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ROC809 Remote Operations Controller

Instruction Manual

Flow Computer Division

Website: www.emersonprocess.com/flow

EMERSON. Process Management

Revision Tracking Sheet

February 2005

This manual is revised periodically to incorporate new or updated information. The revision level of each page is indicated at the bottom of the page opposite the page number. A major change in the content of the manual also changes the date of the manual that appears on the front cover. Listed below is the revision level of each page.

Page	**Revision**
All Pages	Feb/05
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SECTION 1 – GENERAL INFORMATION

This manual focuses on the hardware aspects of the ROC809 Remote Operations Controller. For information about the software, refer to the *ROCLINK™ 800 Configuration Software User Manual* (Form A6121).

This manual contains the following sections:

Section 1 – General Information provides an overview of the ROC809 hardware and specifications.

Section 2 – Installation and Use provides information on installation, tools, wiring, mounting the ROC809, and other essential elements of the ROC809 unit.

Section 3 – Power Connections provides information and specifications for the power input modules available for the ROC809.

Section 4 – Input/Output (I/O) Modules provides information and specifications for the Input / Output (I/O) modules available for the ROC809.

Section 5 – Communications provides information and specifications for the built-in communications and the optional communication modules available for the ROC809.

Section 6 – Troubleshooting provides information on diagnosing and correcting problems for the ROC809.

Section 7 – Calibration provides information for calibrating Analog Inputs, HART Inputs, RTD Inputs, and MVS Inputs for the ROC809.

Glossary – Provides definitions of acronyms and terms.

Index – Lists alphabetically the items contained in this manual, including the section and page number.

The ROC809 Remote Operations Controller is a microprocessor-based controller that provides the functions required for a variety of field automation applications. The ROC809 controller is ideal for applications requiring general logic and sequencing control, historical data archiving, multiple communication ports, Proportional, Integral, and Derivative (PID) control, and flow measurement on up to twelve meter runs.

1.1 Hardware

The ROC809 controller is highly innovative and versatile with a backplane to which the Central Processor Unit (CPU), power input module, communication modules, and I/O modules connect. The ROC809 unit has nine module slots, of which three can house communication modules.

The ROC809 uses a power input module to convert external input power to the voltage levels required by the ROC809 unit's electronics and to monitor voltage levels to ensure proper operation. Two power input modules are available for the ROC809: 12 volts dc and 24 volts dc. For more information on the power input modules, refer to Section 2.5.

The internal Sanyo 3 volt CR2430 lithium backup battery provides backup of the data and the Real-Time Clock when the main power is not connected. The battery has a one-year minimum backup life while the battery is installed and no power is applied to the ROC809. The battery has a ten-year backup life while the backup battery is installed and power is applied to ROC809 unit or when the battery is removed from the ROC809.

The ROC809 supports of a variety of communication protocols: ROC Plus, Modbus, Modbus TCP/IP, Modbus encapsulated in TCP/IP, and Modbus with Electronic Flow Measurement (EFM) extensions.

Figure 1-1 shows the housing, typical I/O modules, and communication modules installed into a ROC809. The ABS (Acrylonitrile Butadiene Styrene) plastic housing has wire covers to protect the wiring terminals. The housing includes DIN rail mounts for mounting on a panel or in a user-supplied enclosure.

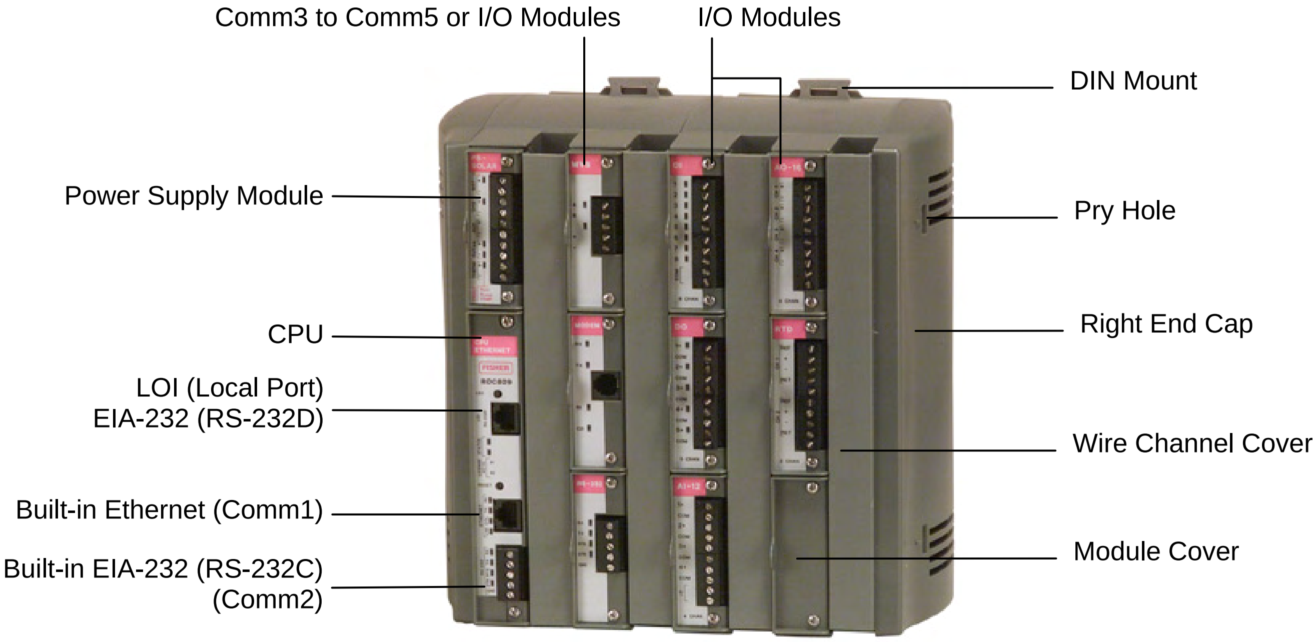


Figure 1-1. ROC809 Module Rack

The CPU (Central Processing Unit) contains the microprocessor, the firmware, a connector to the backplane, the three built-in communication ports, a LED low power wakeup button, a RESET button, the application License Key connectors, a STATUS LED indicating system integrity, diagnostic Light-Emitting Diodes (LEDs) for two of the communications ports, and the main processor.

A maximum of nine Input/Output (I/O) modules can be added to satisfy a wide variety of field I/O requirements. Refer to Section 3, Input/Output Modules. I/O modules include:

- Analog Inputs (AI).
- Analog Outputs (AO).
- Discrete Inputs (DI).
- Discrete Outputs (DO).
- Digital Relay Outputs (DOR).
- HART Inputs/Outputs.
- Pulse Inputs (PI) – High/Low Speed.
- RTD Inputs (RTD).
- J and K Type Thermocouple (T/C) Inputs.

The ROC809 unit allows up to six communication ports. Refer to Section 4, Communications. Three communication ports are built-in:

- **Local Operator Interface (LOI) –** Local Port EIA-232 (RS-232D).
- **Ethernet –** Comm1 Port for use with the DS800 Development Suite Software.
- **EIA-232 (RS-232C) –** Comm2 Port for point-to-point asynchronous serial communications.

Communication modules provide additional ports for communicating with a host computer or other devices (Installed in Comm3 to Comm5) and include:

- **EIA-232 (RS-232C) –** used for point-to-point asynchronous serial communications include Data Terminal Ready (DTR) support, Ready To Send (RTS) support, and radio power control.
- **EIA-422/EIA-485 (RS-422/RS-485) –** used for point-to-point (EIA-422) or multiple-point (EIA-485) asynchronous serial communications.
- **Multi-Variable Sensor (MVS) –** interfaces with MVS Sensors (up to two modules per ROC809).
- **Dial-up modem –** used for communications over a telephone network (14.4K V.42 bis with throughput up to 57.6K bps).

I/O and communication modules easily install in the module slots. Modules may be removed and installed while the unit is powered up (hot-swappable), modules may be installed directly into unused module slots (hot-pluggable), and modules are self-identifying in the ROCLINK 800 Configuration Software. The modules have extensive short circuit, overvoltage protection, and are self-resetting after a fault clears.

1.1.1 Central Processor Unit (CPU)

The CPU (Central Processing Unit) contains the microprocessor, the firmware, connectors to the backplane, the three built-in communication ports two with Light-Emitting Diodes (LEDs), a LED low power wakeup button, a RESET button, the application License Key connectors, a STATUS LED indicating system integrity, and the main processor.

The CPU components include:

- 32-bit microprocessor based on Motorola® MPC862 Quad Integrated Communications Controller (PowerQUICC™) PowerPC® processor.
- SRAM (Static Random Access Memory) with battery backup.
- Flash ROM (Read-Only Memory).
- SDRAM (Synchronous Dynamic Random Access Memory).
- Diagnostic monitoring.
- Real-Time Clock.
- Automatic self-tests.
- Power saving modes.
- Local operator interface (LOI) EIA-232 (RS-232D) Local Port.
- EIA-232 (RS-232C) serial Comm2 port.
- Ethernet Comm1 port.

1.1.2 Processor and Memory

The ROC809 uses a 32-bit microprocessor with processor bus clock frequency at 50 MHz with a watchdog timer. The Motorola® MPC862 Quad Integrated Communications Controller (PowerQUICC™) PowerPC® processor and the Real-Time Operating System (RTOS) provide both hardware and software memory protection.

1.1.3 Real-Time Clock

The Real-Time Clock can be set for year, month, day, hour, minute, and second. The clock provides time stamping of the database values. The battery-backed clock firmware tracks the day of the week, corrects for leap year, and adjusts for daylight savings time (user-selectable). The time chip automatically switches to backup power when the ROC809 unit loses primary input power.

The internal Sanyo 3 volt CR2430 lithium backup battery provides backup of the data and the Real-Time Clock when the main power is not connected. The battery has a one-year minimum backup life while the battery is installed and no power is applied to the ROC809. The battery has a ten-year backup life while the backup battery is installed and power is applied to ROC809 unit or when the battery is removed from the ROC809.

If the Real-Time Clock does not keep the current time when power is removed, replace the lithium battery. Refer to Section 3.5.3.

1.1.4 Diagnostic Monitoring

The ROC809 has diagnostic inputs incorporated into the circuitry for monitoring system integrity. Use ROCLINK 800 software to access the System Analog Inputs. Refer to Table 1-1.

Table 1-1. System Analog Inputs

System AI Point Number	Function	Normal Range
1	Battery Input Voltage	11.25 to 16 volts dc
2	Charge in Voltage	0 to 18 volts dc
3	Module Voltage	11.00 to 14.50 volts dc
4	Not Used	Not Used
5	On Board Temperature	-40 to 85°C (-40 to 185°F)

1.1.5 Options

The ROC809 unit allows you to choose from a wide variety of options to suit many applications.

