FloBoss™ 107 Firmware

The FloBoss™ 107 firmware is the software programmed into the flash memory of the FloBoss 107 Flow Manager (FB107). The firmware determines the functions that the FB107 can perform and includes:

- Flow measurement in accordance with the 1992 American Petroleum Institute (API), International Standards Organization (ISO), and American Gas Association (AGA) standards.
- Logic and sequencing control via four user-defined Function Sequence Table (FST) programs.
- Eight closed-loop Proportional, Integral, and Derivative (PID) control capabilities.
- Custom User C program application support.
- 40 user-defined displays.
- Spontaneous-Report-by-Exception (SRBX) alarming communications to a host computer.

The firmware makes extensive use of configuration parameters, which you configure using ROCLINK™ 800 Configuration Software.

Operating System

The firmware provides a complete operating system for the FB107 and supports:

- Scheduled task executions executed in a priority order.
- Real-time clock.
- Input/output (I/O) database.
- Historical database.
- Event and alarm logs.
- User Interface.
- Communications.
- Identification and diagnosis of communication, I/O, and Multi-Variable Sensor (MVS) modules.
- Security with user access levels.

Event and Alarm Logs – The event log records the last 240 (1000 for Measurement Canada firmware) parameter changes and power on/off cycles. The alarm log records the last 240 (1000 for Measurement Canada firmware) occurrences of alarms (set or clear). You can view, save, and print logs using ROCLINK 800 software.

Real-Time Clock – You can set the real-time clock for year, month, day, hour, minute, and second. The clock provides time stamping of database values.

Input/Output Database – The input and output points supported by the operating system includes the resistance temperature detector (RTD) inputs, Multi-Variable Sensor (MVS) inputs, I/O channels on the central processing unit (CPU), I/O modules, system variables, and smart application modules.

Each input and output is assigned a point in the database. The firmware scans each input or output, placing the values into the respective database point. Each point includes configuration parameters for assigning values, status, or identifiers, as appropriate. These values are made available for display, historical archiving, control, PIDs, and FSTs.

Historical Database – The historical database provides archiving of measured and calculated values for on-demand viewing or saving to a file. You can configure each point in the historical database to archive the current value, average value, totalized value, or accumulated value, or to archive values as determined by an FST. History for meter runs includes the Averaging Techniques for all meter inputs as well as flow and energy accumulations.

History is saved to two databases, Standard and Extended History. The number of entries available to Standard and Extended History is configurable.

You can select the number of history points to archive, the sample interval time, the number of days to archive, and configure if history data is logged at the beginning of the period or the end of the period.

The **Standard History** archives up to 100 points of minimum/maximum (min/max), minute, hourly, and daily values. The min/max values are from today and yesterday; the minute values are from the last 60 minutes; hourly values are from the last 35 days; and daily values are from the last 35 or 60 days.

You can configure **Extended History** to archive up to 25 points of user-selectable values, from 1 second to 60 minute periods. Extended History archiving provides a monitoring resolution for the FB107 that is similar to a chart recorder or data logger.

User Interface – Access to data is available through the communication ports. Using ROCLINK 800 software, you can view and edit values for all FB107 features.

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Process Management

Communications – The FB107 has the capability to communicate with other devices using ROC or Modbus protocol. The firmware can automatically detect the two protocols (ROC or Modbus RTU or ASCII) at baud rates of up to 115,200 bps.

ROC protocol supports serial communications to local or remote devices, such as a host computer.

A FB107 can act as a Modbus slave device (ASCII or RTU), or it can function as a Modbus host on COM1, COM2, or COM3.

The FB107 supports up to four communication ports including:

- **Local Operator Interface (RS-232C)** – LOI for asynchronous serial communications, with DB9 connector.
- **EIA-485 (RS-485)** – COM1 for asynchronous serial communications. Standard for differential data transmission over distances of up to 1220 meters (4000 feet).
- **EIA-232 (RS-232)** – COM2 for serial communications. Standard for single-ended data transmission over distances of up to 15 meters (50 feet).
- **Optional communication modules** – COM3 optional communication modules include EIA-232 (RS-232), EIA-485 (RS-485), Dial-up Modem, and Enhanced Communication Modules.

Spontaneous-Report-By-Exception (SRBX) communication allows the FB107 to monitor for alarm conditions and, upon detection of an alarm, automatically notify the host that an alarm condition exists. SRBX occurs over a serial line if the host is set up for receiving field-initiated calls.

