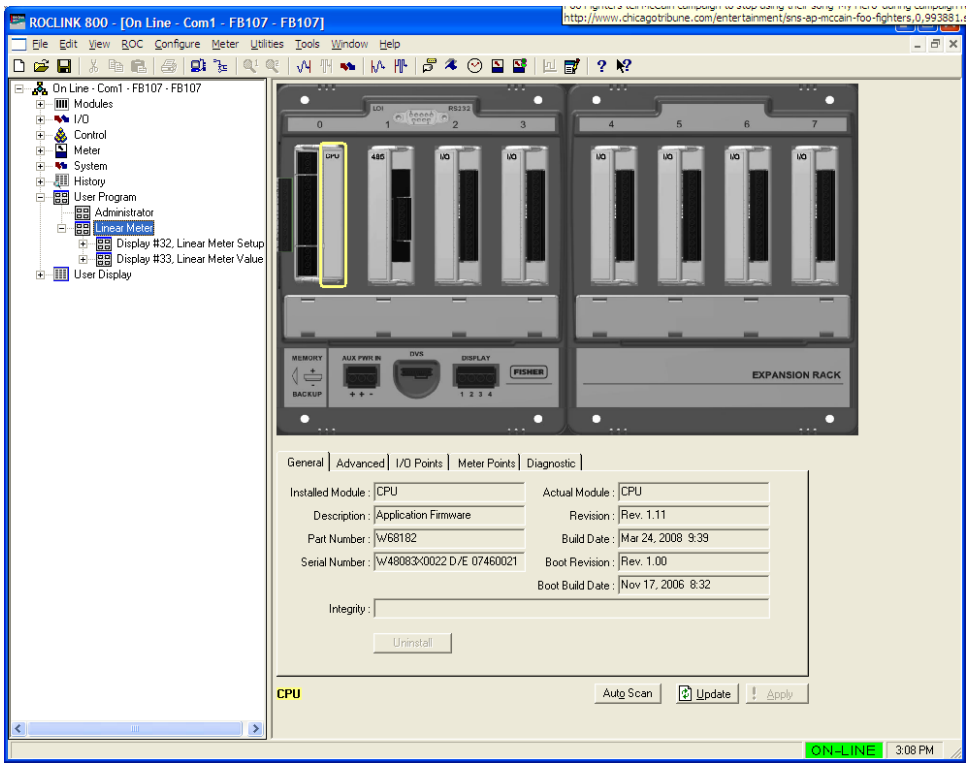

Figure 7. ROCLINK 800

3.1 Linear Meter Setup Screen

Once you have successfully loaded the Linear Meter program into the FloBoss, you can access the Linear Meter Setup screen and configure the meter runs.

To access this screen:

1. Click **User Program** > **Linear Meter** > **Display #32, Linear Meter Setup** from the ROCLINK configuration tree:
2. Double-click **#1, Meter #1**. The Linear Meter screen displays (see *Figure 14*):

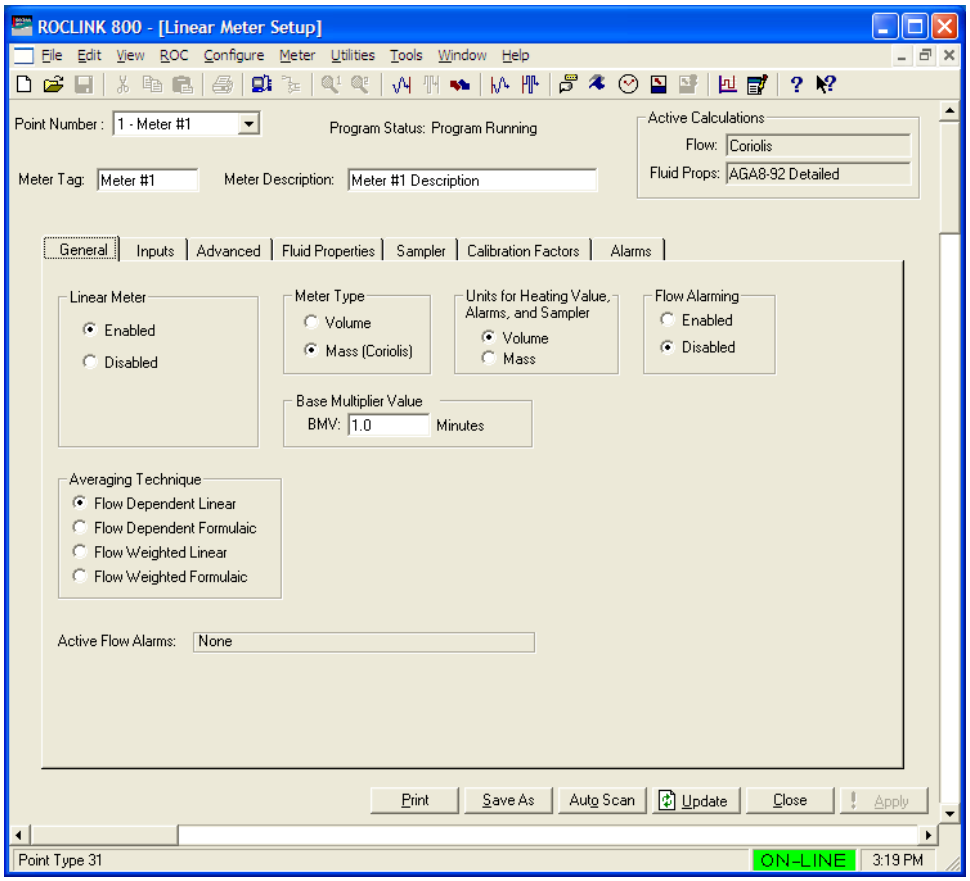

Figure 8. Linear Meter Setup

Note: Six fields at the top of the screen (Point number, Program Status, Meter Tag, Meter Description, Active Calculations – Flow, and Active Calculations – Fluid Props) appear on all tabs.

3. Review—and change as necessary—the values in the following fields:

Field	Description
Point Number	Selects the meter run to configure. Click ▼ to display all defined instances. Clicking a different meter run causes the screen to display the values for that meter run.

Field	Description
Program Status	This **read-only** field shows the current state of the user program. Valid values are: **Program Not Loaded**, **Program Loaded – Not Started**, **Program Running**, **Program Shutting Down**, and **Not Running – Library Version Error.**
Meter Tag	Sets the unique identifier for the selected meter.
Meter Description	Sets the description of the selected meter.
Flow	This **read-only** field shows the flow calculation standard currently performing flow calculations for the selected meter run.
Fluid Props	This **read-only** field shows the properties calculation standard currently performing properties calculations for the selected meter run.

4. Click **Apply** to save your changes, and proceed to *Section 3.1.1* to configure the General tab.

3.1.1 Linear Meter Setup Screen – General Tab

Use the General tab (which displays when you access the Linear Meter Setup screen) to enable the Linear Meter calculation, specify the averaging technique used by the program, and define program-specific options.