Optional **communication modules** include: EIA-232 (RS-232) serial communications, EIA-422/485 (RS-422/485) serial communications, Multi-Variable Sensor (MVS), and Dial-up modem communications. Refer to Section 4, Communications.

The ROC809 unit can handle up to two **MVS interface modules**. This permits communications with up to 12 sensors per ROC809 unit and providing power to 10 sensors per ROC809 unit. Refer to Section 4, Communications.

Optional **I/O modules** include: Analog Inputs, Analog Outputs, Discrete Inputs, Discrete Outputs, Pulse Inputs, RTD Inputs, and Thermocouple Inputs. Refer to Section 3, Input/Output Modules.

The optional application **License Keys** provide extended functionality, such as the use of the IEC 61131-3 compliant DS800 Development Suite Software, user programs, and meter runs. In order to perform AGA calculations, a License Key with the proper license is required. Refer to Section 1.5, DS800 Development Suite Software, on page 1-11.

The Local Operator Interface (LOI) communications terminal requires an **LOI cable** to be installed between the ROC809 unit and PC. The LOI port uses an RJ-45 connector with standard EIA-232 (RS-232D) pin out.

1.2 FCC Information

This equipment complies with Part 68 of the FCC rules. Etched on the modem assembly is, among other information, the FCC certification number, and Ringer Equivalence Number (REN) for this equipment. If requested, this information must be provided to the telephone company.

A FCC compliant telephone modular plug is provided with this module. The module is designed to be connected to the telephone network or premises' wiring, using a compatible modular jack that is Part 68 compliant.

The REN is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. Typically, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to a line (as determined by the total RENs), contact the local telephone company.

If this equipment, dial-up modem, causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. However, if advance notice is not practical, the telephone company will notify the customer as soon as possible. In addition, you will be advised of your right to file a complaint with the FCC if you believe it necessary.

The telephone company may make changes to its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice so you can make the necessary modifications to maintain uninterrupted service.

If trouble is experienced with this equipment, dial-up modem, for repair or warranty information, please contact Emerson Process Management, Flow Computer Division (641) 754-3923. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

1.3 Firmware

The firmware that resides in Flash Read-Only Memory (ROM) contains the operating system, ROC Plus communications protocol, and application software. The CPU module provides battery-backed SRAM (Static Random Access Memory) for saving configurations, storing events, alarms, and the historical logs.

The ROC800-Series Operating System Firmware provides a complete operating system for the ROC809 Remote Operations Controller. The firmware in the ROC809 is field-upgradeable using a serial connection or LOI. For more information, refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

The firmware supports:

- ♦ Input/Output Database.
- ♦ Historical Database.
- ♦ Event and Alarm Log Databases.
- ♦ Applications (PID, AGA, FST, etc.)
- ♦ Measurement Station Support.
- ♦ Determining Task Execution.
- ♦ Real-Time Clock.
- ♦ Establishing and Managing Communications.
- ♦ Self-Test Capability.

The firmware makes extensive use of configuration parameters, which are configured using ROCLINK 800 Configuration Software.

The ROC800-Series firmware uses a pre-emptive, multi-tasking, message-based Real-Time Operating System with hardware-supported memory protection. Tasks are assigned priorities and, at any given time, the operating system determines which task will run. For instance, if a lower priority task is executing and a higher priority task needs to run, the operating system suspends the lower priority task, allows the higher priority task to run to completion, then resumes the lower priority task's execution. This is more efficient than "time sliced" type architectures.

The ROC809 reads and writes to each **Point** in the unit. A Point is a software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of **Parameters**. The **Point Number** indicates the physical location for I/O or logical instance for non-I/O points within the ROC809. The **Point Type** attributes define the database point to be one of the possible types of points available to the system. These three parameters can be used to identify a specific piece of data in a ROC809 and is sometimes referred to as the TLP (Type, Logical, Parameter)

The Input/Output database contains the input and output points supported by the operating system firmware including the System Analog Inputs, Multi-Variable Sensor (MVS) inputs and Input/Output (I/O) modules. The firmware automatically determines the Point Type and Point Number location of each installed I/O module. Each input and output is assigned a point in the database and includes user-defined configuration parameters for assigning values, statuses, or identifiers. The firmware scans each input, placing the values into the respective database point. These values are available for display and historical archiving.

Spontaneous-Report-by-Exception (SRBX) communication allows the ROC809 to monitor for alarm conditions and, upon detection of an alarm, automatically reports the alarm to a host computer. This can be performed over any kind of communications link – dial-up modem or serial line – as long as the host is set up for receiving field-initiated calls.

The firmware supports ROC Plus protocol, Modbus master and slave protocol. ROC Plus protocol can support serial communications and radio or telephone modem communications to local or remote devices, such as a host computer. There is also support for ROC Plus protocol over TCP/IP on the

Ethernet port. The ROC Plus protocol is similar to the ROC 300/400/500 protocol. For more information, contact your local sales representative.

The ROC800-Series firmware also supports Modbus protocol, as Master or Slave device using RTU or ASCII modes. This allows the unit to be easily integrated into other systems. Extensions to the Modbus protocol are provided that allow the retrieval of history, event and alarm data in Electronic Flow Metering (EFM) Measurement applications.

The ROCLINK 800 software provides for access to the ROC809 unit. A maximum of 16 case sensitive user identifiers (User IDs) may be stored. In order for the ROC809 unit to communicate, a case sensitive log-on ID supplied to the ROCLINK 800 software must match one of the IDs stored in the ROC809.

The operating system firmware supports the application-specific firmware supplied in the Flash ROM. The application firmware includes: Proportional, Integral, and Derivative (PID) Control, FSTs, Spontaneous-Report-By-Exception (SRBX) Communications Enhancement, optional American Gas Association (AGA) Flow calculations with station support, and optional IEC 61131-3 language programs (utilizing DS800 Development Suite software). Applications are resident in the firmware. The user is not required to re-build and download the firmware for changes in calculation method.

1.3.1 Historical Database and Event Log

The historical database provides archiving of measured and calculated values for on-demand viewing or saving to a file. It provides an audit trail per API Chapter 21.1. Each point in the historical database (up to 200 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 is maintained in 11 segments. Each segment in the database can be configured to archive selected points at specified time intervals. The segments can continuously archive or can be turned on and off.

The history database holds up to 200 points. History points can be distributed among history segments 1 through 10 and the general history segment. For each history segment, the number of periodic history values archived, the frequency of archiving the periodic values, the number of daily values archived, and the contract hour are configurable. The number of minute values is fixed at 60. The 200 points provide a total of over 197,000 entries (equal to more than 35 days of 24-hour data for 200 points).

The Event Log records the last 450 parameter changes, power on/off cycles, calibration information, and other system events. The event is recorded along with a date/time stamp. The Alarm Log records the last 450 configured occurrences of alarms (set and/or clear). The logs can be viewed, saved to a disk file, or printed using ROCLINK 800 Configuration Software.

1.3.2 Meter Runs and Stations

Similarly configured meter runs can be grouped into stations. The largest benefit of using stations is in configuring and reporting. Configuration is provided for each meter run. As a result, redundant meter run data within a station is eliminated to enable faster data processing.

The meter runs can be grouped among the twelve stations (maximum) in any combination. Meter runs belong in the same station when they have the same gas composition data and calculation methods. Stations allow for:

- ♦ Contract hours to be set differently for each station.
- ♦ Several individual meter runs to be designated as part of a station.

- ♦ One to twelve meter runs to be configured for each station.

1.3.3 Flow Calculations

Gas and liquid calculation methods include:

- ♦ **AGA and API** Chapter 21 compliant (AGA linear and differential meter types).
- ♦ **AGA 3 –** Orifice Plates. [gas]
- ♦ **AGA 7 –** Turbine Meters (ISO 9951). [gas]
- ♦ **AGA 8 –** Compressibility. Detailed (ISO 12213-2), Gross I (ISO 12213-3), and Gross II. [gas]
- ♦ **ISO 5167 –** Orifice Plates. [liquid]
- ♦ **API 12 –** Turbine Meters. [liquid]

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

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

The AGA 7 calculations conform to methods described 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 gasses at specified temperatures and pressures.

Liquid calculation methods, ISO 5167 and API 12, are supported. API 12 correction factors must be supplied through an FST or user program.

1.3.4 Automatic Self Tests

The operating system firmware supports diagnostic tests on the ROC809 hardware, such as RAM integrity, Real-Time Clock operation, input power voltage, board temperature, and watchdog timer.

The ROC809 performs the following self-tests on a periodic basis:

- ♦ Voltage tests (battery low and battery high) ensure the ROC809 has enough power to run while not allowing the battery to be overcharged. The ROC809 operates with 12 volts dc (nominal) power. The LEDs become active when input power with the proper polarity and startup voltage (9.00-11.25 volts dc) is applied to the BAT+ / BAT– connectors. Refer to Table 1-1.

- ♦ The software watchdog is controlled by the CPU. This watchdog checks the software for validity every 2.7 seconds. If necessary, the processor automatically resets.

- ♦ The ROC809 monitors Multi-Variable Sensor(s), if applicable, for accurate and continuous operation.

- ♦ A memory validity self-test is performed to ensure the integrity of memory.

1.3.5 Low Power Modes

The ROC809 uses low power operation under predetermined conditions. Two low power modes are supported: Standby and Sleep.

Standby — This mode is used during periods of inactivity. When the operating system cannot find a task to run, the ROC809 enters Standby mode. This mode keeps all peripherals running and is transparent to the user.

Wake-up from Standby occurs when the ROC809 needs to perform a task.

Sleep — This mode is used if a low battery voltage is detected. This mode only applies to ROC800-Series units with the 12 V dc power input module. The battery voltage is measured by System AI Battery Point Number 1 and is compared to the LoLo Alarm limit associated with this point. The default value for the LoLo Alarm limit is 10.6 volts dc. When in Sleep mode, AUX_{sw} is turned off. For information on configuring alarms and System AI points, refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).

1.3.6 PID

The PID Control applications firmware provides Proportional, Integral, and Derivative (PID) gain control for the ROC809 and enables the stable operation of 16 feedback control-loops that employ a regulating device, such as a control valve.

The firmware sets up an independent PID algorithm (loop) in the ROC809. The 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 a setpoint. If PID override control is configured, the primary loop is normally in control of the regulating 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 regulating 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 into either loop or force it to stay in one loop.

1.3.7 FST

The Function Sequence Table (FST) applications firmware gives analog and discrete sequencing control capability to the ROC809. This programmable control is implemented in an FST, which defines the actions to be performed by the ROC809 using a series of functions. The FST is developed using the FST Editor in ROCLINK 800 Configuration Software.

