FloBoss™ 103 and 104 Firmware

The FloBoss™ 103 and 104 firmware is the software programmed into the flash memory of the FloBoss 103 and 104 Flow Managers (FB103/FB104). The firmware determines the functions that these units can perform and includes:

- Real-Time Operating System, I/O processing, logging, and user interface.
- AGA flow calculations.
- Logic and sequencing control via two user-defined Function Sequence Table (FST) programs.
- Closed-loop PID control capabilities.
- Supports User C program applications.
- Spontaneous Report by Exception (SRBX) communication to a host computer.

The firmware, Version 2.00 or greater, makes extensive use of configuration parameters, which are configured using the ROCLINK™ 800 Configuration Software, Version 1.30 or greater (see *Product Data Sheet RL800*).

Operating System

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

- Task Execution.
- Real-Time Clock.
- Input/Output Database.
- Historical Database.
- Event and Alarm Logs.
- User Interface.
- Communications.
- Communication Card Identification.
- Security with User Access Levels.

Task Execution – The tasks within the FB103/104 firmware are scheduled to run by a pre-emptive Real-Time Multi-tasking Operating System (CMX). The tasks executes in a priority order.

Real-Time Clock – You can set the real-time clock for year, month, day, hour, minute, and second. The clock provides time-stamping for database values. You can elect to have the clock automatically adjust for Daylight Saving Time. The clock also calculates the day of the week and corrects for leap year.

Input/Output Database – The number of input or output points supported by the operating system includes the Resistance Thermal Detector (RTD) inputs, Dual Variable Sensor (DVS) inputs, Pulse Interface Module inputs, and optional I/O channels on the termination board.

Each input and output is assigned a point in the database; each point includes configuration parameters for assigning values, status, or identifiers, as appropriate.

The firmware scans each input, placing the values into the respective database point. These values are made available for display, historical archiving, control, PIDs, FSTs, etc.

Historical Database – The historical database archives measured and calculated values for on-demand viewing or saving to a file. Each point in the historical database can be configured to archive the current value, average value, totalized value, or accumulated value, or to archive values as determined by an FST.

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

The Standard history archives up to 35 points (8 are pre-configured) of 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; the hourly values are from the last 35 days; and the daily values are from the last 35 days.

The Extended History database creates 1 entry for up to 15 points at a user-specified interval (see Specifications table). All the points in the Extended History will be logged at the same interval.

The Extended history can be configured to archive 4 points of 10-minute values (from the last 35 days). 10-minute archiving provides a monitoring resolution for the FB103 that is similar to a chart recorder.

Event and Alarm Logs – The Event Log records the last 240 parameter changes and power on/off cycles. The Alarm Log records the last 240 occurrences of alarms (set or clear). The logs can be viewed, saved to a file, or printed by using ROCLINK 800 software.

User Interface – Access to data is made available through the Liquid Crystal Display (LCD) on the FloBoss, as well as the Local Operator Interface (LOI) port. The display allows viewing of database values gathered and stored by the operating system. With ROCLINK™ 800 software, the LOI port allows values to be viewed and edited.

Communications – The FB103/FB104 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) at baud rates of up to 19,200 bps.

The open ROC protocol used in the FB103/FB104 is the same protocol used in the ROC300-Series, FloBoss 407, and FloBoss 500-Series units. It supports serial communications and telephone modem communications to local or remote devices, such as a host computer.

An FB103/FB104 unit can act as a Modbus slave device (ASCII or RTU), or it can function as a Modbus host. Modbus slave is standard in the firmware, and Modbus host is an option available with the installation of a user program.

Spontaneous Report By Exception (SRBX) communication allows the FloBoss to monitor for alarm conditions and, upon detection of an alarm, automatically notifies the host that an alarm condition exists. This can be performed over dial-up modem or serial line, if the host is set up for receiving field-initiated calls.

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 unit 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) port has security enabled by default. The host port can be configured to enable the same security protection.

Flow Calculations

The firmware calculates gas flow through an orifice meter (AGA3 calculation) or a turbine meter (AGA7 calculation). The AGA3 calculations conform to methods described in American Gas Association Report No. 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids. The AGA7 calculations conform to methods described in American Gas Association Report No. 7, Measurement of Gas by Turbine Meters. The calculation methods are AGA3 (1992) or AGA7 (1996), with AGA8 compressibility methods (Detail, Gross I, or Gross II).