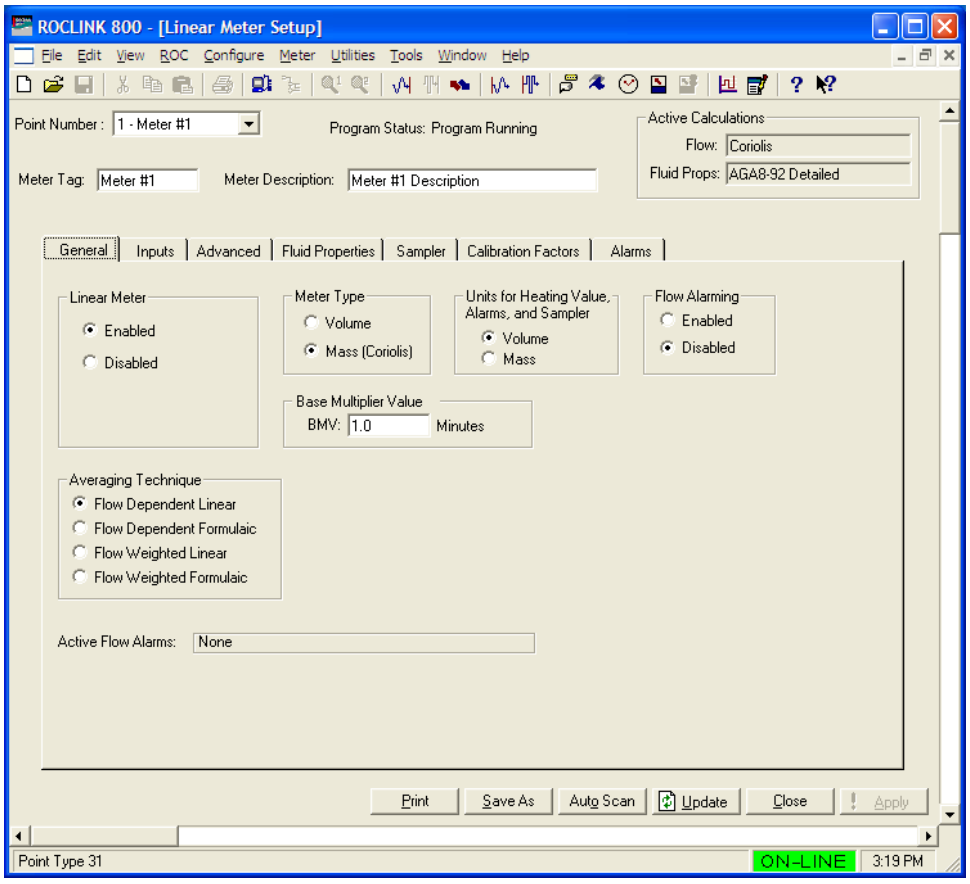

Figure 9. Linear Meter, General Tab

1. Review—and change as necessary—the values in the following fields:

Field	Description
Linear Meter	Enables or disables the Linear Meter program to perform the flow calculations for the selected meter run. Valid selections are Enabled or Disabled.
Meter Type	Sets the type of meter associated with the meter run. Valid selections are Volume (volume metering device such as a turbine meter) or Mass (Micro Motion Coriolis Mass Meter or similar mass meter). This field is hidden when the Linear Meter is Disabled for the meter run.
Units for Heating Value, Alarms, and Sampler	Sets the type of units used for heating value, alarms, and sampler of the meter run. Valid selections are Volume**,** (units are BTU/CF or MJ/M3, Ft^3 or M3, etc) and Mass (units are BTU/Lb or MJ/Kg, Lb or Kg, etc).
Flow Alarming	Enables or disables flow alarming for the meter. If enabled, alarm status changes are added to the Alarm Log. Use the Alarms tab to configure the alarms. If disabled, no alarm generates for this meter, regardless of the alarm configuration.

Field	Description	
Base Multiplier Period (BMP) or Integral Multiplier Period (IMP)	Sets, in minutes, how frequently the system recalculates the fluid properties and resulting Base Multiplier Value (BMV) (per the API measurement standard *Chapter 21, Section 1*). If the flow calculation for the meter run is AGA3-92, ISO5167-2003, or another calculation standard where the flow input is a differential pressure, this field is labeled Integral Multiplier Period (IMP).	
Averaging Technique	Sets the averaging technique for determining the average static pressure and flowing temperature during each BMP/IMP for the meter run. If the flow input is from a differential pressure meter, the average differential pressure is also determined. For further details, see API measurement standard *Chapter 21, Section 1, Appendix B*. Valid selections are:	
	Flow Dependant Linear	Calculates the average static pressure and average flowing temperature with equal weighting given to each sample when there is flow through the meter. For samples in which there is no flow, the value is not included in the average. However, if there is no flow during the BMP/IMP, averages are determined using all of the samples.
	Flow Dependant Formulaic	Calculates averages for the static pressure and flowing temperature where each sample is raised to the power to which the parameter is raised in the flow equation, with equal weighting given to each sample when there is flow through meter. For samples where there is no flow, the value is not included in the averaging. However, if there is no flow during the BMP/IMP, averages are determined using all of the samples. At the end of the BMP/IMP, the resulting average is raised to the reciprocal of the power to which the value is raised in the flow equation. **Note:** Flow Dependent Linear and Flow Dependent Formulaic averaging yield the same result when used with linear meters.
	Flow Weighted Linear	Calculates averages for the static pressure and flowing temperature with weighting for a sample being the ratio of the flow through the meter at the time of the sample to the total flow during the BMP/IMP. For samples where there is no flow, the value is not included in the average. However, if there is no flow during the BMP/IMP, averages are determined using all of the samples.
	Flow Weighted Formulaic	Calculates averages for the static pressure and flowing temperature where each sample is raised to the power to which the parameter is raised in the flow equation, with weighting for a sample being the ratio of the flow at the time of the sample to the total flow during the BMP/IMP. For samples where there is no flow, the value is not included in the average. However, if there is no flow during the BMP/IMP, averages are determined using all of the samples. At the end of the BMP/IMP, the resulting average is raised to the reciprocal of the power to which the value is raised in the flow equation. With a linear meter, flow weighted formulaic averaging yields the same result as flow weighted linear averaging. **Note:** Flow Weighted Linear and Flow Weighted Formulaic averaging yield the same result when used with linear meters.

Field	Description
Active Flow Alarms	This **display-only** field shows any alarm currently active. For example, **Low** indicates that the calculated flow is below the Low Alarm limit. Other alarms can include **High**, **No Flow**, and **Manual Mode**.

2. Click **Apply** to save any changes, and proceed to *Section 3.1.2* to configure the Inputs tab.

3.1.2 Linear Meter Setup – Inputs Tab

Use the Inputs tab to define the inputs used by the Linear Meter calculation.

To access this screen:

1. Select the **Inputs** tab on the Linear Meter Setup screen. One of the following four screens display:

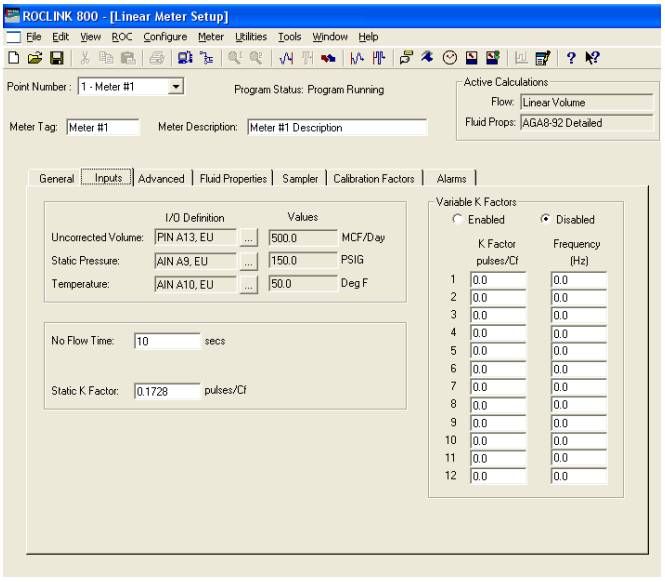

Figure 10(a). Linear Meter Setup, Inputs tab (Meter Type is Volume, I/O Definition is a PI Point)

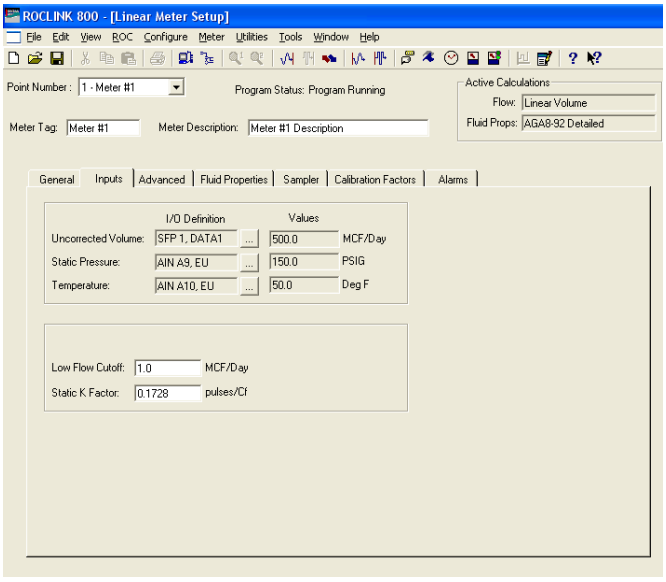

Figure 10(b). Linear Meter Setup, Inputs tab (Meter Type is Volume, I/O Definition is an Analog Value)

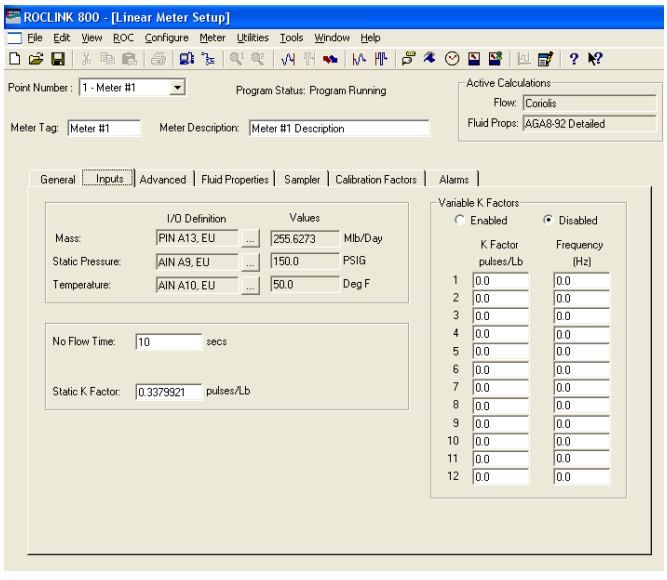

Figure 10(c). Linear Meter Setup, Inputs tab (Meter Type is Mass, I/O Definition is a PI Point)

