ROC800-Series Operating System Firmware Series 2 Enhanced Architecture

The ROC800-Series Operating System Firmware provides the functionality for the ROC800-Series Remote Operations Controller (ROC). This functionality includes:

- Input / Output (I/O) Database
- Historical Database
- Event and Alarm Log Databases
- Applications
- Measurement Station Support
- Determining Task Execution
- Real-Time Clock
- Establishing and Managing Communications
- Self-Test Capability

The firmware resides in flash ROM and makes extensive use of configuration parameters. You can configure the parameters using ROCLINK™ 800 Configuration Software version 1.87 or later.

Task Execution – The ROC800-Series firmware uses a pre-emptive, multi-tasking, message-based real-time operating system with hardware-supported memory protection. The operating system determines which task runs based on priorities assigned to the tasks. For instance, if a lower priority task is executing and a higher priority task is required, the ROC suspends the lower priority task, allows the higher priority task to run to completion, and then resumes execution of the lower priority task.

Real-Time Clock – The real-time clock allows for the setting and viewing of year, month, day, hour, minute, and second. The real-time clock provides time stamping of historical, event log, and alarm log database values. The battery-backed clock tracks the day of the week and corrects for leap year.

Input/Output Database – The firmware automatically determines the type and location of each installed Input and Output (I/O) and communications module. A point assignment for each input and output occurs in the database. The point includes configuration parameters for changing behavior, assigning values, statuses, and identifiers as appropriate. The firmware scans each input, placing the values into its respective database point. These values are made available for display and historical archiving.

The firmware supports system diagnostic points and the following types of I/O modules:

- Advance Pulse Module (APM)
- Alternating Current Input/Output (ACIO)
- Analog Inputs (AI)
- Analog Outputs (AO)
- Discrete Inputs (DI)
- Discrete Outputs (DO)
- Discrete Output Relay (DOR)
- HART® (HART2)
- Multi-Variable Sensor (MVS)
- Pulse Inputs (PI) – High and Low Speed
- Resistance Temperature Detector (RTD) Inputs
- Thermocouple (T/C)

The firmware supports the following types of communication modules:

- EIA-232 (RS-232)
- EIA-485 (RS-485)
- Dial-up Modem

Configurable Historical Database – The historical database provides archiving of measured and calculated values for on-demand viewing or saving to a file. The historical database provides an audit trail per API Chapter 21.1 (Second Edition, February 2013). Each point in the historical database (up to 240 points) can be configured to archive values under various schemes, such as averaging or accumulating, as appropriate for the type of database point.

The historical database includes 13 segments. Configure each segment in the database to archive selected points at specified time intervals. The segments can continuously archive or can be turned on and off.

The historical database holds up to 240 points. The history segments 1 through 12 and the general history segment contain the distributed history points. For each history segment, you can configure the number of periodic history values archived, the frequency of archiving the periodic values, the number of daily values archived, and the contract hour. The number of minute values is fixed at 60. The 240 points provide a total of over 224,000 entries (equal to more than 35 days of 24-hour data for 240 points).

Log Databases – The Event Log records the last 450 parameter changes, power on and off cycles, calibration information, and other system events. The event includes the date and time stamp. The Alarm Log records the last 450 configured occurrences of alarms (set and/or clear). You can view, print, or save the logs using ROCLINK 800 Configuration Software.

Communications – The firmware supports ROC Plus, Modbus, Modbus with EFM extensions, Modbus encapsulated in TCP/IP, and Modbus TCP/IP Protocols. Modbus protocol communica-tions support master and slave functionality over serial ports. ROC Plus protocol supports radio, telephone modem, or serial communications to local or remote devices, such as a host computer.

The Ethernet communications port supports ROC Plus, Modbus encapsulated in TCP/IP, and Modbus TCP/IP protocol communications.

The ROC800-Series firmware also supports Modbus protocol, as a Master or Slave device using Remote Terminal Unit (RTU) or American Standard Code for Information Interchange (ASCII) modes. This allows the unit to be easily integrated into other systems. Extensions to the Modbus protocol allow the retrieval of history, event and alarm data in Electronic Flow Metering (EFM) Measurement applications.