By using FB107 communication ports, **Pass-Through** allows data to be received by a unit and then passed through to other devices connected on another communications port. Pass-Through supports ROC Protocol and Modbus (slave).

For example, the host communicates via a radio on the FB107 COM2 port. Other FB107s can then be connected via EIA-485 (RS-485) on the COM1 port of the first FB107, and then all the FB107s can use the single radio to communicate to the host.

Security – A maximum of 16 log-on identifiers (IDs) for operators may be stored in the operating system. Each ID is associated with a user access level. For the FB107 to communicate, the log-on ID and password supplied to the ROCLINK 800 software must match one of the stored IDs. The Local Operator Interface (LOI Local Port) has security enabled by default. You can configure the host port to enable the same security protection.

RTD – The resistance temperature detector (RTD) input on the CPU monitors the temperature signal from an RTD source. The RTD can accommodate input from a three- or four-wire RTD source.

Flow Calculations

The firmware allows a variety of gas and liquid flow calculation methods including AGA3, AGA7, and ISO 5167 for up to four meter runs. Property calculation AGA8 gas compressibility is included in the firmware.

The AGA3 (1992) calculations conform to methods described in American Gas Association Report No. 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids.

The AGA7 (2006) calculations conform to methods described in American Gas Association Report No. 7, Measurement of Gas by Turbine Meters.

The ISO 5167-2003 firmware calculates gas flow. Measurement of fluid flow occurs through pressure differential devices inserted in circular cross-section pipes running full.

The AGA8 (1992) properties calculation provides the compressibility factor based on the physical chemistry of the component gases at specified temperatures and pressures using Detail, Gross I, or Gross II compressibility methods.

The AGA Reports Utility, supplied with the ROCLINK 800 software, works with the firmware to generate hourly and daily reports of a meter run. The Reports Utility creates fixed-format reports of the operational characteristics of the meter run. The Reports Utility also makes the reports available for display and saves them as disk files that can be viewed or printed later. The Reports Utility maintains an API Chapter 21.1 compliant audit trail.

Measurement Canada – A Measurement Canada version of firmware is available. Flow calculations used by Measurement Canada firmware include AGA3 (1992) or AGA7 (2006). Supercompressibility calculations used by Measurement Canada firmware include AGA8 (1992) Detail, Gross I, or Gross II.

PID Control

The PID Control applications firmware provides Proportional, Integral, and Derivative (PID) closed-loop control for a FB107, which enables the stable operation of a feedback control loop that employs a regulating device, such as a control valve. The FB107 supports eight PID control loops and may require an optional I/O CPU assembly or I/O module.

The firmware sets up independent PID algorithms (loops) in the FB107. Each PID loop has its own user-defined input, output, and override capability.

A PID control loop maintains a process variable at setpoint. If PID override control is configured, the primary loop is normally in control of the regulating device. When the change in output (user-selectable) for the primary loop

becomes lesser or greater than the change in output calculated for the secondary (override) loop, the override loop takes control of the regulating device. A typical example would be for flow control with a pressure override loop.

User C Program Capability

Optionally, you can order custom application programs developed in User C to provide functionality not included in the firmware, such as calculations for steam and custom communication drivers. Examples of custom User C programs include:

- Flow calculations.
- Properties calculations.
- Communications programs.
- Special applications.

The license key allows extended functionality, such as the use of various user programs. The FB107 supports up to seven user programs. You can transfer licenses for User C programs from a master license key to the FB107 using the ROCLINK 800 License Key Administrator. You can also remove licenses from the FB107 and store them on a master license key in the event the unit application changes.

Configurable Softpoints and Opcodes

Softpoints are global storage areas for data that can be used by any FB107 application. For example, a softpoint may store the results of a specified calculation by an FST or user program or store an intermediate result of a specified value acquired by an FST. Softpoints consist of a tag identifier, one integer value, and twenty floating values. Thirty-two softpoints provide storage for up to 704 variables.

Use the **Opcode Table** to group data being polled for more efficient communications. Parameters from different point types can be assigned to the opcode table data points, which can substantially reduce the number of polls from a host computer. The FB107 supports eight opcode tables, each with 44 values.

Function Sequence Table

The four Function Sequence Table (FST) programs give analog and discrete sequencing control capability to the FB107. An FST defines the actions to be performed by the FB107 using a series of functions. You can configure the number of FST instructions executed per scan period using ROCLINK 800 software.

FST Functions – The function is the basic building block of an FST. Functions are organized in a sequence of steps to form a control algorithm. Each function step can consist of a label, a command (CMD), and arguments.

Labels identify functions and allow branching to specific steps within an FST.