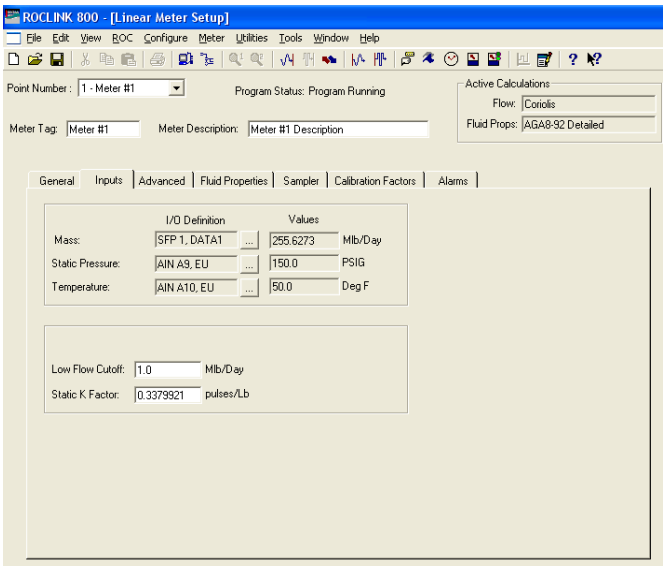

Figure 10(d). Linear Meter Setup, Inputs tab (Meter Type is Mass, I/O Definition is an Analog Value)

Note: The Linear Meter Enabled/Disabled selection on the General tab must be set to Enabled to view this tab.

2. Review—and change as necessary—the values in the following fields:

Field	Description
Uncorrected Volume	Sets the parameter for the uncorrected volume flow rate from the meter. Click … to display the Select TLP dialog box you use to assign the parameter. The units for the uncorrected volume value are MCF/Day or kM^3/Day. If the parameter for the uncorrected volume flow rate is from a PI point, select parameter 13 (EU). If the parameter for the uncorrected volume flow rate is an analog value, select that parameter. **Note**: This field displays **only** if the meter type is volume.
Mass	Sets the parameter for the mass flow rate from the meter. Click … to display the Select TLP dialog box you use to assign the parameter. The units of the mass are Mlb/Day or Tonnes/Day. If the parameter for the mass flow rate is from a PI point, select parameter 13 (EU). If the parameter for the mass is an analog value, select that parameter. **Note**: This field displays **only** if the meter type is mass (Coriolis).
Static Pressure	Sets the parameter for the static pressure. Click … to display the Select TLP dialog box you use to assign the parameter. The units for the static pressure are PSIG/PSIA or kPa(g)/kPa(a).
Temperature	Sets the parameter for the flowing temperature of the fluid. Click … to display the Select TLP dialog box you use to assign the parameter. The units for the flowing temperature are Deg F or Deg C.
No Flow Time	Sets the amount of time without a pulse, in seconds, before the no flow status is set. **Note**: This field displays **only** if the I/O Definition for the flow rate parameter is a PI point.
Low Flow Cutoff	Sets the low flow cutoff point. When the value of the flow input parameter is less than or equal to this value, the calculated flow rate is set to zero and, if alarming is enabled, the No Flow alarm status is set and an entry is made in the Alarm Log. The units of the low flow cutoff are MCF/Day or kM^3/Day. **Note**: This field displays **only** if the I/O Definition for the flow rate parameter is an analog value.
Static K Factor	Sets the K factor when the variable K factor is disabled or the I/O definition for the flow rate parameter is an analog value. If the flow rate parameter is an analog value, pulses are generated from the analog value and added to the total pulses stored in parameter 59 of point type 47. If the variable K factor is enabled, the static K factor is the last K factor calculated from the variable K factor table. The K factor is the number of pulses per unit of flow. The units are pulses/Cf, pulses/M3, pulses/Lb, or pulses/Kg.
Variable K Factors	Enables the use of the variable K Factor table and sets the K Factor values over a range of pulse frequencies. The units of the values of the K Factor are pulses/Cf, pulses/M^3, pulses/Lb, or pulses/Kg. The units of the pulse frequencies are Hz. If this field is **Disabled**, the Static K Factor is used. **Note**: These fields displays **only** if the I/O Definition for the flow rate parameter is a PI point.

3. Click **Apply** to save any changes, and proceed to *Section 3.1.3* to configure the Advanced tab.

3.1.3 Linear Meter Setup Screen – Advanced Tab

Use the Advanced tab to define additional meter run information for the Linear Meter flow calculation.

To access this screen:

1. Select the **Advanced** tab on the Linear Meter Setup screen. One of the following two screens display:

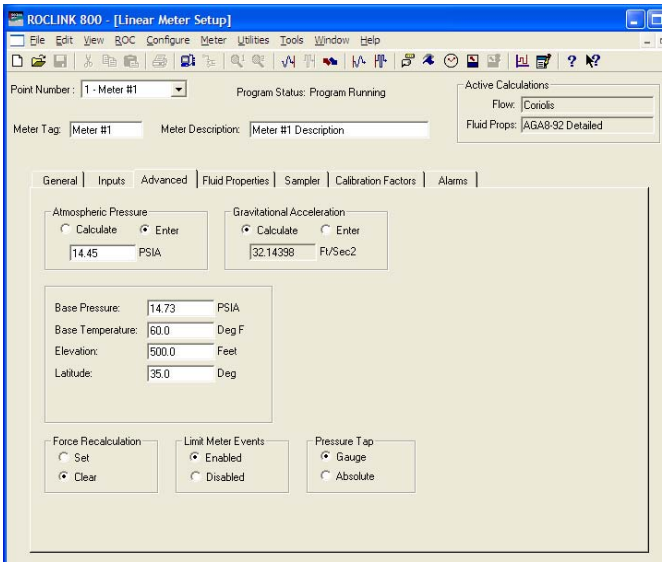

Figure 11(a). Linear Meter Setup, Advanced tab (Meter Type is Volume)

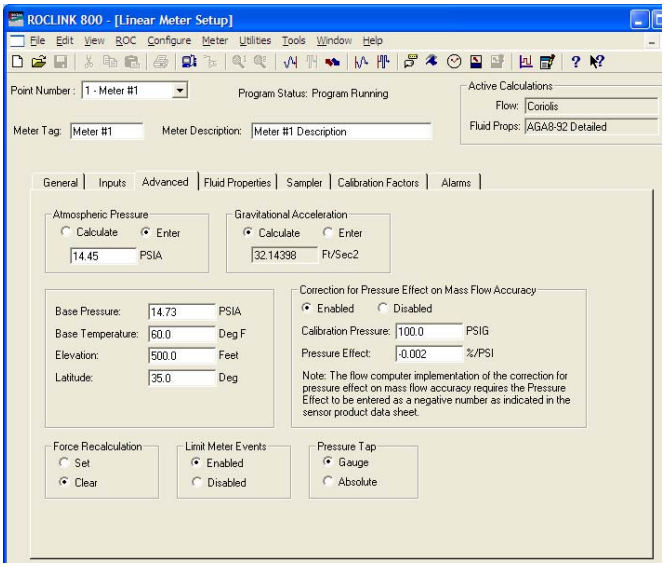

Figure 11(b). Linear Meter Setup, Advanced tab (Meter Type is Mass)

Note: The Linear Meter Enabled/Disabled selection on the General tab must be set to Enabled to view this tab.

2. Review—and change as necessary—the values in the following fields:

Field	Description
Atmospheric Pressure	Sets how the program determines atmospheric pressure (absolute) at the metering location. Valid selections are Calculate (calculate atmospheric pressure from other parameters defined on this screen) or Enter (use the value, either as PSIA or kPa(a), entered in the field in this frame). The default is **Enter**. **Note**: If you select **Enter**, the value **must** be greater than zero.
Gravitational Acceleration	Sets how the program determines gravitational acceleration at the metering location. Valid selections are Calculate (calculate gravitational acceleration from other parameters defined on this screen) or Enter (use the value, either as Ft/Sec^2 or M/Sec^2, entered in the field in this frame). The default is **Calculate**. **Note**: If you select **Enter**, the value must be greater than zero.
Base Pressure	Sets, in PSIA or kPa(a), the flow measurement base pressure specified in the gas contract.
Base Temperature	Sets, in degrees Fahrenheit or degrees Celsius, the flow measurement base temperature specified in the gas contract.

Field	Description
Elevation	Sets, in feet or meters above sea level, the elevation of the metering location.
Latitude	Sets, in degrees, the latitude of the metering location.
Correction for Pressure Effect on Mass Flow Accuracy	Enables or disables the correction of the mass flow input due to pressure effects. **Note:** This field displays only if the meter type is mass (Coriolis).
Calibration Pressure	Sets the calibration pressure of the mass flow meter for determining the pressure effect correction of the mass flow input. Units are PSIG or kPa(g). **Note:** This field displays only if the meter type is mass (Coriolis).
Pressure Effect	Sets the coefficient for the effect of pressure on the mass flow accuracy. Units are %/PSI or %/kPa. **Note:** The flow computer implementation of the correction for pressure effect on mass flow accuracy requires the Pressure Effect to be entered as a negative number as indicated in the sensor product data sheet.
Force Recalculation	Forces the program to recalculate the flow without waiting for the next normal recalculation. Select Set and click Apply to force the recalculation. **Note:** You define normal recalculation periods using the Base Multiplier Period field (located on the Linear Meter Setup screen's General tab).
Limit Meter Events	Sets whether the FB107 logs all flow-related events. Valid selections are Enabled (log all events) or Disabled (do not log events).
Pressure Tap	Sets the reference of the static pressure. This field must match how the sensor or transmitter actually measures the static pressure. Valid selections are Gauge and Absolute.