Application Firmware – The application firmware includes: Proportional, Integral, and Derivative (PID) Control, Function Sequence Tables (FSTs), Spontaneous-Report-By-Exception (SRBX) Communications Enhancement, optional flow calculations with station support, and optional IEC 61131-3 language programs (utilizing DS800 Development Suite software). Applications reside in the firmware. You are not required to rebuild and download the firmware for changes in calculation method.

Flow Calculation Methods (Optional) – Flow calculation methods include:

- AGA and API Chapter 21.1 (Second Edition, February 2013) compliant (AGA linear and differential meter types)
- AGA 3 – Orifice Plates
- AGA 7 – Turbine Meters
- AGA 8 – Compressibility for Detailed ISO (12213-2), Gross I, and Gross II
- AGA 9 – Ultrasonic Meters
- AGA 10 – Speed of Sound
- AGA 11 – Coriolis Meters
- ISO 5167 – Orifice Plates
- ISO 9951 – Turbine Meters
- API Chapter 12, Section 2 – Volume Calculation

Full calculations are completed every second on all configured runs (up to 12) for AGA 3, AGA 7, AGA 8, AGA 9, AGA 11, ISO 5167 and ISO 9951. Full calculations are completed every minute on all configured runs (up to 12) for AGA 10.

The AGA 3 calculations conform to the methodologies in American Gas Association Report No. 3, *Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids*. Based on the 2nd and 3rd editions, the calculation method is 1992 AGA 3.

The AGA 7 calculations conform to methodologies in American Gas Association Report No. 7, *Measurement of Gas by Turbine Meters*, and use the AGA 8 method for determining the compressibility factor.

The AGA 8 method calculates the compressibility factor based on the physical chemistry of the component gases at specified temperatures and pressures.

The AGA 9 calculations conform to the methodologies in American Gas Association Report No. 9, Measurement of Gas by Multipath Ultrasonic Meters.

The AGA 10 calculations conform to the methodologies in American Gas Association Report No. 10, Speed of Sound in Natural Gas and Other Related Hydrocarbon Gases.

The AGA 11 calculations conform to the methodologies in American Gas Association Report No. 11, Measurement of Natural Gas by Coriolis Meter.

Station Capability – The ROC800-Series organizes meter runs into stations. Each of the meter runs (12 maximum) can be grouped among the stations (12 maximum) in any combination. Meter runs can be in the same station when they share common fluid properties and contract requirements, such as contract hour, gas composition, and compressibility method.

Self-Tests – The operating system firmware supports diagnostic tests on the ROC800-Series hardware, such as Random Access Memory (RAM) integrity, real-time clock operation, input power voltage, board temperature, and watchdog timer.

PID Control – The PID Control applications firmware provides Proportional, Integral, and Derivative (PID) control for a ROC800-Series unit. The ROC800-Series supports up to 16 control points with each control point supporting a primary and an override loop. Each PID loop has its own user-defined input, output, and override capability.

The typical use for PID control is to maintain a process variable at setpoint. If PID override control is configured, the primary loop is normally in control of the control device. When the change in output for the primary loop becomes less or greater (user-selected) than the change in output calculated for the secondary (override) loop, the override loop takes control of the control device. When the switchover conditions are no longer met, the primary loop regains control of the device. Parameters are also available to force the PID to stay in a specified loop.

SRBX – Spontaneous-Report-by-Exception (SRBX) communication allows the ROC800-Series to monitor for alarm conditions and, upon detection of an alarm, automatically notify a host that an alarm condition exists. You can configure SRBX alarming over a dial-up modem, radio, or serial line, as long as you configure the host to receive field-initiated calls.

Function Sequence Table – The Function Sequence Table (FST) environment provides analog and discrete sequencing control capability in the ROC800-Series controller. The FST defines the actions the ROC800-Series performs by using a series of commands. Use the FST Editor in ROCLINK 800 Configuration Software to develop FSTs.