The basic building block of an FST is the function. Functions are organized in a sequence of steps to form a control algorithm. Each function step can consist of a label, a command, and associated arguments. Labels are used to identify functions and allow branching to specific steps within an FST. Commands are selected from a library of mathematical, logical, and other command options. Commands are identified by a name consisting of up to three characters or symbols. Finally, arguments provide access to process I/O points and retrieve real-time values. A function may have zero, one, or two arguments.

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

1.4 ROCLINK 800 Configuration Software

The ROCLINK 800 Configuration Software, a Windows®-based program, provides the capability to monitor, configure, and calibrate ROC800-Series Remote Operations Controllers.

The ROCLINK 800 software has a standard, easy to use Windows interface. Tree based navigation makes accessing features quick and easy.

Many of the configuration screens, such as stations, meters, I/O, and PIDs, are available while ROCLINK 800 software is off-line. Configuration can be made while on-line or off-line with the ROC809.

The Local Operator Interface (LOI) port provides a direct link between the ROC809 unit and a personal computer (PC). The LOI port uses an RJ-45 connector with standard EIA-232 (RS-232D) pinout. With the computer running ROCLINK 800 Configuration Software, you can locally configure the ROC809, extract data, and monitor its operation.

Configuration can be made remotely from a host computer using a serial or dial-up modem communications line. Configurations can be duplicated and saved to a disk. In addition to creating a backup, this feature is useful when multiple ROC809 units requiring similar configurations are being configured for the first time, or when configuration changes need to be made off-line. Once a backup configuration file is created, it can be loaded into a ROC809 by using the Download function.

Access to the ROC809 is restricted to authorized users with correct User ID and password.

You can build custom displays for the ROC809 that combines both graphic and dynamic data elements. The displays can monitor the operation of the ROC809 either locally or remotely.

Historical values can be archived for any numeric parameter in the ROC809. For each parameter configured for historical archiving, time-stamped minute, periodic, and daily data values are kept as well as yesterday's and today's daily minimum and maximum values.

History values can be collected from the ROC809 via ROCLINK 800 or other third-party host system. You can view history directly from the ROC809 or from a previously saved disk file. For each history segment, the number of periodic history values archived, the frequency of archiving the periodic values, the number of daily values archived, and the contract hour are configurable.

ROCLINK 800 software has the ability to create an EFM (Electronic Flow Measurement) report file that contains all the configuration, alarms, events, periodic and daily history logs, and other history logs associated with the stations and meter runs in the ROC809. This file then becomes the custody transfer audit trail.

The SRBX (Spontaneous-Report-By-Exception) alarming feature is available for the host communication ports (the Local and Dial-up modem ports). SRBX allows the ROC809 to contact the host to report an alarm condition.

Use ROCLINK 800 software to:

- Configure and view Input/Output (I/O) points, flow calculations, meter runs, PID control loops, system parameters, and power management features.
- Retrieve, save, and report historical data.
- Retrieve, save, and report events and alarms.
- Perform five-point calibration on Analog Inputs and Multi-Variable Sensor Inputs.
- Implement user security.
- Create, save, and edit graphical displays.
- Create, save, edit, and debug Function Sequence Tables (FSTs) of up to 500 lines each.
- Setup communication parameters for direct connection, telephone modems, and other communications methods.
- Configure Modbus parameters.
- Setup radio power control.
- Update the firmware.

1.5 DS800 Development Suite Software

DS800 Development Suite Software allows you to program in any one of the five IEC 61131-3 languages. DS800 applications can be downloaded to a ROC809 unit over the Ethernet port, independent of the ROCLINK 800 Configuration Software.

DS800 Development Suite Software allows programming in all five of the IEC 61131-3 languages:

- Ladder Logic Diagrams (LD).
- Sequential Function Chart (SFC).
- Function Block Diagram (FBD).
- Structured Text (ST).
- Instruction List (IL).

A Flow Chart language is also provided as a sixth programming language. With these six languages, FSTs, and built-in functionality, you can configure and program the ROC809 in an environment in which you are comfortable.

Programs developed in the DS800 Development Suite Software may be downloaded and implemented in the ROC809 unit in addition to, or as an alternative to, FST programs. DS800 software has definite benefits for programmers who prefer to use the IEC 61131-3 languages, who desire to multi-drop units in a distributed architecture, or who desire enhanced program diagnostics capabilities.

DS800 Development Suite Software has the additional following features:

- Cross-reference (bindings) between variables in separate ROC809 units.
- Variable Dictionary.
- Off-line simulation for diagnostics and testing.
- On-line modification of programs.
- On-line debugging of programs.

- Locking and forcing of variables.
- User developed functions and function blocks.
- User defined templates.
- Creation and support of user defined libraries.

1.6 Specifications

ROC809 Remote Operations Controller Specifications

PROCESSOR

32-bit microprocessor based on the Motorola MPC862 Quad Integrated Communications Controller (PowerQUICC™) PowerPC processor running at 50 MHz.

PROCESSOR MEMORY

Boot Flash: 256 KB for system initialization and diagnostics.

Flash: 4 MB for firmware image.

SRAM: 1 MB for Historical Data Logs and configuration.

Synchronous DRAM: 8 MB for firmware execution and execution memory.

I/O MODULES

Analog Input-12: 4 channels. 12 bits of resolution.
Analog Output: 4 channels.
Discrete Input: 8 channels.
Discrete Output: 5 channels.
Digital Relay Output: 5 channels.
HART Input/Output: 4 channels, each capable of communications with up to 5 HART devices (when in input multi-drop mode).
Pulse Input: 2 channels – high speed or low speed is user-selectable per channel.
RTD Input: 2 channels.
J & K Type Thermocouple Input: 5 channels – type is software configurable per channel.

Refer to Specification Sheets 6.3:HART, 6.3:IOM1, 6.3:IOM2, 6.3:IOM3, and 6.3:IOM4.

EIA-232 (RS-232) PORT ON CPU

Type: Single. 57,600 bps Maximum Data Rate.

Refer to Specification Sheet 6.3:COM.

ETHERNET PORT ON CPU

Type: 10BASE-T twisted pair. IEEE multi-segment 10 MB/second baseband Ethernet.

Maximum Segment: 100 m (330 ft).

LOI PORT ON CPU

Type: EIA-232D (RS-232D) Standard. 57,600 bps Maximum Data Rate.

Refer to Specification Sheet 6.3:COM.

BOARD TEMPERATURE ACCURACY

1% typical, 2% maximum.

POWER REQUIREMENTS

Base system draws 70 mA typical at 12 V dc, or 35 mA Typical at 24 V dc (power module, backplane, and CPU).

12 V dc Module Recommended Voltage Range: 11.5 to 14.5 V dc.
12 V dc Module Maximum Voltage Range: 11.25 to 16 V dc.
24 V dc Module Operating Input Range (+): 20 to 30 V dc.

BATTERY BACKUP

User-replaceable.

Type: Sanyo 3 V CR2430 lithium.

Normal use life: 10 years while power is applied to unit.

Backup life: 1 year minimum while jumper is disengaged and no power is applied to unit.

Shelf life: 10 years.

VOLTAGE MONITOR ACCURACY

0.75% typical, 1% maximum.

TIME FUNCTIONS

Clock Type: 32 KHz crystal oscillator with regulated supply, battery-backed. Year/Month/Day and Hour/Minute/Second, with Daylight Savings Time control.

Clock Accuracy: 0.01%.

Watchdog Timer: Hardware monitor expires after 3 seconds and resets the processor.

MATERIALS

Case: Acrylonitrile Butadiene Styrene (ABS) Plastic.

Wire Channel Covers: Polypropylene Plastic.

Modules: Thermoplastic Polyester, solvent-resistant.

WIRING

Size 12 AWG or smaller for terminal blocks.

DIN RAILS

Size: 35.

DIMENSIONS

241 mm H by 244 mm W by 174 mm D (9.5 in. H by 9.6 in. W by 6.85 in. D), allow an additional 19 mm (.75 in) for cables.

ROC809 Remote Operations Controller Specifications (Continued)

WEIGHT

1.65 kg (3.65 lb) for housing, backplane and CPU.

I/O Modules: Vary from 49-60 g (1.76-2.1 oz).
Modem Module: 113.4 g (4 oz).
EIA-232 (RS-232) Module: 47.6 g (1.68 oz).
EIA-422/485 (RS-422/485) Module: 49.9 g (1.76 oz).
MVS Module: 61.2 g (2.16 oz).
12 VDC Power Input Module: 97.5 g (3.44 oz).
24 VDC Power Input Module: 120 g (4.24 oz).

ENVIRONMENTAL

Operating Temp.: -40 to 75°C (-40 to 167°F).
Storage Temp.: -40 to 85°C (-40 to 185°F).
Relative Humidity: IEC68-2-3; 5-95% non-condensing.
Vibration: IEC68-2-6; 0.15 mm/sec^2 @10-150 Hz.
Mechanical Shock: IEC68-2-27; 11 ms, sinusoidal 50 Gs non-operating, 15 Gs operating.
Thermal Shock: IEC68-2-14; Air to air from -20 to 85°C (-4 to 185°F).

APPROVALS

Complies with the following European Standards:
EN55011 (Emissions).
EN61000-4-2 (Electrostatic Discharge Immunity).
EN61000-4-4 (Electrical Fast Transients Immunity).
EN61000-4-6 (Conducted Immunity).
EN61000-4-8 (Power Frequency Magnetic Field Immunity).
EN61000-6-2 (Radiated RF Immunity).

Evaluated per the following North American Standards:
CSA C22.2 No. 142 & No. 213.
CAN/CSA E79-0-95 & E79-15-95.
UL 1604. 3rd Edition.
UL 508. 17th Edition.
UL 2279.

Product Markings for Hazardous Locations:
Class I, Division 2, Groups A, B, C, and D, T4A.
Class I, Zone 2, Group IIC, T4A.
AEx nA IIC, T4A.

ROC809 Operating System Firmware Specifications

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.

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, RBX enable, averaging enable, and clipping enable.

Read Only: Point number, alarm state, raw A/D input, and actual scan.

Minimum Scan Period: 50 msec.

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 RBX enable.

Read Only: Point number, alarm state, and raw D/A output value.

Minimum Scan Period: 50 msec.

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 RBX enable.

Read Only: Point number and alarm state.

Minimum Scan Period: 4 msec.

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 RBX enable.

Read Only: Point number and alarm state.

Minimum Channel Activation Time: 4 msec for a DO, 48 msec for a DOR.

PULSE INPUT PARAMETERS[1]

Configurable: Point tag, units name, rate period, scan period, conversion, alarming enable, alarm limits, alarm deadband, RBX 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: 0-12 KHz, Low Speed Input: 0-125 Hz.

RTD INPUT PARAMETERS[1]

Configurable: Point tag, units name, value, scan period, units, scanning enable, filter value, raw A/D input, alarm limits (low, high, low-low, high-high, rate), RTD alpha, alarm deadband, RBX enable, averaging enable, and clipping enable.