The AGA8 methods calculate the compressibility factor based on the physical chemistry of the component gasses at specified temperatures and pressures.

The AGA Reports Utility, supplied with the ROCLINK 800 software, works with 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 files that can be viewed or printed later. The Reports Utility maintains an API Chapter 21.1 compliant audit trail.

The following flow calculations can also be supported with the use of available user programs:

- ISO 5167 – Orifice, Venturi tube, Nozzle (ISA 1932 and Long radius)
- Annubar – Diamond II and 485
- McCrometer – V-cone & Wafer-cone

PID Control

The PID Control applications firmware provides Proportional, Integral, and Derivative (PID) closed-loop control for a FB103/FB104, which enables the stable operation of a feedback control loop that employs a regulating device, such as a control valve.

The firmware sets up an independent PID algorithm (loop) in the FloBoss. The PID loop has its own user-defined input, output, and override capability (see the Specifications table for a list of user-configurable parameters).

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 (as selected by user) 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 is for flow control with a pressure override loop.

User C Program Capability

The FB103/FB104 unit has User C capability that can support special applications to enhance the function of the FB103/FB104 unit. The user programs can provide communications emulation (Modbus Host), alternate flow calculations (Steam, Water, ISO5167), and alternate applications (V-cone, Annubar) support. Contact your local sales representative for more information on User C programs.

Function Sequence Table

The two Function Sequence Table (FST) programs give analog and discrete sequencing control capability to the FloBoss. An FST defines the actions to be performed by the FloBoss using a series of Functions (see the Function Sequence Table Example). The FST code resides in Static RAM and can be backed up to flash memory. The number of FST programs and the number of Functions executed per second are configurable through ROCLINK 800 software.

Functions — The basic building block of an FST is the function. Functions are organized in a sequence of steps to form a control algorithm. As shown in the Function Sequence Table Example, each function step can consist of a label, a command (CMD), and arguments.

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

The command, which is the heart of each function, is selected from a library of mathematical, logical, program control and other commands (see Specifications table). 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 are used to store the results of one function and pass them along to the next. Ten additional registers (R1-R10) are provided for storing intermediate values.

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

The editor provides a workspace that accepts the entry of up to 3000 bytes (typically 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

FloBoss™ 103 and 104 Firmware Specifications

History Database		
Standard History	Up to 35 standard history points provided, with archiving of min/max (for today and yesterday), minute (for last 60 minutes), hourly and daily values (for last 35 days). The first 8 of these are non-configurable	
Extended History	Up to 15 extended history points provided with archiving of up to 5040 entries at 1, 2, 3, 4, 5, 10, 20 or 60 minute intervals.	
Flow Calculations		
Orifice	AGA3, 1992 method and AGA7, 1996 method AGA8 compressibility factor, 1992 method Detail, Gross I, Gross II	
Meter Runs	1	
Audit Trail	API Chapter 21.1 compliant.	
User Program Supported	The following calculations can also be supported with the use of available user programs.	
	ISO 5167	Orifice, Venturi Tube, Nozzle (ISA and Long radius)
	Annubar	Diamond II and 485
	McCrometer	V-Cone and Wafer-Cone
FST		
2 FST programs with up to 3000 bytes (typically 300 steps) 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, Timed Discrete Output.	
Database	Read from Historical Database, Write to Historical Database, Write Time to Historical Database.	
General	Load Value into Results Register (RR), Store RR into Database, Go To Indicated Step, Write Message to Local Display Panel, End of FST, Log Alarm, Log Event.	
Logging		
Events	240 before rollover.	
Alarms	240 before rollover.	
PID Control Parameter		
Control type	Selects the “modes” in which the PID loop operates: auto/manual, primary/override, AO control, stop on reset, manual tracking, and override high/low select.	
Input definition	The input (process variable) assigned to the PID loop.	
Output definition	The output assigned to the PID loop.	
Setpoint	Value to which the process variable is controlled.	
Setpoint EU/Min	The maximum rate at which the setpoint is allowed to ramp to a new value.	
Loop period	The 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. Also 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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