The basic building block of an FST is the function, which shows up as a command in the FST Editor. A sequence of steps organize functions to form a control algorithm.

Each function step can consist of a label, a command, and associated arguments. Use labels to identify sections and allow branching to specific steps within an FST. You can select commands from a library of full mathematical, logical, history access, and controls.

The FST Editor provides a workspace that accepts the entry of up to 500 functions in each of the six FSTs (up to 3000 bytes total).

Licensing – The firmware, using Emerson Process Management licensing technology, provides protection for licensed intellectual property.

ROC800-Series Operating System Firmware

System Variables		
Configurable	Device group, device address, station name, active PIDs, active AGAs, and active Samplers.	
Read Only	Firmware version, time created, and CPU loading.	
Advance Pulse Module Parameters[1]		
Configurable	Point tag, API level check, meter input on prove, scan period, alarming enable, SRBX enable, detector reset, detector switch filter time, pulse output scan period, pulse input mode, output scaling value, maximum buffered pulses, maximum pulse output frequency.	
Read Only	Raw pulse count, pulse input frequency, API pulse count, meter whole pulse count, meter interpolated pulse count, alarm status, API phase alarm count, API same channel alarm, detector switch status.	
Minimum Scan Period	50 milliseconds.	
Alternating Current I/O Parameters[1]		
Configurable	Point tag, scanning input, filter, status input, scan period, input accumulated value, cumulative on time, cumulative off time, input alarming enable, SRBX alarming enable, scanning output mode (disabled, auto, manual), failsafe output, output accumulated value, failsafe on reset, momentary mode, time on, cycle time, units tag, low/high reading time, EU value, in-rush time, fault reset, output alarming, AC input frequency, failure action.	
Read Only	Power in, channel mode, physical input, actual scan time, physical output, momentary active, holding current, output alarm code.	
Minimum Scan Period	Slots 1-3	20 milliseconds
	Slots 4-27	50 milliseconds
Analog Input Parameters[1]		
Configurable	Point tag, units name, value, scan period, scanning enable, filter value, adjusted Analog/Digital (A/D) 0% and 100% values, low-reading Engineering Units (EU), high-reading EU, alarm limits, rate alarm, alarm deadband, SRBX enable, averaging enable, and clipping enable.	
Read Only	Point number, alarm state, raw A/D input, and actual scan.	
Minimum Scan Period	50 milliseconds.	
Analog Output Parameters[1]		
Configurable	Point tag, auto value, manual value, physical value, units, scanning enable, adjusted D/A 0% and 100% values, low-reading EU, high-reading EU, value on power reset, alarming enable, and SRBX enable.	
Read Only	Point number, alarm state, and raw D/A output value.	
Minimum Scan Period	50 milliseconds.	
Discrete Input Parameters[1]		
Configurable	Point tag, scan period, status enable, scanning enable, DI type (standard or latched), input type (normal or inverted), filter value, accumulated value, on/off counter, alarming enable, and SRBX enable.	
Read Only	Point number and alarm state	
Minimum Scan Period	4 milliseconds.	