Read Only: Point number and alarm state.

Minimum Scan Period: 64 msec.

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 RBX enable.

Read Only: Point number, alarm state, current rate, and yesterday's total.

Minimum Scan Period: 150 msec.

HART INPUT/OUTPUT PARAMETERS

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, pv damping value, sensor info, and pv range units and limits.

ROC809 Operating System Firmware Specifications (Continued)

MVS INPUT PARAMETERS[1]

Configurable: Sensor tag, sensor address, sensor configuration, poll mode, sensor status, sensor alarms, 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 Differential Pressure (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.

COMMUNICATIONS PARAMETERS[1]

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 197,000 entries (for example: 35 days of 24 hour data on 200 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 6 up to 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. Refer to Specifications Sheet 4.1:DS800.

1. Refer to the ROC Plus Protocol User Manual (Form A6127) for a complete list of parameters.

SECTION 2 – INSTALLATION AND USE

This section describes the housing (case), the backplane (electronic connection board at the back of the housing), and the CPU (Central Processing Unit). This section provides a description and specifications of these hardware items and explains installation and startup of the ROC809.

2.1 Installation Requirements

The design of the ROC unit makes it highly adaptable to a wide variety of installations; therefore, not all possibilities can be covered in this manual. If information is required concerning a specific installation not contained in this manual, contact your local sales representative.

Planning is essential to a good installation. Because installation requirements depend on many factors, such as the application, location, ground conditions, climate, and accessibility, this document only provides generalized guidelines.

2.1.1 Environmental Requirements

Always install the ROC unit in a user-supplied enclosure, as the ROC unit requires protection from direct exposure to rain, snow, ice, blowing dust or debris, and corrosive atmospheres. If the ROC unit is installed outside a building, it must be placed in a National Electrical Manufacturer’s Association (NEMA) 3 or higher rated enclosure to ensure the necessary level of protection.

- ❖ **NOTE:** In salt spray environments, it is especially important to ensure that the enclosure is sealed properly, including all entry and exit points.

ROC units operate over a wide range of temperatures. However, in extreme climates it may be necessary to provide temperature-controlling devices to maintain stable operating conditions. In extremely hot climates, a filtered ventilation system or air conditioning may be required. In extremely cold climates, it may be necessary to provide a thermostatically controlled heater in the same enclosure as the ROC unit. To maintain a non-condensing atmosphere inside the ROC enclosure in areas of high humidity, it may be necessary to add heat or dehumidification.

2.1.2 Site Requirements

Careful consideration when locating the ROC unit on the site can help reduce future operational problems. Consider the following items when choosing a location:

- ♦ Local, state, and federal codes often place restrictions on locations and dictate site requirements. Examples of these restrictions are fall distance from a meter run, distance from pipe flanges, and hazardous area classifications. Ensure that all code requirements are met.
- ♦ Choose a location for the ROC to minimize the length of signal and power wiring.
- ♦ ROC units equipped for radio communications should be located so the antenna has an unobstructed signal path. Antennas should not be aimed into storage tanks, buildings, or other tall structures. If possible, antennas should be located at the highest point on the site. Overhead clearance should be sufficient to allow the antenna to be raised to a height of at least twenty feet.
- ♦ To minimize interference with radio communications, choose a location for the ROC away from electrical noise sources, such as engines, large electric motors, and utility line transformers.
- ♦ Choose a location for the ROC away from heavy traffic areas to reduce the risk of being damaged by vehicles. However, provide adequate vehicle access to aid monitoring and maintenance.
- ♦ The site must comply with class limits of Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) the device must accept any interference received, including interference that may cause undesired operation.

2.1.3 Compliance with Hazardous Area Standards

The ROC hazardous location approval is for Class I, Division 2, Groups A, B, C, and D. The Class, Division, and Group terms include:

1. **Class** defines the general nature of the hazardous material in the surrounding atmosphere. Class I is for locations where flammable gases or vapors may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
2. **Division** defines the probability of hazardous material being present in an ignitable concentration in the surrounding atmosphere. Division 2 locations are locations that are presumed to be hazardous only in an abnormal situation.
3. **Group** defines the hazardous material in the surrounding atmosphere. Groups A to D are as follows:
   - ♦ **Group A** – Atmosphere containing acetylene.
   - ♦ **Group B** – Atmosphere containing hydrogen, gases, or vapors of equivalent nature.
   - ♦ **Group C** – Atmosphere containing ethylene, gases, or vapors of equivalent nature.
   - ♦ **Group D** – Atmosphere containing propane, gases, or vapors of equivalent nature.

For the ROC unit to be approved for hazardous locations, it must be installed in accordance with the National Electrical Code (NEC) guidelines or other applicable codes.

CAUTION

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing procedures in a hazardous area could result in personal injury or property damage.

2.1.4 Power Installation Requirements

Be sure to route power away from hazardous areas, as well as sensitive monitoring and radio equipment. Local and company codes generally provide guidelines for installations. Adhere rigorously to all local and National Electrical Code (NEC) requirements.

The removable terminal blocks accept 12 AWG or smaller wiring.

Although the ROC809 can operate on 11.25 to 14.25 volts dc power, it is good practice to install a low-voltage cutoff device to help protect batteries and other devices not powered by the ROC.

2.1.5 Grounding Installation Requirements

The National Electrical Code (NEC) governs the ground wiring requirements. When the equipment uses a DC voltage source, the grounding system must terminate at the service disconnect. All equipment grounding conductors must provide an uninterrupted electrical path to the service disconnect. This includes wire or conduit carrying the power supply conductors.

> The *National Electrical Code Article 250-83* (1993), paragraph c, defines the material and installation requirements for grounding electrodes.
>
> The *National Electrical Code Article 250-91* (1993), paragraph a, defines the material requirements for grounding electrode conductors.
>
> The *National Electrical Code Article 250-92* (1993), paragraph a, provides installation requirements for grounding electrode conductors.
>
> The *National Electrical Code Article 250-95* (1993) defines the size requirements for equipment grounding conductors.

Proper grounding of the ROC unit helps to reduce the effects of electrical noise on the ROC unit's operation and protects against lightning. Install a surge protection device at the service disconnect on DC voltage source systems to protect against lightning and power surges for the installed equipment. You may also consider a telephone surge protector for the dial-up modem communications module.

The grounding installation method for the ROC depends on whether the pipeline has cathodic protection. On pipelines with cathodic protection, the ROC must be electrically isolated from the pipeline. All earth grounds must have an earth to ground rod or grid impedance of 25-ohms or less as measured with a ground system tester.

When connecting shielded cable, be sure to tie the shielded cable to earth ground at the end of the cable attached to the ROC unit only. Leave the other end of the shielded cable open to avoid ground loops.

2.1.6 I/O Wiring Requirements

I/O wiring requirements are site and application dependent. Local, state, and NEC requirements determine the I/O wiring installation methods. Direct buried cable, conduit and cable, or overhead cable are options for I/O wiring installations.

Shielded, twisted-pair cable is recommended for I/O signal wiring. The twisted-pair minimizes signal errors caused by EMI (Electro-Magnetic Interference), RFI (Radio Frequency Interference), and transients. Insulated, shielded, twisted-pair wiring is required when using MVS signal lines. The removable terminal blocks accept 12 AWG or smaller wire.

2.2 Required Tools

The following tools will be required to perform installation and maintenance procedures on the ROC unit. For tools required for installation or maintenance of accessories, refer to the *ROC/FloBoss Accessories Instruction Manual* (Form A4637).

- Philips screwdriver, size 0.
- Flat blade screwdriver, size 2.5 mm (0.1 inch).
- Flat blade screwdriver, large, or other prying instrument.

2.3 Housing

The housing case is made of Acrylonitrile Butadiene Styrene (ABS) Plastic and the wire channel covers are made of Polypropylene Plastic.

2.3.1 How to Remove and Replace the End Caps

Normal use and maintenance of the ROC809 will not require removal of the end caps on the housing. However, instructions are provided, in case removal is necessary. Refer to Figure 1-1.

To remove the end caps:

1. Place the tip of a screwdriver into the top pry hole of the end cap, loosen the end cap by pulling the handle of the screwdriver away from the backplane.

❖ **NOTE:** The pry holes are located on the sides of the end caps. Refer to Figure 1-1.

2. Place the tip of a screwdriver into the bottom pry hole of the end cap, loosen the end cap by pulling the handle of the screwdriver away from the backplane.
3. Pivot the front end cap away from the back edge of the housing.

To replace the end caps:

1. Align the back edge of the end cap on the housing.
2. Rotate the end cap towards the housing and snap the end cap into place.

2.3.2 How to Remove and Install Wire Channel Covers

Install the wire channel covers over the wiring channels once wiring of the terminal blocks is complete. Wire channel covers are located on the front of the ROC809 housing. Refer to Figure 1-1.

To remove a wire channel cover:

1. Grasp the wire channel cover at both the top and bottom.
2. Start at the top or bottom and pull the wire channel cover out of the wire channel.

To replace a wire channel cover:

1. Align the wire channel cover over the wire channel, allowing unobstructed wire access.
2. Press wire channel cover into place until it snaps.

❖ **NOTE:** The tabs on the left side of the wire channel cover should rest in the slots on the left edge of the channel.

2.3.3 How to Remove and Install Module Covers

Before inserting an I/O or communication module, remove the module cover over the empty module slots in which you will be installing the modules. You are not required to remove the power to the ROC809 to perform this procedure, though caution is always advisable when working with a powered ROC809 unit.

⚠ CAUTION

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To remove a module cover:

1. Remove the wire channel cover.
2. Unscrew the two captive screws on the face of the cover.
3. Using the tab at the left side of the removable terminal block, pull the module cover straight out from the ROC809 housing.

❖ **NOTE:** If you remove a module for an extended period, install a module cover plate over the empty module slot to keep dust and other matter from getting into the ROC809 unit.

To install a module cover:

1. Place the module cover over the module slot.
2. Screw the two captive screws on the module cover plate.
3. Replace the wire channel cover.

2.4 How to Mount the ROC809 Unit on a DIN Rail

When choosing an installation site, be sure to check all clearances. Provide adequate clearance for wiring and service. The ROC809 controller mounts on Type 35 DIN rails. The ROC809 requires two strips of DIN rail. Refer to Figure 2 1, Figure 2 2, and Figure 2 3.