3. Click **Apply** to save any changes, and proceed to *Section 3.1.4* to configure the Fluid Properties tab.

3.1.4 Linear Meter Setup Screen – Fluid Properties Tab

Use the Fluid Properties tab to define the fluid composition and other properties.

To access this screen:

1. Select the **Fluid Properties** tab on the Linear Meter Setup screen.

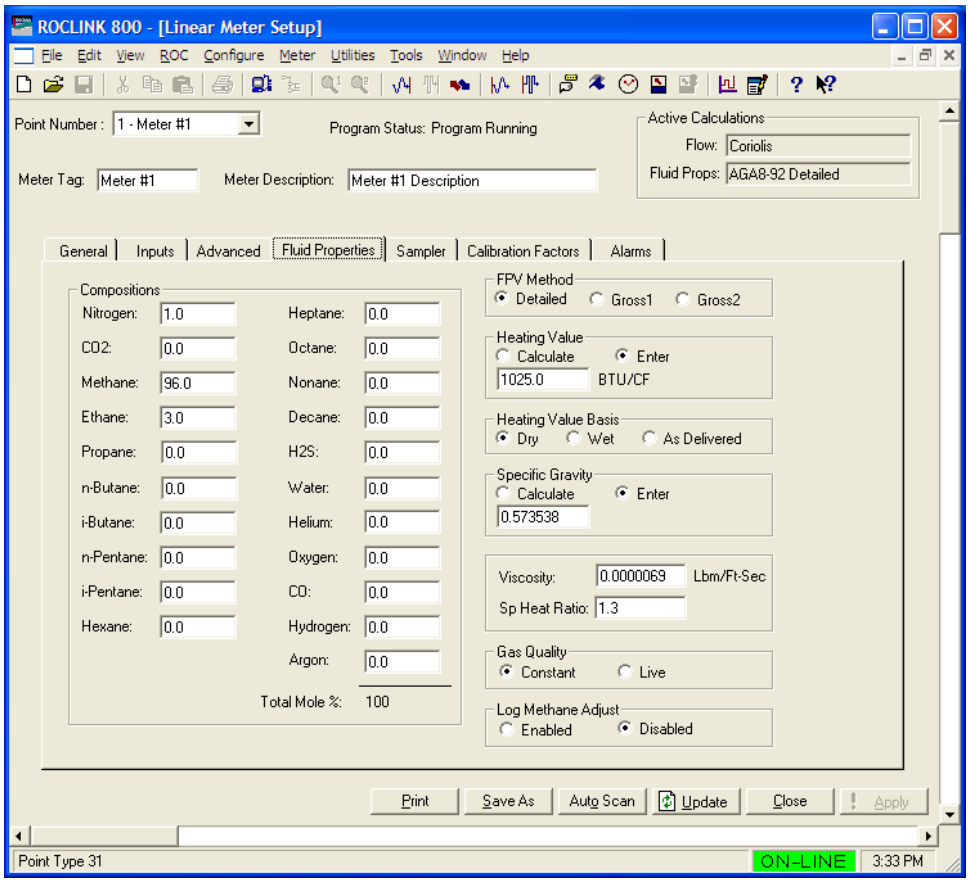

Figure 12. Linear Meter Setup, Fluid Properties tab

Note: The Linear Meter Enabled/Disabled selection on the General tab must be set to Enabled and the active fluid properties calculation must be AGA8-92 to view this tab.

2. Review—and change as necessary—the values in the following fields:

Field	Description	
Composition	Sets the mole percent for each gas component. If the FPV Method is Detailed, the value in the Total Mole % field must equal 100%. If the FPV Method is Gross1, only the mole % of CO_2 must be entered. If the FPV Method is Gross2, the mole % of CO_2 and the mole % of N_2 must be entered.	
FPV Method	Sets the method of determining the compressibility factors for AGA8 calculations. Valid selections are:	
	Detailed	Requires the natural gas composition in mole percent to be entered for all components.
	Gross1	Requires the specific gravity of the natural gas, the real gas gross heating value per unit volume, and the

Field	Description	
		mole % of CO_2 to be entered.
FPV Method (continued)	**Gross2**	Requires the specific gravity of the natural gas, the mole % of CO_2, and the mole % of N_2 to be entered.
	Note: If you choose either **Gross1** or **Gross2**, you must manually enter values for Specific Gravity and Heating Value on this screen. Gross2 only requires a value for Heating Value if you're calculating the gas energy flow. While the Detailed method provides the highest accuracy in a broad range of measurement conditions, you can use either of the Gross methods when: ▪ Temperature is between 32°F and 130°F (0°C and 54°C). ▪ Pressure is between 0 and 1200 PSIA (0 and 8274 kPa(a)). ▪ Gas composition is within the Normal range, as defined in the 1992 AGA8 report.	
Heating Value	Sets how the system determines the heating value of the gas. Valid selections are **Calculate** (allow the system to calculate the heating value from the gas composition data) or **Enter** (use the value specified in the energy calculation). **Note**: Set the *Units for Heating Value, Alarms, and Sampler* parameter on the General tab to select volume or mass measurement in English units (BTU/CF or BTU/Lb) or metric units (MJ/M^3 or MJ/Kg).	
Heating Value Basis	Identifies the basis the system uses to determine the heating value for flow or energy calculations. Valid selections are:	
	Dry	No water vapor present in gas.
	Wet	Saturated water vapor present in gas. **Note**: When you select this option, the FB107 calculates the mole percentage of water based on the algorithm from IAPWS—IF97 standards and adjusts the other mole percentages accordingly.
	As Delivered	Gas may contain some water vapor.
Specific Gravity	Sets the ratio of the molar mass of the gas to the molar mass of the air. Valid selections are **Calculate** (the system calculates the value) and **Enter** (use the specific value for the flow calculation). **Note**: If you select **Enter**, the value should represent the gas at standard conditions and cannot be less that 0.07.	
Viscosity	Sets the dynamic viscosity of the flowing gas. Units are Lbm/Ft-Sec (English units) or cP (metric units).	
Sp Heat Ratio	Sets the specific heat ratio of the gas (defined as the specific heat of the gas at constant pressure divided by the specific heat of the gas at constant volume). Accepted practice for natural gas applications is to use a value of 1.3, which was used to develop the expansion factor tables in the AGA 3 Report – Part 3. If entered, the value must be greater than zero.	
Gas Quality	Sets the source for the gas compositions and other properties. Valid selections are **Constant** (readings are manually entered and changes are added to the event log) or **Live** (readings come from a gas chromatograph or are periodically downloaded from a host and changes are not added to the event log).	

Field	Description
Log Methane Adjust	Sets if system adjustments to the methane composition are added to the event log. Valid selections are **Enabled** (adjustments are added to the event log) or **Disabled** (adjustments are not added to the event log).

3. Click **Apply** to save any changes, and proceed to *Section 3.1.5* to configure the Sampler tab.

3.1.5 Linear Meter Setup Screen – Sampler Tab

Use the Sampler tab to set up the discrete output (DO) to send a pulse output to another device, such as an odorizer, or to control a gas sampler for a meter run.

To access this screen:

1. Select the **Sampler** tab on the Linear Meter Setup screen.

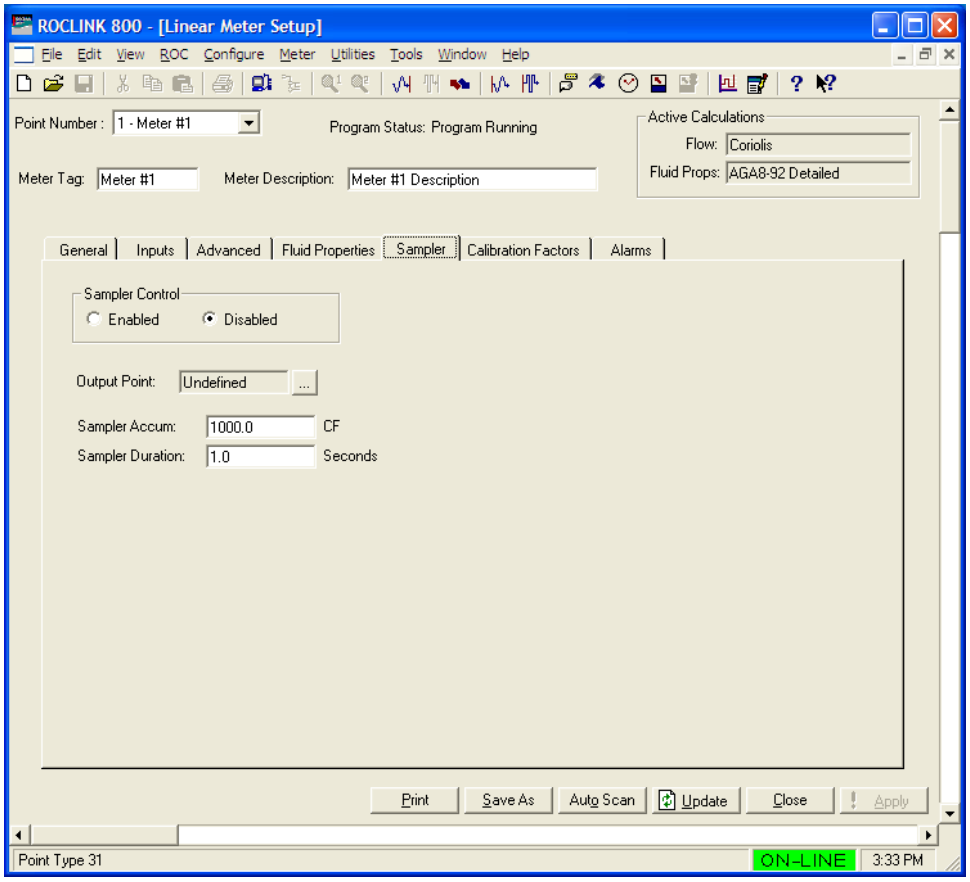

Figure 13. Linear Meter Setup, Sampler tab

Note: The Linear Meter Enabled/Disabled selection on the General tab must be set to Enabled to view this tab.

2. Review—and change as necessary—the values in the following fields:

Field	Description
Sampler Control	Enables sampling for the meter run. When enabled, the Output Point is set when the previous flow matches or exceeds the value in the Sampler Accum field.
Output Point	Sets the parameter for the output to drive the sampler. Click ... to display the Select TLP dialog box you use to define the parameter. It must be parameter 3 of a DO point.
Sampler Accum	Sets the quantity of fluid that must pass before the status of the Output Point is set. Units are Cf, M^3, Lb, or Kg based on the Units Type for Heating Value, Alarms, and Sampler on the General tab.

Field	Description
Sampler Duration	Sets the duration, in seconds, for holding the status of the Output Point to ON when the quantity of fluid passed matches or exceeds the Sampler Accum.

3. Click **Apply** to save any changes, and proceed to *Section 3.1.6* to configure the Calibration Factors tab.

3.1.6 Linear Meter Setup Screen – Calibration Factors Tab

Use the Calibration Factors tab to define information related to pressure calibration.

To access this screen:

1. Select the **Calibration Factors** tab on the Linear Meter Setup screen.

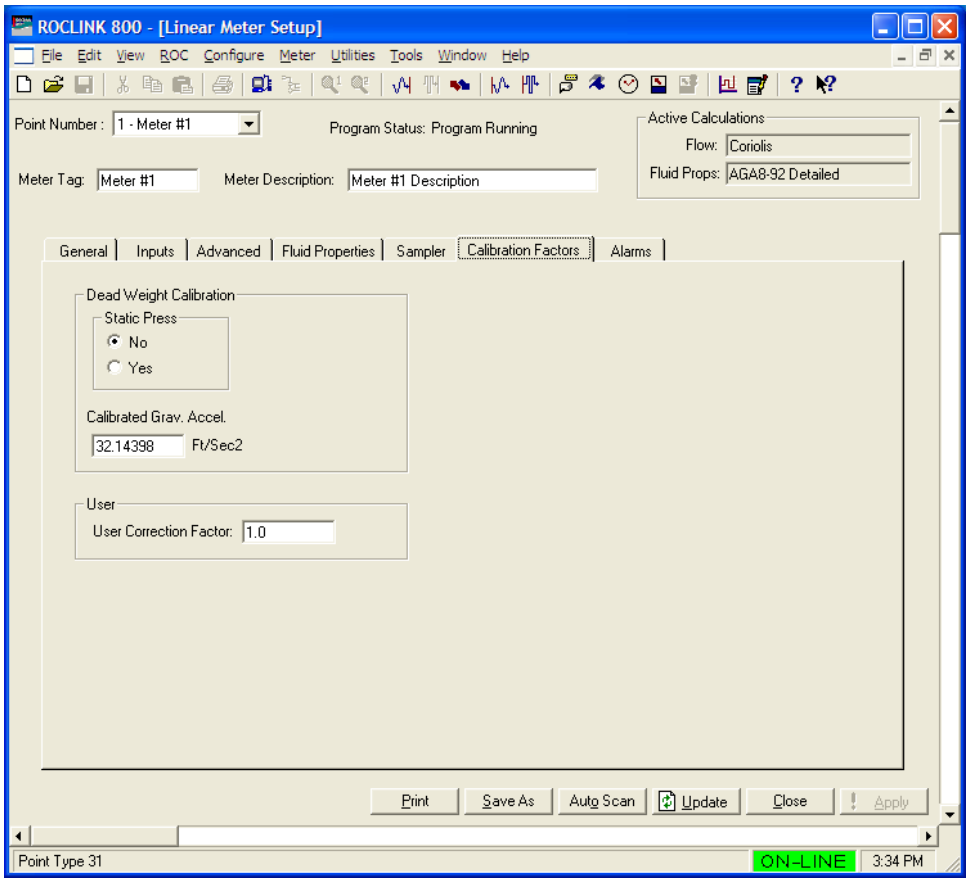

Figure 14. Linear Meter Setup, Calibration Factor tab

Note: The Linear Meter Enabled/Disabled selection on the General tab must be set to Enabled to view this tab.

2. Review—and change as necessary—the values in the following fields:

Field	Description
Dead Weight Calibration: Static Pressure	Sets if the program compensates the static pressure value for the difference between the gravitational acceleration at the location where the static pressure was calibrated and the gravitational acceleration associated with the dead weight calibrator.
Calibrated Gravitational Acceleration	Sets the gravitational acceleration associated with the dead weight calibrator. The units are Ft/Sec^2 or M/Sec^2.
User Correction Factor	Sets a multiplier value to adjust the flow for factors not included with the Linear Meter User program. **Note**: Use the default value of **1.0** if no correction is desired.

3. Click **Apply** to save any changes, and proceed to *Section 3.1.7* to configure the Alarms tab.

3.1.7 Linear Meter Setup Screen – Alarms Tab

Use the Alarms tab to define information related to flow alarming.

To access this screen:

1. Select the **Alarms** tab on the Linear Meter Setup screen.

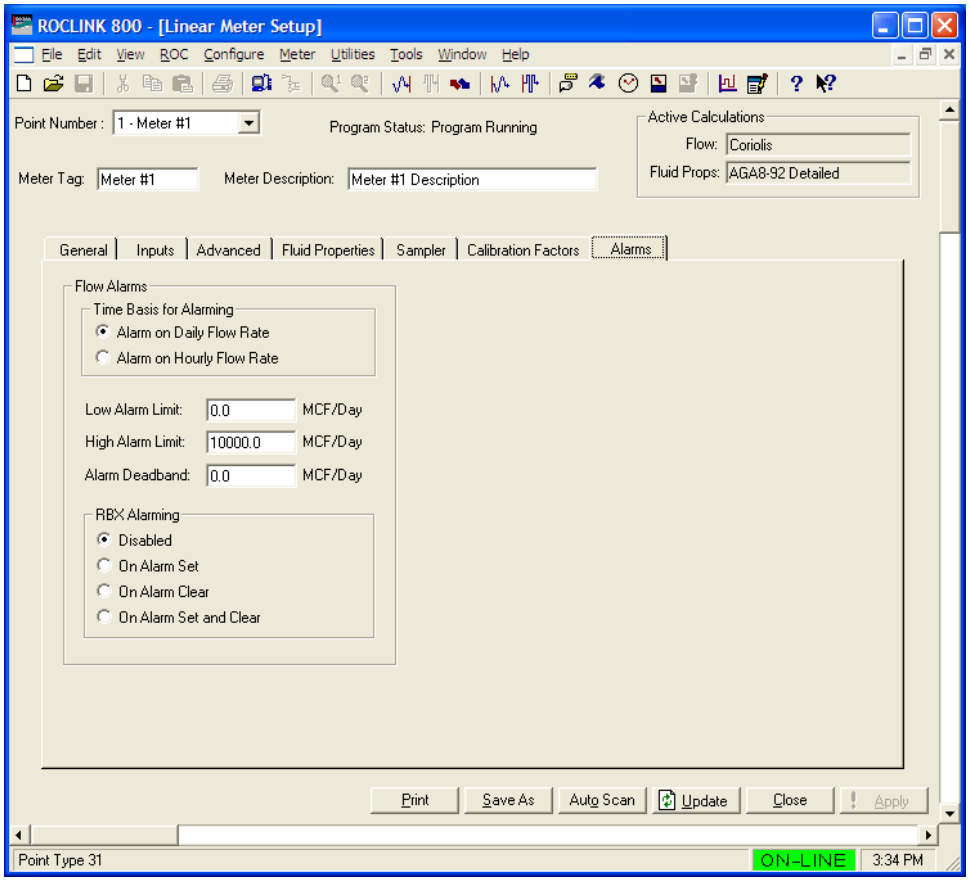

Figure 15. Linear Meter Setup, Alarms tab

Note: The Linear Meter Enabled/Disabled selection on the General tab must be set to Enabled to view this tab.