1. Refer to the ROC Plus Protocol User Manual for a complete list of parameters.

Discrete Output Parameters[1]		
Configurable	Point tag, time on, state on/off, manual state on/off, momentary on/off, time on, DO type, scanning enable, accumulated value, status on power reset, units name, TDO cycle time, 0 and 100% count, low-reading time, high-reading time, low-reading EU, high-reading EU, EU value, alarming enable, and SRBX enable.	
Read Only	Point number and alarm state.	
Minimum Channel Activation Time	4 milliseconds for a DO, 48 milliseconds for a DOR.	
Pulse Input Parameters[1]		
Configurable	Point tag, units name, rate period, scan period, conversion, alarming enable, alarm limits, alarm deadband, SRBX enable, value in EUs, accumulated pulses, and EU options.	
Read Only	Point number, alarm state, current rate, and yesterday's total.	
Frequency Range	High Speed Input	0 to 12 KHz.
	Low Speed Input	0 to 125 Hz.
RTD Input Parameters[1]		
Configurable	Point tag, units name, value, scan period, units, scanning enable, filter value, bias, alarm limits (low, high, low-low, high-high, rate), RTD alpha, alarm deadband, SRBX enable, averaging enable, and clipping enable.	
Read Only	Point number, alarm state, raw A/D input, and actual scan.	
Minimum Scan Period	64 milliseconds.	
Thermocouple Input Parameters[1]		
Configurable	Point tag, J or K type, units, value, scan period, scanning enable, filter value, averaging enable, alarming enable, alarm limits, alarm deadband, and SRBX enable.	
Read Only	Point number, alarm state, current rate, and yesterday's total.	
Minimum Scan Period	150 milliseconds.	
HART® (HART2 Module) Parameters[1]		
Per Channel Configurable	Low and high reading EU, analog scanning, communications mode, output mode, output values, value on reset, pass through, and failsafe value.	
Per Device Configurable	Poll mode, dynamic variables, slot variables, tag, descriptor, and message.	
Read Only	Version, comm status, EU value, A/D values, actual scan period, current % of range, status, poll address, device ID, process variable damping value, sensor info, and process variable range units and limits.	
MVS Input Parameters[1]		
Configurable	Sensor tag, sensor address, sensor configuration, poll mode, sensor status, sensor alarms, Differential Pressure (DP) pressure and temperature readings, DP full scale, and calibrate command.	
Read Only	Point number, sensor voltage, pressure and temperature full scale, DP pressure and temperature minimum scale, static pressure effect, and manual DP, Absolute Pressure (AP), and Process Temperature (PT).	
Modbus Parameters[1]		
Master/Slave, RTU/ASCII, event log enable, master start polling, starting request, number of requests, continuous polling, poll request delay, float conversions, and mappable addresses. Extensions for retrieval of history, event and alarm data provided.		

1. Refer to the ROC Plus Protocol User Manual for a complete list of parameters.

Communications Parameters	
Configurable	Port tag, baud rate, stop bits, data bits, parity, key-on delay, key-off delay, port owner, TCP/IP, and diagnostic counters.
Database Logging	
Segment Database	Archives more than 224,000 entries (Example: 35 days of 24 hour data on 240 points) in user-configured time segments and time intervals.
Alarm Logs	Records 450 alarms, such as high, high-high, low, low-low, and rate.
Event Logs	Records 450 events, such as parameter changes and power cycling.
Control	
FST	Maximum of six FSTs with up to 3000 bytes each (typically 500 lines), full math, logical and control commands.
PID	Maximum of up to 16 loops, primary or override, analog or discrete control action support.
DS800 Development Suite	Multiple resources per ROC800-Series are supported.

1. Refer to the ROC Plus Protocol User Manual for a complete list of parameters.

Headquarters:
Emerson Process Management
Remote Automation Solutions
6005 Rogerdale Road
Houston, TX 77072 U.S.A.
T +1 281 879 2699 | F +1 281 988 4445
www.EmersonProcess.com/Remote

Europe:
Emerson Process Management
Remote Automation Solutions
Unit 8, Waterfront Business Park
Dudley Road, Brierly Hill
Dudley UK DY5 1LX
T +44 1384 487200 | F +44 1384 487258
www.EmersonProcess.com/Remote

North American/Latin America:
Emerson Process Management
Remote Automation Solutions
6005 Rogerdale Road
Houston TX USA 77072
T +1 281 879 2699 | F +1 281 988 4445
www.EmersonProcess.com/Remote

Middle East/Africa:
Emerson Process Management
Remote Automation Solutions
Emerson FZE
P.O. Box 17033
Jebel Ali Free Zone – South 2
Dubai U.A.E.
T +971 4 8118100 | F +971 4 8865465
www.EmersonProcess.com/Remote

Asia-Pacific:
Emerson Process Management
Remote Automation Solutions
1 Pandan Crescent
Singapore 128461
T +65 6777 8211| F +65 6777 0947
www.EmersonProcess.com/Remote