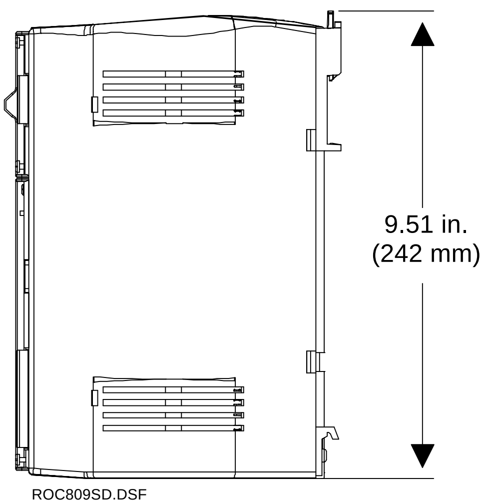


Figure 2-1. Side View of the ROC809

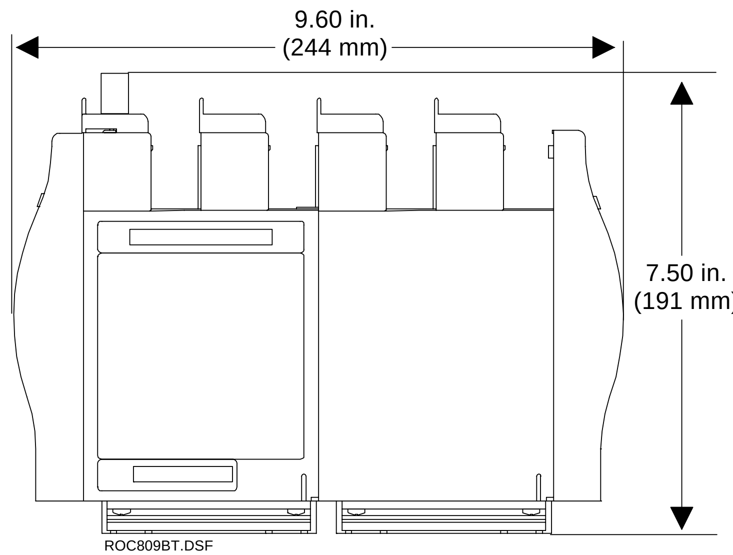


Figure 2-2. Bottom View of the ROC809

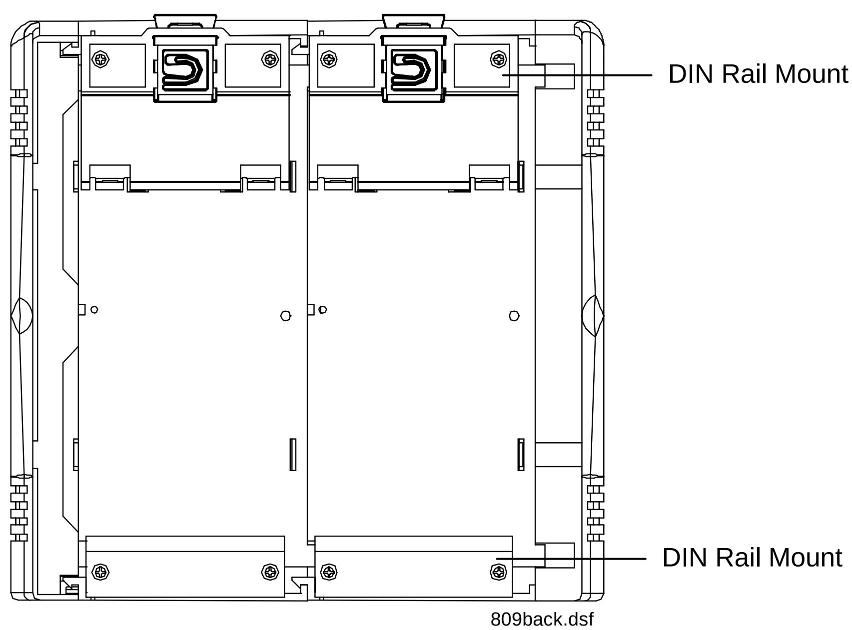


Figure 2-3. Back of the ROC809

2.4.1 How to Install the DIN Rail

To install the ROC809 housing using the 35 x 7.5 mm DIN rails:

1. Mount the lower DIN rail onto the enclosure panel. Refer to Figure 2 3.
2. Snap the second DIN rail into the ROC809 upper DIN rail mounting blocks.

3. Place the ROC809 onto the lower rail that is mounted to the plane and ensure that the ROC809 (with the second strip of DIN rail still in its upper mounting blocks) is seated against the panel.
4. Fasten the top strip of DIN rail to the panel.

By following this procedure, which uses the ROC809 to provide the correct DIN rail spacing, the ROC809 will be held securely in place.

2.4.2 How to Remove the ROC809 from the DIN Rail

To remove the ROC809 housing from DIN rails, release the two DIN rail catches located on the top the housing.

2.5 Backplane

The backplane has connectors for the CPU, the power input module, and all the I/O and communication modules. When a module is completely inserted into the module slot, the connector on the module fits into one of the connectors on the backplane. The backplane does not require any wiring, and there are no jumpers associated with the backplane.

Removing the backplane from the housing is not recommended, as there are no field serviceable parts. If the backplane requires maintenance, please contact your local sales representative.

2.6 Central Processor Unit (CPU)

The CPU (Central Processing Unit) contains the microprocessor, the firmware, connectors to the backplane, the three built-in communication ports (two with LEDs), a LED low power wakeup button, a RESET button, the application License Key connectors, a STATUS LED indicating system integrity, and the main processor. Refer to Figure 2-4, Figure 2-5, Table 2-1 and Table 2-2.

The 32-bit microprocessor is based on a Motorola® MPC862 Quad Integrated Communications Controller (PowerQUICC™) PowerPC® processor running at 50 MHz.

The internal Sanyo 3 volt CR2430 lithium backup battery provides backup of the data and the Real-Time Clock when the main power is not connected.

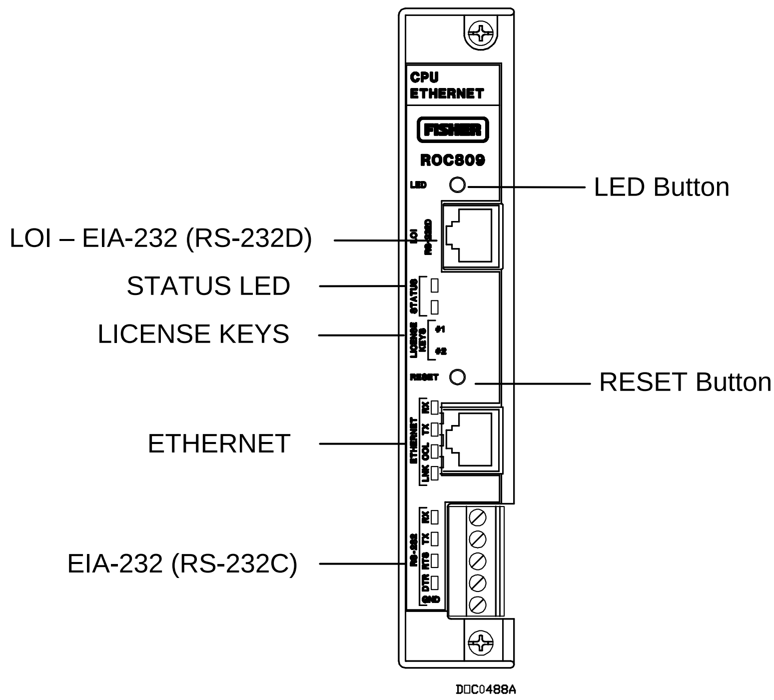


Figure 2-4. CPU Front View

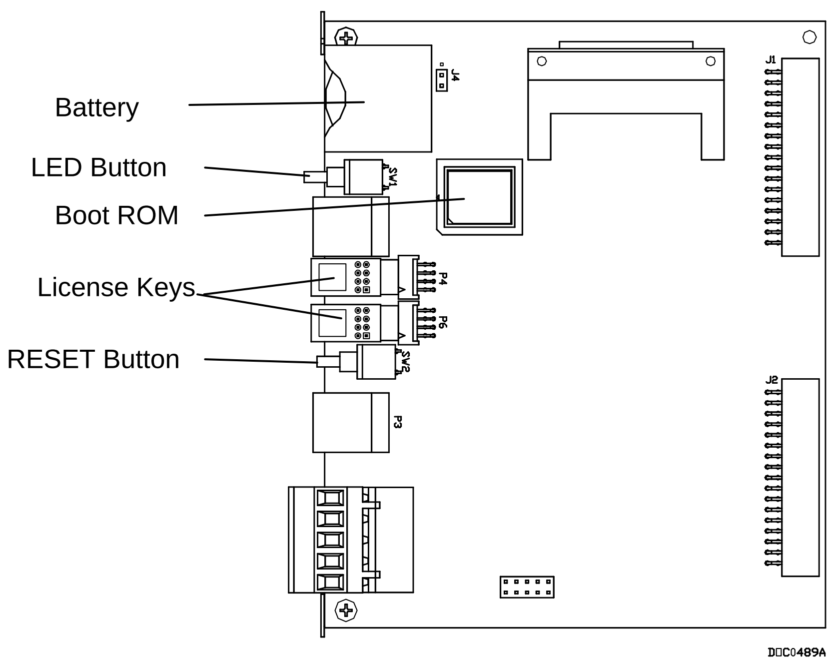


Figure 2-5. CPU Connectors

Table 2-1. CPU Connector Locations

CPU Number	Definitions
J4	Not Used
P2	LOI Port RJ-45
P3	Ethernet RJ-45
P4	License Key Terminal
P6	License Key Terminal
SW1	LED Button
SW2	RESET Button

The CPU contains a microprocessor supervisory circuit. This device monitors the battery voltage, resets the processor, and disables the SRAM chip if the voltage goes out of tolerance. The CPU has an internal Analog to Digital Converter (A/D). The A/D monitors the supply voltage and board temperature. Refer to Section 2.4.6, Automatic Self Tests, on page 2-12.

The CPU has two buttons (Figure 2 4):

- **LED –** Press to turn on the LEDs on the CPU module, I/O modules, and communication modules when the ROC809 has timed out.
- **RESET –** Press to reset the ROC809 system to defaullts. Refer to Section 2.8.4.1, Reset, on page 2-37.

The STATUS LED helps to indicate the integrity of the ROC809. Refer to Table 2 2.

Table 2-2. STATUS LED Function

Status LED	Color	Definitions	Solution
Continually Lit	Green	ROC809 functioning normally.	N/A
Continually Lit	Red	Low Battery Voltage alert. System AI (Point Number 1) LoLo Alarm.	♦ Charge battery. ♦ Apply DC voltage source.
Flashing	Green	Firmware invalid.	Update firmware.
Flashing	Green-Green to Red-Red	Firmware update in decompression.	DO NOT restart the ROC809.
Flashing	Green to Red	Firmware update is flashing image.	DO NOT restart the ROC809.

LEDs on the ROC809, with the exception of the LED on the power module, can be enabled or disabled as a power saving feature. In ROCLINK 800 software, the user configures how long the LEDs remains on after the LED button on the CPU module is pressed. For instance, with the default setting of 5 minutes, all LEDs will go off after 5 minutes. If you press the LED button, LEDs become active again for 5 minutes. By entering a 0 (zero) setting, they will always stay active.