2. Review—and change as necessary—the values in the following fields:

Field	Description
Time Basis for Alarming	Sets the parameter whose value is to be used for alarming. If **Alarm on Daily Flow Rate** is selected, the daily volume or mass flow rate is used for alarming. If **Alarm on Hourly Flow Rate** is selected, the hourly volume or mass flow rate is used for alarming. The use of the volume or mass flow rate is dependent on the Units Type for Heating Value, Alarms, and Sampler on the General tab.
Low Alarm Limit	Sets the value below which the calculated flowrate must fall to generate a low alarm. The units are MCF/Day, CF/Hour, Mlb/Day, Lb/Hour, kM^3/Day, M^3/Hour, Tonnes/Day, or Kg/Hour.

Field	Description	
High Alarm Limit	Sets the value above which the calculated flowrate must rise to generate a high alarm. The units are MCF/Day, CF/Hour, Mlb/Day, Lb/Hour, kM^3/Day, M^3/Hour, Tonnes/Day, or Kg/Hour.	
Alarm Deadband	Sets a value that defines a zone above the Low Alarm limit and below the High Alarm limit. When an alarm condition is set, the flowrate must clear the alarm limit plus the zone defined by the deadband, before the alarm condition clears. This deadband prevents the system from setting and clearing the alarm continuously when the input value is oscillating around the alarm limit. The units are MCF/Day, CF/Hour, Mlb/Day, Lb/Hour, kM^3/Day, M^3/Hour, Tonnes/Day, or Kg/Hour.	
RBX Alarming	Sets alarming options for initiating Report-by-Exception messages. These messages are sent out through communication ports that have RBX mode enabled.	
	Disabled	RBX Alarming is turned off.
	On Alarm Set	When the point **enters** an alarm condition, the FB107 generates a Report-by-Exception message to the host.
	On Alarm Clear	When the point **leaves** an alarm condition, the FB107 generates a Report-by-Exception message to the host.
	On Alarm Set and Clear	In either condition, an RBX message generates to the host.

3. Click **Apply** to save any changes.
4. Click **Close** to close this screen, and proceed to *Section 3.2* to configure the Linear Meter Values screen.

3.2 Linear Meter Values Screen

Use this screen to view the results and calculation factors used in Linear Meter calculations

To access this screen:

1. Click **User Program** > **Linear Meter** > **Display #32, Linear Meter Values** from the ROCLINK configuration tree:
2. Double-click **#1, Meter #1**. The Linear Meter Values screen displays:

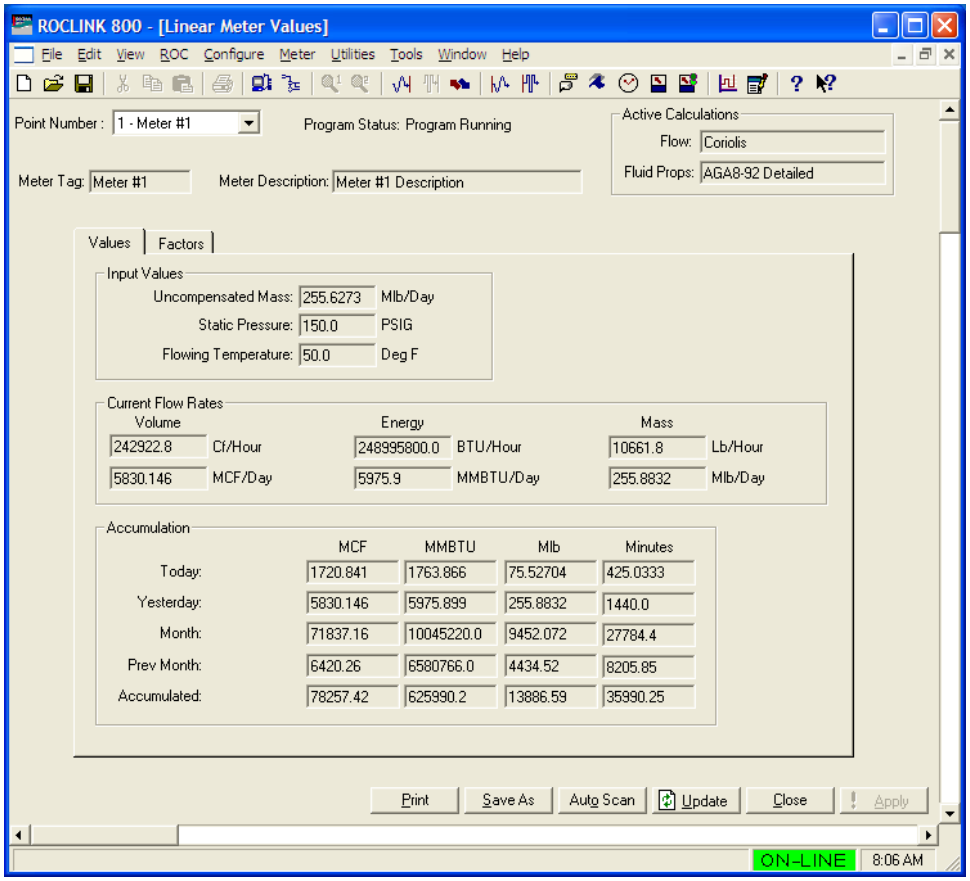

Figure 16. Linear Meter Values

Note: Six fields at the top of the screen (Point number, Program Status, Meter Tag, Meter Description, Active Calculations – Flow, and Active Calculations – Fluid Props) appear on all tabs.

3. Review—and change as necessary—the values in the following fields:

Field	Description
Point Number	Selects the meter run to configure. Click ▼ to display all defined instances. Clicking a different meter run causes the screen to display the values for that meter run.
Program Status	This **read-only** field shows the current state of the user program. Valid values are: **Program Not Loaded**, **Program Loaded – Not Started**, **Program Running**, **Program Shutting Down**, and **Not Running – Library Version Error.**

Field	Description
Meter Tag	This **read-only** field shows the unique identifier for the selected meter.
Meter Description	This **read-only** field shows the description of the selected meter.
Active Calculations: Flow	This **read-only** field shows the flow calculation standard currently performing flow calculations for the selected meter run.
Active Calculations: Fluid Props	This **read-only** field shows the properties calculation standard currently performing properties calculations for the selected meter run.

4. Click **Apply** to save any changes, and proceed to *Section 3.2.1* to configure the Values tab.

3.2.1 Linear Meter Values –Values Tab

Use the Values tab (which displays one of the following three screens when you access the Linear Meter Values screen) to view results of the Linear Meter calculations.

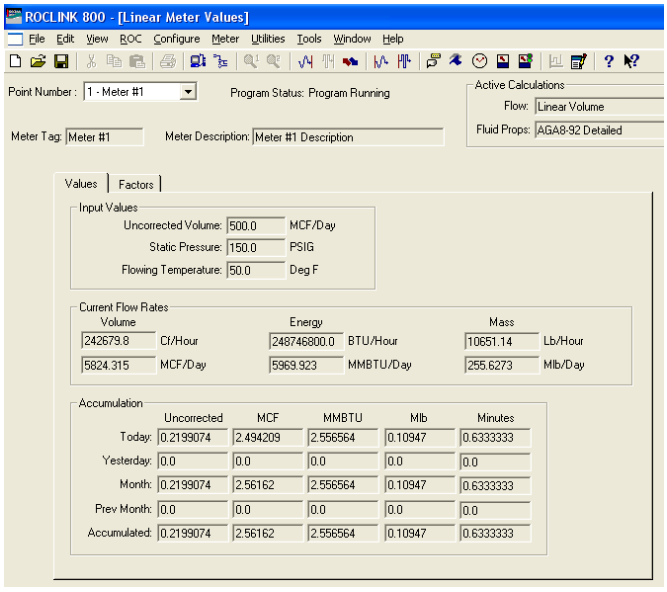

Figure 17(a). Linear Meter Values,Values tab (Meter Type is Volume)