The command is selected from a library of mathematical, logical, program control and other commands. Commands are identified by a name consisting of up to three characters or symbols.

Arguments provide the means to access process I/O points and retrieve real-time values. A function may have zero, one, or two arguments.

As the sequence of functions is executed, two storage locations record the results of one function and pass them along to the next. Ten additional registers (R1 to R10) store intermediate values.

FST Editor – The FST Editor (part of the ROCLINK 800 software) allows you to create a new FST, modify an existing FST, print an FST, copy an FST to and from the FB107 or disk, start and stop the FST, change runtime parameters in the FST, and monitor and debug the FST.

The FST editor provides a workspace that accepts the entry of up to 300 lines per FST. The modes of operation for the FST editor are: Ready, Edit, Menu, Monitor, and Trace.

STEP	LABEL	CMD	ARGUMENT 1	ARGUMENT 2
000		VAL	AIN B1, EU	
001		AO	AOU B2, EU	FST 1, RR
002		>=	SFP 1, DATA1	END
003	PUMPON	DO	DOU B4, STATUS	1
004		VAL	AIN B1, EU	
005		<=	SFP 1, DATA2	PUMPON
006		DO	DOU B4, STATUS	0
007	END	END		

Function Sequence Table Example

Loop Output Power

You can configure the I/O on the CPU to set the loop output power to 10 volts dc or 24 volts dc. The I/O module only supports 24 volts dc loop output power.

The intent of the loop output power is to power devices (such as Rosemount transmitters) that require 24 volts dc to ground and then send the FB107 a 4 to 20 mA signal based on pressure, temperature, and level.

The 10-volt loop output power is intended for low power transmitters that send a 1 to 5 volt dc rather than a 4 to 20 mA signal. The loop current is designed to deliver 80 mA to power two field devices that connect back to the two analog inputs.

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History Database

Up to 100 standard history points provided, with archiving of min/max (for today and yesterday), minute (for last 60 minutes), hourly (for 35 days), and daily values (for last 35 or 60 days).

Up to 25 extended history points provided with archiving entries at 1, 2, 3, 4, 5, 10, 12, 15, 20, 30, or 60 minute or second intervals.

Flow Calculations

Meter Runs	Four
Differential	AGA3 (1992) and ISO 5167-2003
	Note: ISO 5167-2003 is not used by Measurement Canada firmware.
Pulse	AGA7 (2006)
Properties	AGA8 compressibility factor (1992); Detail, Gross I, and Gross II methods
Audit Trail	API Chapter 21.1 compliant

User Programs

Up to seven user programs

FST

Four FST programs with up to 300 lines allowed per FST

FST Command Library

Logical	NOT, AND, OR, Exclusive OR
Mathematical	Add, Subtract, Multiply, Divide, Raise to a Power, Absolute Value, Exponent (base e), Integer Value, Base 10 Logarithm, Natural Logarithm, Square Root, 3rd Order Polynomial
Comparison	Test if Equal, Not Equal, Less Than, Less Than Or Equal, Greater Than, Greater Than Or Equal
Time-Related	Set Timer, Check Timer, Wait (Suspend), Break (Delay), Day of Week, Minutes Past Midnight
Control-Related	Analog Output, Discrete Output, and Timed Discrete Output
Database	Read from Historical Database, Write to Historical Database, and Write Time to Historical Database
General	Load Value into Results Register (RR), Store RR into Database, Go To Indicated Step, End of FST, Log Alarm, and Log Event

Softpoints

Thirty-two softpoints provide global storage for up to 704 variables

Opcode Table

Eight configurable opcode tables

Logging

Standard Firmware	Events	240 before rollover
	Alarms	240 before rollover
Measurement Canada Firmware	Events	1000 before rollover
	Alarms	1000 before rollover

PID Control Parameters

Eight configurable PID control loops. Configurable PID loop parameters include:

Control Type	Selects the "modes" in which the PID loop operates: auto/manual, primary/override, AO control, DO control, stop on reset, manual tracking, and override high/low select
Input Definition	Input (process variable) assigned to the PID loop
Output Definition	Output assigned to the PID loop
Setpoint	Value to which the process variable is controlled
Setpoint EU/Min	Maximum rate at which the setpoint is allowed to ramp to a new value
Loop Period	Amount of time between PID calculations
PID Gains	Proportional, integral, and derivative gains used by the loop for desired response
Scale Factor	Ratio of output span to input (process variable) span and determines direct or reverse action for the loop
Deadband	Integral action is disabled when the process variable is within this "window"

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