2.6.1 How to Remove the CPU Module

To remove the CPU module:

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.
2. Remove power from the ROC809 unit.
3. Remove the wire channel cover.
4. Unscrew the two small screws on the front of the CPU module and remove the faceplate.
5. Place a small screwdriver under the ejector clip at the top or bottom of the CPU module and lightly pry the CPU module out of its socket. You may find it easiest to carefully pry on the top ejector clip a little, then carefully pry the bottom ejector. Refer to Figure 2 5. You will feel and hear the CPU as it detaches from the backplane.
6. Remove the CPU module carefully. Do not scrape either side of the module against the ROC809 unit. Make sure not to pull on any cables attached to the CPU module.

2.6.2 How to Install the CPU Module

To install the CPU module:

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Slide the CPU module into the slot.
2. Press the CPU firmly into the slot ensuring the ejector clips are lying on the module rail guides. The connectors at the back of the CPU module fit securely into the connectors on the backplane.
3. Place the CPU faceplate on the CPU.
4. Tighten the two screws on the faceplate of the CPU module firmly. Refer to Figure 2 5.
5. Replace the wire channel cover.
6. Return power to the ROC809 unit.
7. Refer to Section 2.8.5, After Removing Power from the ROC809, on page 2-38 and perform the restore procedure.

2.7 License Keys

License Keys, with valid license codes, grant access to applications. Examples of licensed applications include DS800 Development Suite Software, meter run calculations, and various user programs. These applications can then be configured using the ROCLINK 800 configuration software and the DS800 Development Suite Software.

The term License Key refers to the physical piece of hardware that can contain up to 7 different licenses. Refer to Figure 2-6. Each ROC809 can have none, one or two License Keys installed. If a License Key is removed after an application is enabled, the firmware disables the task from running. This prevents unauthorized execution of protected applications in a ROC809.

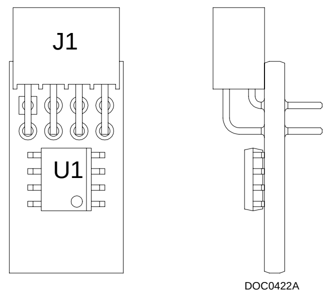


Figure 2-6. License Key

2.7.1 How to Install a License Key

To install a License Key:

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.
2. Remove power from the ROC809.
3. Remove the wire channel cover.
4. Unscrew the screws from the CPU faceplate.
5. Remove the CPU faceplate.
6. Place the License Key in the appropriate terminal slot P4 or P6 in the CPU. Refer to Figure 2-5.

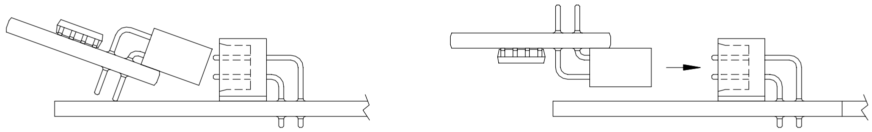


Figure 2-7. License Key Installation

❖ **NOTE:** When using a single License Key, it must be installed in slot P4.

7. Press the License Key into the terminal until it is firmly seated. Refer to Figure 2-7.

8. Replace the CPU faceplate.

9. Replace the screws on the CPU faceplate.

10. Replace the wire channel cover.

11. Restore power to the ROC809.

12. Refer to Section 2.8.5, After Removing Power from the ROC809, on page 2-38 and perform the restore procedure.

2.7.2 How to Remove a License Key

To remove a License Key:

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.

2. Remove power from the ROC809.

3. Remove the wire channel cover.

4. Unscrew the screws from the CPU faceplate.

5. Remove the CPU faceplate.

6. Remove the License Key from the appropriate terminal slot P4 or P6 in the CPU. Refer to Figure 2-5.

7. Replace the CPU faceplate.

8. Replace the screws from the CPU faceplate.

9. Replace the wire channel cover.

10. Restore power to the ROC809.

11. Refer to Section 2.8.5, After Removing Power from the ROC809, on page 2-38 and perform the restore procedure.

2.8 Startup and Operation

Before starting up the ROC809, perform the following checks to ensure the unit is properly installed.

- Make sure the power input module is properly seated in the backplane.
- Make sure I/O and communication modules are seated in the backplane.
- Check the field wiring for proper installation.
- Make sure the input power has the correct polarity.
- Make sure the input power is fused at the power source.

⚠ CAUTION

Check the input power polarity before connecting power to the ROC809. Incorrect polarity can damage the ROC809.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing procedures in a hazardous area could result in personal injury or property damage.

2.8.1 Startup

Apply power to the ROC809. Refer to Section 2.6.1, Wiring the DC Power Input Module, on page 2-31. The power input BAT+ LED indicator should light green to indicate that the applied voltage is correct. Then, the STATUS indicator should light, and stay lit green, to indicate a valid reset sequence has been completed. Refer to Table 2-2.

2.8.2 Operation

Once startup is successful, configure the ROC809 to meet the requirements of the application. Once the ROC809 is configured and the I/O and MVS are calibrated, it can be placed into operation.

⚠ CAUTION

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing procedures in a hazardous area could result in personal injury or property damage.

SECTION 3 – POWER CONNECTIONS

This section describes the power input module. This section provides a description and specifications and explains power input module installation and wiring for the ROC800-Series units.

3.1 Power Input Module Descriptions

The ROC800-Series unit uses a power input module to convert external input power to the voltage levels required by the ROC800-Series unit's electronics and to monitor voltage levels to ensure proper operation. Two power input modules are available for the ROC800-Series: 12 volts dc and 24 volts dc.

The power consumption of a ROC800-Series unit and related devices determines the current (I) requirements for the external power supply. Refer to Section 3.2.

The power input module has removable terminal blocks for convenient wiring and servicing. The terminal blocks can accept wire sizes 12 AWG or smaller.

3.1.1 12 Volt DC Power Input Module

The ROC800-Series unit can accept 12 volts dc (nominal) input power from an AC/DC converter or other 12 volt dc supply. The input source should be fused and connected to the BAT+ and BAT– terminals. The base system (CPU, power input, and backplane) requires less than 70 mA. The power input module economizes power consumption using 3.3 volts dc switching power that provides power to the ROC800-Series modules via the backplane. The ROC800-Series unit requires 11.25 to 14.25 volts dc for proper operation.

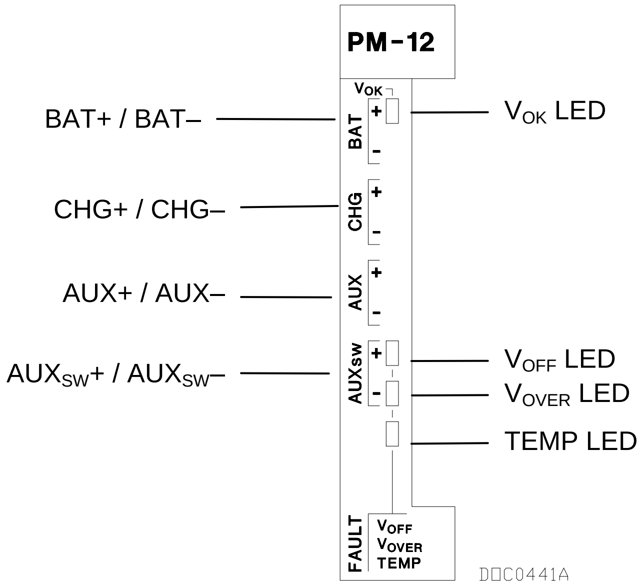


Figure 3-1. 12 Volt DC Power Input Module

The CHG+ and CHG– terminals comprise a Analog Input channel that allows you to monitor a voltage, such as an external charging source. The voltage that can be applied to the CHG+ / CHG– terminals is 0 to 18 volts dc. For example, you may connect the solar panel voltage, upstream of the solar regulator to monitor the output of the solar panel. This allows you to compare the System AI Point Number 2 for the charging voltage (CHG+) to the actual battery voltage (BAT+) System AI Point Number 1 and take action as required. The ROC800-Series unit has a low-voltage cut-off circuit built-in to guard against draining down power supply batteries. Refer to Section 2.4.6, Automatic Self Tests, on page 2-12.

The AUX+ / AUX - terminals can be used to supply reverse polarity protected source voltage to external devices, such as a radio or solenoid. The AUXSW+ and AUXSW - terminals can be used to provide switched power for external devices. The AUXSW+ is turned off when a software configurable voltage is detected at the BAT+ and BAT - terminals.

Table 3-1. 12 Volts DC Power Input Terminal Block Connections

Terminal Blocks	Definition	Volts DC
BAT+ and BAT–	Accepts 12 volts dc nominal from an AC/DC converter or other 12 volts dc supply.	Absolute Maximum: 11.25 to 16 volts dc Recommended Operating Range: 11.25 to 14.25 volts dc
CHG+ and CHG–	Analog Input used to monitor an external charging source.	0 to 18 volts dc
AUX+ and AUX–	Supplies reverse polarity protected source voltage to external devices.	(BAT+ minus ~0.7 volts dc)
AUX_{SW}+ and AUX_{SW}–	Supplies switched power for external devices.	0 to 14.25 volts dc

Table 3-2. 12 Volts DC Power Input LED Indicators

Signal	LED
V_{OK}	Green LED on when voltage is in tolerance on BAT+ and BAT–.
V_{OFF}	Fault – Red LED on when the AUX_{SW}+ output are disabled by the CPU control line.
V_{OVER}	Fault – Red LED on when AUX_{SW}+ is disabled due to excess voltage on BAT+.
TEMP	Fault – Red LED on when AUX_{SW}+ output are disabled due to the excess temperature of the power input module.

3.1.2 24 Volts DC Power Input Module

The ROC800-Series unit can accept 24 volts dc (nominal) input power from an AC/DC converter or other 24 volts dc supply connected to the + and – terminals. Input power can be connected to either or both of the + and – channels. The 24 V dc power module does not have CHG terminals for monitoring a charging voltage. This module does not monitor the input voltage for alarming, sleep mode, or other monitoring purposes. The module does have two LEDs that indicate voltage is received at the backplane and the CPU.

The base system (CPU, power input, and backplane) requires less than 70 mA. The power input module economizes power consumption using 3.3 volts dc switching power that provides power to the ROC800-Series modules via the backplane. When this module is installed, the ROC800-Series unit requires 20 to 30 volts dc for proper operation.

The AUX+ / AUX - terminals can be used to supply reverse polarity protected source voltage to external devices, such as a radio or solenoid.