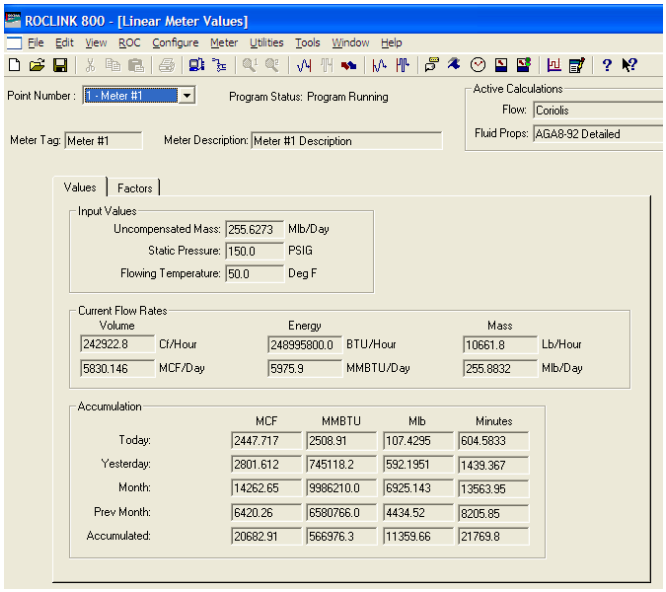

Figure 17(b). Linear Meter Values, Values tab (Meter Type is Mass)

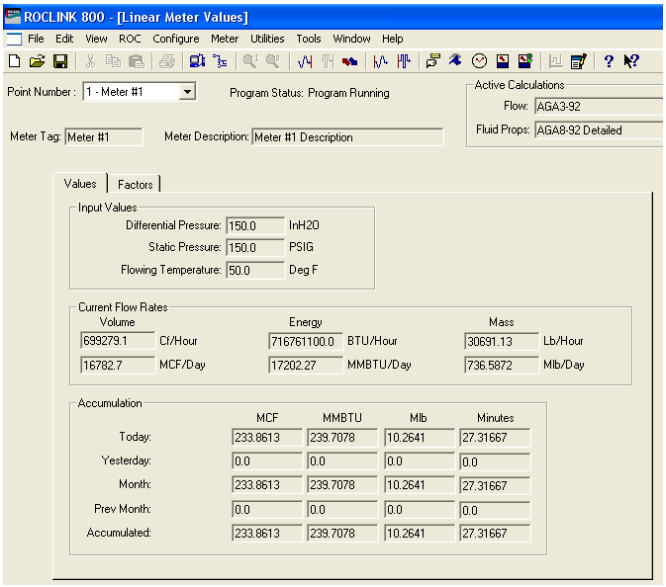

Figure 17(c). Linear Meter Values,Values tab (Linear Meter Type is Disabled, Calculation Standard is AGA3-92 or ISO5167-2003)

1. Review the values in the following fields:

Field	Description
Uncorrected Volume	This **read-only** field displays uncorrected volume flow rate, which is the volumetric flow input before any density correction is applied. The units are MCF/Day or kM3/Day. **Note:** This field displays only if the meter type is volume.
Uncompensated Mass	This **read-only** field displays uncompensated mass flow rate, which is the mass flow input before pressure compensation is applied. The units are Mlb/Day or Tonnes/Day. **Note:** This field displays only if the meter type is mass (Coriolis).
Differential Pressure	This **read-only** field displays current differential pressure. The units are INH2O or kPa. **Note:** This field displays only if Linear Meter is disabled for the meter run and the flow input for the meter run is a differential pressure.
Static Pressure	This **read-only** field displays current static pressure in PSIG, PSIA, kPa(g) or kPa(a).
Flowing Temperature	This **read-only** field displays current flowing temperature in Deg F or Deg C.
Current Flow Rate – Volume	This **read-only** field displays current hourly and daily flow rates in CF/Hour and MCF/Day or M3/hr and kM3/Day.
Current Flow Rate – Energy	This **read-only** field displays current hourly and daily energy rates in BTU/Hour and MMBTU/Day or MJ/Hour and GJ/Day.
Current Flow Rate – Mass	This **read-only** field displays current hourly and daily mass rates in Lb/Hour and Mlb/Day or Kg/Hour and Tonnes/Day.
Accumulation – Uncorrected	This **read-only** field displays uncorrected volume total flow in MCF or Km3 for the current day, the previous day, the current month, the previous month, and the accumulated total since the accumulator last reset.
Accumulation – MCF	This **read-only** field displays total flow in MCF or kM3 for the current day, the previous day, the current month, the previous month, and the accumulated total since the accumulator last reset.
Accumulation – MMBTU	This **read-only** field displays total energy in MMBTU or GJoules for the current day, the previous day, the current month, the previous month, and the accumulated total since the accumulator last reset.
Accumulation – Mlb	This **read-only** field displays total mass in Mlb or Tonnes for the current day, the previous day, the current month, the previous month, and the accumulated total since the accumulator last reset.
Accumulation – Minutes	This **read-only** field displays flowing time in Minutes for the current day, the previous day, the current month, the previous month, and the accumulated total since the accumulator last reset.

2. Click **Apply** to save any changes and proceed to *Section 3.2.2* to configure the Calculated Factors tab.

3.2.2 Linear Meter Values Screen – Calculated Factors Tab

Use this tab to view calculation factors used in Linear Meter calculations.

To access this screen:

1. Select the **Factors** tab on the Linear Meter Values screen. One of the following two screens display:

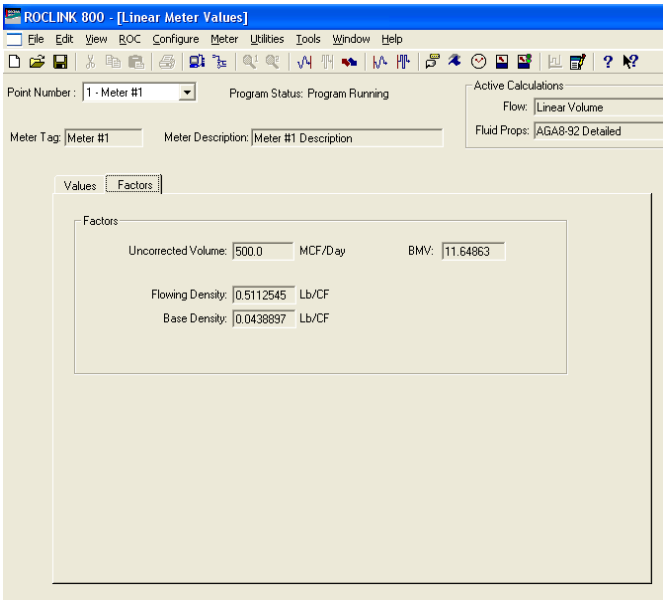

Figure 18(a). Linear Meter Values,Values tab (Meter Type is Volume)

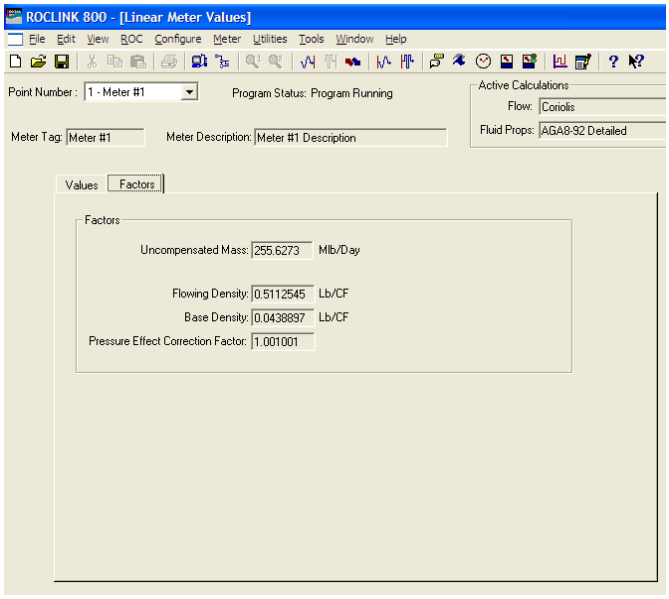

Figure 18(b). Linear Meter Values, Values tab (Meter Type is Mass)

Note: The Linear Meter Enabled/Disabled selection on the General tab of the Linear Meter Setup screen must be set to Enabled to view this tab.

2. Review the values in the following fields:

Field	Description
Uncorrected Volume	This **read-only** field displays the uncorrected volume flow rate, which is the volumetric flow input before any density correction is applied. The units are MCF/Day or kM3/Day. **Note:** This field displays only if the meter type is volume.
Uncompensated Mass	This **read-only** field displays the uncompensated mass flow rate, which is the mass flow input before the correction for pressure effect is applied. The units are Mlb/Day or Tonnes/Day. **Note:** This field displays only if the meter type is mass (Coriolis).
Flowing Density	This **read-only** field shows the calculated density at flowing conditions in Lb/CF or Kg/M3.
Base Density	This **read-only** field shows the calculated density at base conditions in Lb/CF or Kg/M3.

Field	Description
BMV	This **read-only** field displays the base multiplier value (BMV), which is the factor for multiplying by the uncorrected volume flow rate to determine the corrected volume flow rate. **Note:** This field displays only if the meter type is volume.
Pressure Effect Correction Factor	This **read-only** field displays the pressure effect correction factor, which is calculated from the pressure effect coefficient and the difference between the flowing and calibration pressures. **Note:** This field displays only if the meter type is mass (Coriolis).

3. Click **Apply** to save any changes.
4. Click **Close** to close this screen. Proceed to *Section 3.3* to save your configuration.

3.3 Saving the Configuration

Whenever you modify or change the configuration, it is a good practice to save the final configuration to memory. To save the configuration:

1. Select **ROC** > **Flags**. The Flags screen displays:

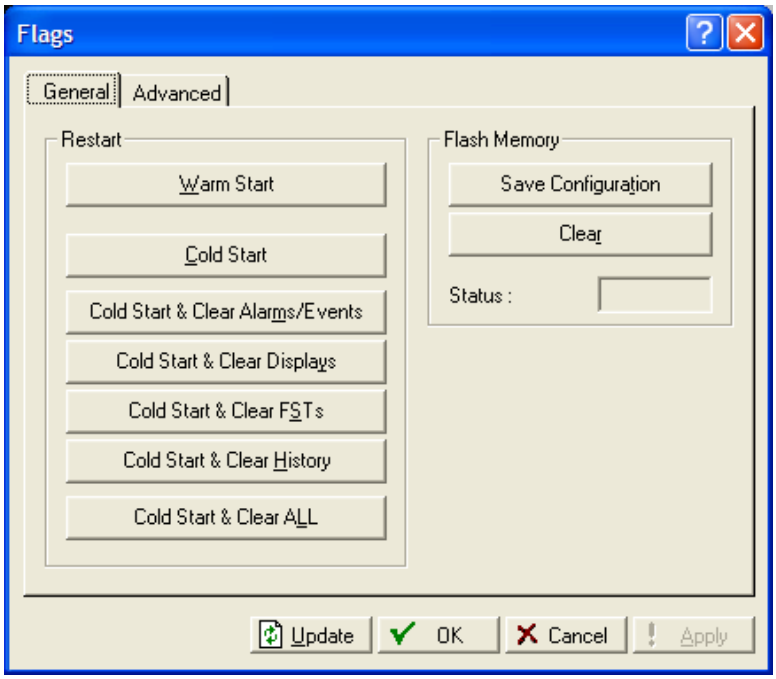

Figure 19. Flags

2. Click **Save Configuration**. A verification message displays:

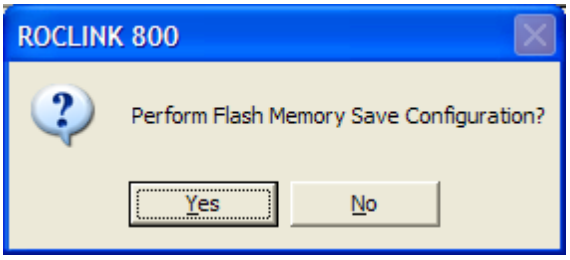

Figure 20. Save Verification

3. Click **Yes.** When the save process completes, a confirmation message displays:

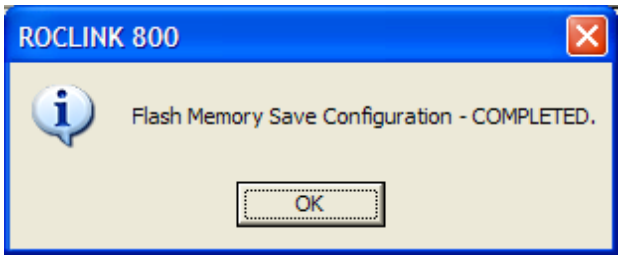

Figure 21. Confirmation

Note: Depending on the size and complexity of the user program, this process may take several minutes. When the process ends, the Status field on the Flags screen displays *Completed*.

4. Click **Update** on the Flags screen. This completes the process of saving your new configuration.

Note: For archive purposes, you should also save this configuration to your PC's hard drive or a removable media (such as a diskette or a flash drive) using the **File** > **Save Configuration** option on the ROCLINK 800 menu bar.

4 REFERENCE

This section provides calculation details and tables of information on the user defined points used by the Linear Meter Flow Calculation program.

- Calculation Details
- Point Type 31: Linear Meter Setup
- Point Type 32: Linear Meter Values

4.1 Calculation Details

The Linear Meter flow calculations are based on equations presented in the following flow calculation standards.

- *Measurement of Gas by Turbine Meters, Transmission Measurement Committee Report No. 7, American Gas Association (AGA), Second Revision, April, 1996.*
- *Measurement of Natural Gas by Coriolis Meter, AGA Report No. 11, API MPMS 14.9, Transmission Measurement Committee,, American Gas Association (AGA), 2003.*

Each of these flow calculation standards can be implemented using the Linear Meter program. However, AGA7 is already available with the FB107 Application Firmware, so it is recommended to use that implementation for meter runs requiring AGA7.

If the meter type is specified as volume, the flow calculations are as follows.

$$Q_b = Q_f * \rho_f / \rho_b$$

$$q_m = Q_b * \rho_b$$

where:

Q_b = Volumetric flow at base conditions. Units are MCF or kM3.
Q_f = Volumetric flow at flowing conditions (uncorrected flow). Units are MCF or kM3.
q_m = Mass flow. Units are Mlb or Tonnes.
ρ_b = Density at base conditions. Units are Lb/CF or Kg/M^3.
ρ_f = Density at flowing conditions. Units are Lb/CF or Kg/M^3.

If the meter type is specified as mass (Coriolis), the flow calculations are as follows.

$$q_m = q_{m,u} * F_P$$

$$Q_b = q_m / \rho_b$$

where:

F_P = Correction for pressure effect on the mass flow accuracy.
Q_b = Volumetric flow at base conditions. Units are MCF or kM3.
q_m = Mass flow. Units are Mlb or Tonnes.
$q_{m,u}$ = Mass flow before correction for pressure effect. Units are Mlb or Tonnes.
ρ_b = Density at base conditions. Units are Lb/CF or Kg/M^3.

If correction for pressure effect is enabled:

$$F_P = 1.0 / (1.0 + (K_P / 100.0) * (P_f - P_c))$$

where:

K_P = Pressure effect coefficient. Units are %/PSIG or %/kPa(g).
P_f = Calibration pressure. Units are PSIG or kPa(g)
P_c = Flowing pressure. Units are PSIG or kPa(g)

If correction for pressure effect is disabled:

$$F_P = 1.0$$

With both volume and mass meters, the flow inputs are updated once a second, from which approximations of the flow rates and totals are calculated. The approximated flow totals are revised at the specified base multiplier period (BMP) using the total of the flow input, base density, and average flowing density, which is recalculated using the average pressure and temperature during the BMP.

4.2 Point Type 31: Linear Meter Setup

Point type 31 contains the parameters for configuring the Linear Meter program. There are four logicals of this point type (one logical for each meter run).

Point Type 31: Linear Meter Setup

Parm #	Name	Access	Data Type	Length	Range	Default	Description of functionality and meaning of values
0	Point Tag ID	R/O	AC	10	0x20 -> 0x7E for Each ASCII character	" "	Point tag identification. This value is copied from point type 46, parameter 0.
1	Enable Linear Meter	R/W	UINT8	1	0 -> 1	0	Enable/disable status of the linear meter flow calculation for the meter run. Valid values are: 0 = Disable 1 = Enable
2	Meter Type	R/W	UINT8	1	0 -> 1	0	Type of meter. Valid values are: 0 = Volume – The flow input is proportional to the uncorrected volumetric flow. 1 = Mass (Coriolis) – The flow input is proportional to the mass flow.
3	Press Effect Enable	R/W	UINT8	1	0 -> 1	0	If the meter type is volume: Not used. If the meter type is mass (Coriolis): Enable/disable the correction for the pressure effect on the mass flow accuracy. Valid values are: 0 = Disable 1 = Enable
4	Calibration Pressure	R/W	FLP	4	Any floating point number	0.0	If the meter type is volume: Not used. If the meter type is mass: Calibration pressure of the mass meter from which the correction for the pressure effect on the mass flow accuracy is determined. Units are PSIG or kPa(g).

Point Type 31: Linear Meter Setup

Parm #	Name	Access	Data Type	Length	Range	Default	Description of functionality and meaning of values
5	Press Effect Coeff	R/W	FLP	4	Any floating point number	0.0	If the meter type is volume: Not used. If the meter type is mass: Pressure effect coefficient for the mass meter. Units are %/PSIG or %/kPa(g). The correction for pressure effect on mass flow accuracy requires the pressure effect coefficient to be a negative number as indicated in the sensor product data sheet.

4.3 Point Type 32: Linear Meter Values

Point type 32 contains the calculated parameters for the Linear Meter program. There are four logicals of this point type (one logical for each meter run).

Point Type 31: Linear Meter Setup

Parm #	Name	Access	Data Type	Length	Range	Default	Description of functionality and meaning of values
0	Point Tag ID	R/O	AC	10	0x20 -> 0x7E for Each ASCII character	" "	Point tag identification. This value is copied from point type 46, parameter 0.
1	Press Effect Factor	R/O	FLP	4	Any floating point number	1.0	If the meter type is volume: Not used. If the meter type is mass (Coriolis): Pressure effect correction factor, which is calculated from the pressure effect coefficient and the difference between the flowing and calibration pressures.

If you have comments or questions regarding this manual, please direct them to your local sales representative or contact:

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