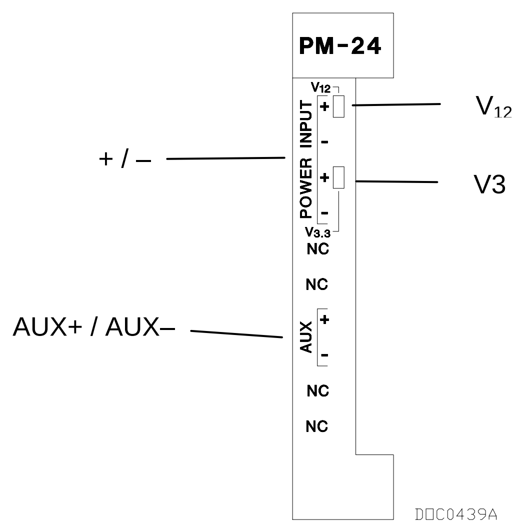


Figure 3-2. 24 Volt DC Power Input Module

Table 3-3. 24 Volts DC Power Input Terminal Block Connections

Terminal Blocks	Definition	Volts DC
+ and –	Accepts 24 volts dc nominal from an AC/DC converter or other 24 volts dc supply.	18 to 30 volts dc
AUX+ and AUX–	Supplies reverse polarity protected source voltage to external devices.	+12 volts dc minus ~0.7 volts dc)

Table 3-4. 24 Volts DC Power Input LED Indicators

Signal	LED
V_{12}	Green LED on when voltage is provided to backplane.
$V_{3.3}$	Green LED on when voltage is provided to CPU.

3.1.3 Auxiliary Output (AUX+ and AUX–)

AUX+ and AUX– terminals can be used to supply reverse polarity protected source voltage to external devices, such as a radio or solenoid. All module terminal blocks accept 12 AWG or smaller wiring. Refer to Figure 3-3 and Figure 3-4.

For the 12 volt Power Input Module, the auxiliary output follows the voltage located at BAT+ minus ~ 0.7 Volts DC, which is the protection diode voltage drop. For example, if the BAT+ voltage is 13 volts dc, then AUX+ is ~ 12.3 volts dc.

For the 12 volt Power Input Module, AUX+ / AUX– is always on and is current-limited by a fast acting glass 2.5 Amp x 20 mm fuse. In the event that the fuse blows, CSA requires that the 2.5 Amp fast-acting fuse be replaced, with a Little Fuse 217.025 or equivalent. Refer to Section 2.5.5.1, Removing the Auxiliary Output Fuse, on page 2-20.

For the 24 volt Power Input Module, The AUX voltage is always 12 volts dc minus ~ 0.7 volts. AUX+ / AUX is internally current-limited by a 0.5 Amp PTC.

If power to the radio or other device needs to be cycled to reduce the load on the power source (recommended when batteries are used), use a Discrete Output (DO) module to switch power on and off. Refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

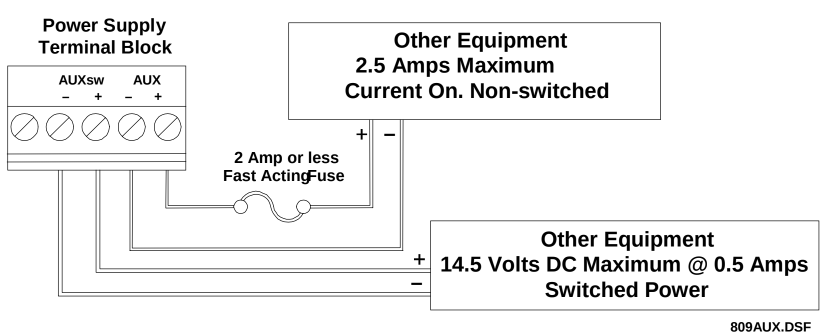


Figure 3-3. 12 Volts DC Auxiliary Power Wiring

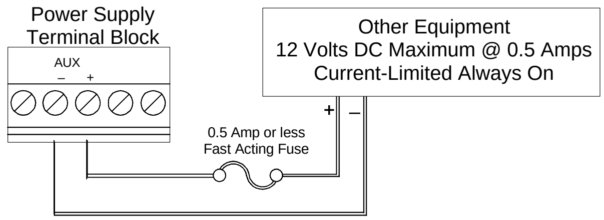


Figure 3-4. 24 Volts DC Auxiliary Power Wiring

3.1.3.1 How to Remove the Auxiliary Output Fuse

To remove the auxiliary output fuse, perform the procedure in Section 2.5.3 to remove the power input module. Then remove the fuse located at F1 on the power input module.

3.1.3.2 How to Install the Auxiliary Output Fuse

To re-install the auxiliary output fuse, replace the fuse located at F1 on the power input module. Then perform the procedure in Section 2.5.4 to re-install the power input module.

3.1.4 Switched Auxiliary Output (AUXSW+ and AUXSW–)

The AUXSW+ and AUXSW– terminals on the 12 volts dc Power Input Module provide switched power for external devices, such as radios. AUXSW+ is current-limited for protection of the power input and the external device via a 0.5 Amp nominal Positive Temperature Coefficient (PTC). The AUXSW+ and AUXSW– terminals provides voltages from 0 to 14.25 volts dc. AUXsw+ is turned off when a software configurable voltage (LoLo Alarm) is detected at the BAT+ and BAT– terminals. All module terminal blocks accept 12 AWG or smaller wiring. Refer to Figure 3-3.

If the source voltage falls to a level below which reliable operation cannot be ensured, the hardware circuitry on the power input module automatically disables the AUXSW+ outputs. This occurs at approximately 8.85 volts dc. This is based on the LoLo Alarm limit set for the System Battery Analog Input Point Number 1. The low input voltage detect circuit includes approximately 0.75 volts dc of hysteresis between turn-off and turn-on levels.

Because the linear regulator can be damaged by the presence of high input voltage, if the dc input voltage at BAT+ exceeds 16 volts, the over-voltage detect circuit automatically disables the linear regulator, shutting off the unit.

Refer to Table 2-2, concerning LEDs.

3.2 How to Determine Power Consumption

Table 3-5 lists the power consumption of the ROC800-Series unit and the optional devices.

- ❖ **NOTE:** When calculating power consumption, include all device relays, meters, solenoids, radios, and other devices that receive DC power from the ROC800-Series unit (excluding those connected to the I/O modules). Refer to Table 3-16.

Table 3-6 through Table 3-15 list the power consumption of the various I/O modules. In estimating total I/O power requirements, the Duty Cycle must also be estimated for each I/O channel on each I/O module.

To calculate the power required by the ROC800-Series unit:

1. Determine how many communication modules you will be implementing and enter those numbers in the Quantity Used column of Table 3-5.
2. Multiply the PTypical value times the Quantity Used and enter the values in the Sub-Total column of Table 3-5. Perform this calculation for both the communications module and the LED.

   $$\mathbf{P_{Typical} * Quantity\ Used = Sub\text{-}Total}$$

3. Determine how many I/O modules you will be implementing and enter those numbers in the Quantity Used column of Table 3-6 through Table 3-15.
4. Calculate the PTypical values and enter them in the PTypical columns of Table 3-6 through Table 3-15. Perform this calculation for both the I/O module, other device, and the LED.

   $$\mathbf{Calculate\ P_{Typical} = P_{Typical}}$$

5. Calculate the Duty Cycle for each I/O module and enter the value in the Duty Cycle column of Table 3-6 through Table 3-15.

   $$\mathbf{Calculate\ Duty\ Cycle = Duty\ Cycle}$$

6. Multiply the PTypical values times the Quantity Used times the Duty Cycle and enter the values in the Sub-Total column of Table 3-6 through Table 3-15.

   $$\mathbf{P_{Typical} * Quantity\ Used * Duty\ Cycle = Sub\text{-}Total}$$

7. Total the Sub-Total column for Table 3-6 through Table 3-15.
8. Enter the Sub-Totals (Total) from Table 3-6 through Table 3-15 into the Sub-Totals column of Table 3-5.

❖ **NOTE:** Do not forget to add the Total from the Other Devices in Table 3-16.

9. Add the Table Totals of all values in the Sub-Totals column of Table 3-5.
10. Multiply the Table Totals by a safety factor of 1.25 to account for losses and other variables not factored into the power consumption calculations. This safety factor may vary depending on external influences, thus the factor may be adjusted up or down.

   $$\mathbf{1.25 * Table\ Totals = TOTAL\ mW}$$

Table 3-5. Power Consumption

Device	Power Consumption (mW)		Quantity Used	Sub-Total (mW)
	Description	$P_{Typical}$		
CPU, Backplane, & Power Input	70 mA @ 12 volts dc	840 mW	1	840.00
Per Active LED – Maximum 10	1.5 mA	18 mW		
EIA-232 (RS-232) Module	4 mA @ 12 volts dc	48 mW		
Per Active LED – Maximum 4	1.5 mA	18 mW		
EIA-422/485 (RS-422/485) Module	112 mA @ 12 volts	1344 mW		
Per Active LED – Maximum 2	1.5 mA	18 mW		
Dial-up Modem Module	95 mA @ 12 volts dc	1140 mW		
Per Active LED – Maximum 4	1.5 mA	18 mW		
AI Modules (Table 3-6)				
AO Modules (Table 3-7)				
DI Modules (Table 3-8)				
DO Modules (Table 3-9)				
DOR Modules (Table 3-10)				
PI Modules (Table 3-11)				
MVS Modules (Table 3-12)				
RTD Modules (Table 3-13)				
Thermocouple Modules (Table 3-14)				
HART Modules				
Other Devices (Table 3-16)				
			Table Totals	**mW**
			TOTAL	**mW**

NOTE: The power drawn by field devices connected to I/O modules is included in the $P_{Typical}$ values in Table 3-6 through Table 3-14.

Table 3-6. Power Consumption of the Analog Input Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Analog Input					
AI Module Base	84 mA @ 12 volts dc	1008 mW			
Jumper set for +T @ 12 volts dc					
Channel 1	Channel's mA current draw from +T * 1.25 * 12				
Channel 2	Channel's mA current draw from +T * 1.25 * 12				
Channel 3	Channel's mA current draw from +T * 1.25 * 12				
Channel 4	Channel's mA current draw from +T * 1.25 * 12				
Jumper set for +T @ 24 volts dc					
Channel 1	Channel's mA current draw from +T * 2.50 * 12				
Channel 2	Channel's mA current draw from +T * 2.50 * 12				
Channel 3	Channel's mA current draw from +T * 2.50 * 12				
Channel 4	Channel's mA current draw from +T * 2.50 * 12				
				Total	

The Duty Cycle is based on the average current flow compared to the full-scale current flow value.

Approximate the Duty Cycle by estimating the average current consumption in relation to its maximum range.

For example, if an AI channel's current averages 16 mA:

Duty Cycle = Average mA output ÷ Maximum mA Output = (16 ÷ 20) = 0.80

Table 3-7. Power Consumption of the Analog Output Modules

I/O Module	Power Consumption (mW) Description	$P_{Typical}$	Quantity Used	Duty Cycle	Sub-Total (mW)
Analog Output					
AO Module Base	100 mA @ 12 volts dc	1200 mW			
Jumper set for +T @ 12 volts dc					
Channel 1	Channel's mA current draw from +T * 1.25 * 12				
Channel 2	Channel's mA current draw from +T * 1.25 * 12				
Channel 3	Channel's mA current draw from +T * 1.25 * 12				
Channel 4	Channel's mA current draw from +T * 1.25 * 12				
Jumper set for +T @ 24 volts dc					
Channel 1	Channel's mA current draw from +T * 2.50 * 12				
Channel 2	Channel's mA current draw from +T * 2.50 * 12				
Channel 3	Channel's mA current draw from +T * 2.50 * 12				
Channel 4	Channel's mA current draw from +T * 2.50 * 12				
				Total	

The Duty Cycle is based on the average current flow compared to the full-scale current flow value.

Approximate the Duty Cycle by estimating the average current consumption in relation to its maximum range.

For example, if an AO channel's current averages 12 mA:

Duty Cycle = Average mA output ÷ Maximum mA Output = (12 ÷ 20) = 0.60

Table 3-8. Power Consumption of the Discrete Input Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Discrete Input					
DI Module Base	19 mA @ 12 volts dc No Channels Active	228 mW			
Channel 1	3.2 mA @ 12 volts dc	38.4 mW			
Channel 2	3.2 mA @ 12 volts dc	38.4 mW			
Channel 3	3.2 mA @ 12 volts dc	38.4 mW			
Channel 4	3.2 mA @ 12 volts dc	38.4 mW			
Channel 5	3.2 mA @ 12 volts dc	38.4 mW			
Channel 6	3.2 mA @ 12 volts dc	38.4 mW			
Channel 7	3.2 mA @ 12 volts dc	38.4 mW			
Channel 8	3.2 mA @ 12 volts dc	38.4 mW			
Per Active LED – Maximum 8	1.5 mA	18 mW			
				Total	

The Duty Cycle is the time on divided by the total time.

The Duty Cycle is essentially the percent of time that the I/O channel is active (maximum power consumption).

Duty Cycle = Active time ÷ (Active time + Inactive time)

For example, if a Discrete Input is active for 15 seconds out of every 60 seconds:

Duty Cycle = 15 seconds ÷ (15 seconds + 45 seconds) = 15 seconds ÷ 60 seconds = 0.25

Table 3-9. Power Consumption of the Discrete Output Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Discrete Output					
DO Module	20 mA @ 12 volts dc No Channels Active	240 mW			
Channel 1	1.5 mA	18 mW			
Channel 2	1.5 mA	18 mW			
Channel 3	1.5 mA	18 mW			
Channel 4	1.5 mA	18 mW			
Channel 5	1.5 mA	18 mW			
Per Active LED – Maximum 5	1.5 mA	18 mW			
				Total	

The Duty Cycle is the time on divided by the total time.

The Duty Cycle is essentially the percent of time that the I/O channel is active (maximum power consumption).

Duty Cycle = Active time ÷ (Active time + Inactive time)

For example, if a Discrete Output is active for 15 seconds out of every 60 seconds:

Duty Cycle = 15 seconds ÷ (15 seconds + 45 seconds) = 15 seconds ÷ 60 seconds = 0.25

Table 3-10. Power Consumption of the Discrete Output Relay Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Discrete Relay Output					
DOR Module	6.8 mA @ 12 volts dc No Channels Active	81.6 mW			
Channel 1	150 mA for 10 msec during transition	1800 mW for 10 msec			
Channel 2	150 mA for 10 msec during transition	1800 mW for 10 msec			
Channel 3	150 mA for 10 msec during transition	1800 mW for 10 msec			
Channel 4	150 mA for 10 msec during transition	1800 mW for 10 msec			
Channel 5	150 mA for 10 msec during transition	1800 mW for 10 msec			
Per Active LED – Maximum 5	1.5 mA	1800 mW for 10 msec			
				Total	

The Duty Cycle is:

[((Number of Transitions in some time period) ∗ 0.01 sec)] ÷ (Seconds in the period) = Duty Cycle

For example, if a DOR channel is changing state 80 time per hour:

- 80 = Number of transitions
- Hour is the time period
- There are 3600 seconds in an hour

Duty Cycle = [(80 ∗ 0.01) ÷ 3600] = 0.0002

Table 3-11. Power Consumption of the High and Low Speed Pulse Input Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
High and Low Speed Pulse Input					
PI Module	21 mA @ 12 volts dc No Channels Active	252 mW			
Channel 1	7.4 mA	88.8 mW			
Channel 2	7.4 mA	88.8 mW			
Per Active LED – Maximum 4	1.5 mA	18 mW			
Jumper set to +T @ 12 volts dc	1.25 ∗ Measured Current Draw at +T Terminal				
Jumper set to +T @ 24 volts dc	2.5 ∗ Measured Current Draw at +T Terminal				
				Total	

The Duty Cycle is the time on divided by the total time.

The Duty Cycle is essentially the percent of time that the I/O channel is active (maximum power consumption).

Duty Cycle = [Active Time ∗ (Signals Duty Cycle)] ÷ (Total Time Period)

For example, if a Pulse Input is receiving signal for 6 hours over a 24-hour time period and the signal's wave form consist of an on time of 1/3 of the signal's period:

Duty Cycle = [6 hours ∗ (1 ÷ 3)] ÷ (24 hours) = 0.0825

Table 3-12. Power Consumption of the MVS Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
MVS Module					
MVS Module	112 mA @ 12 volts dc	1344 mW			
Per Active LED – Maximum 2	1.5 mA	18 mW			
Power provided by the module for the MVS sensors	1.25 ∗ Measured Current Draw at + Terminal			1	
				Total	
For an MVS sensor, the typical mW per MVS will be about (300 mW).					

The Duty Cycle is the time on divided by the total time. For an MVS, the sensor is always drawing power, so the Duty Cycle should be entered as a "1" for the MVS power calculations.

The LEDs can also have a Duty Cycle associated with them. The Duty Cycle for the LEDs are essentially the percent of time that the LEDs are active.

Duty Cycle = Active time ÷ (Active time + Inactive time)

For example, if the LEDs are on approximately 20 minutes a day:

Duty Cycle = 20 minutes ÷ (24 ∗ 60 minutes in a day) = 20 ÷ 1440 = 0.014

Table 3-13. Power Consumption of the RTD Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
RTD Module					
RTD Module	65 mA @ 13.25 volts dc			1	
				Total	

There is no Duty Cycle associated with a RTD. The Duty Cycle is always set as "1".

Table 3-14. Power Consumption of the Thermocouple Modules

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Type J or K Thermocouple Module					
T/C Module	84 mA @ 12 volts dc	1008 mW		1	
				Total	

There is no Duty Cycle associated with a thermocouple. The Duty Cycle is always set as "1".

Table 3-15. Power Consumption of the HART Modules

Other Device	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Other Devices					
HART Module Base	110 mA @ 12 volts dc	1320 mW			
Each Channel	Channel's mA current draw from +T * 2.50 * 12				
				Total	

Table 3-16. Power Consumption of Other Devices

Other Device	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{Typical}$			
Other Devices					
				Total	

Although Table 3-5 and Table 3-6 through Table 3-16 take into account the power supplied by the ROC800-Series unit to its connected devices, be sure to add the power consumption (in mW) of any other devices used with the ROC800-Series unit in the same power system, but are not accounted for in the tables. Other devices may include radios or solenoids that are powered by the ROC800-Series unit.

Enter that Total value in the Other Devices row of Table 3-5.

❖ **NOTE:** mW = 0.001 Watts = Watts divided by 1000.

3.3 How to Remove a Power Input Module

To remove the power input module:

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.

2. Remove power from the ROC800-Series unit.
3. Remove the wire channel cover.
4. Unscrew the two captive screws on the front of the power input module.
5. Remove the power input module.

❖ **NOTE:** Remove the internal backup battery if you intend to store the ROC800-Series unit for an extended period.

3.4 How to Install a Power Input Module

To install the power input module:

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Slide the power input module into the slot.
2. Press the power input firmly into the slot. Make sure the connectors at the back of the power input module fit into the connectors on the backplane.
3. Tighten the two captive screws on the front of the power input module firmly. Refer to Figure 3-1 and Figure 3-2.
4. Replace the wire channel cover.
5. Return power to the ROC800-Series unit.
6. Refer to Section 2.8.5, After Removing Power from the ROC800-Series unit, on page 2-38 and perform the restore procedure.

3.5 How to Connect the ROC800-Series Unit to Wiring

The following paragraphs describe how to connect the ROC800-Series unit to power. Use the recommendations and procedures described in the following paragraphs to avoid damage to equipment.

Use 12 American Wire Gauge (AWG) wire or smaller for all power wiring.

⚠ CAUTION

Always turn off the power to the ROC800-Series unit before you attempt any type of wiring. Wiring of powered equipment could result in personal injury or property damage.

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

The ROC800-Series unit should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

3.5.1 How to Wire the DC Power Input Module

Use 12 American Wire Gauge (AWG) wire or smaller for all power wiring. It is important to use good wiring practice when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes.

Verify the hook-up polarity is correct.

To make DC power supply connections:

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.
2. Install a surge protection device at the service disconnect.
3. Remove all other power sources from the ROC800-Series unit.
4. Install a fuse at the input power source.
5. Remove the terminal block connector from the socket.
6. Insert each bared wire end from either:
   - the 12 volts dc source into the clamp beneath the appropriate BAT+ / BAT– termination screw. Refer to Figure 2 13.
   - the 24 volts dc source into the clamp beneath the appropriate + /   termination screw. The + terminal should have a similar fuse to the 12 volts dc Power Input Module. See Figure 3-5.

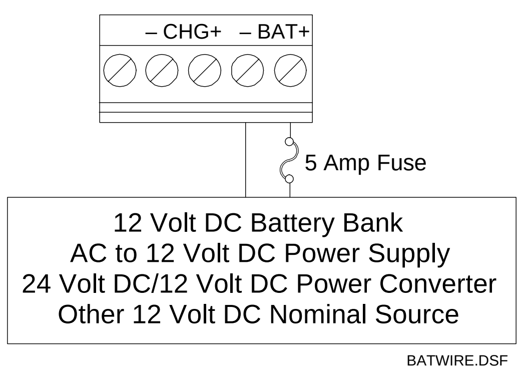


Figure 3-5. 12 VDC Power Supply and BAT+ / BAT– Wiring

7. Screw each wire into the terminal block.
8. Plug the terminal block connector back into the socket.

9. If you are monitoring an external charge voltage (12 volts dc Power Input Module only), wire the CHG+ and CHG– terminal block connector. Refer to Figure 3-6.

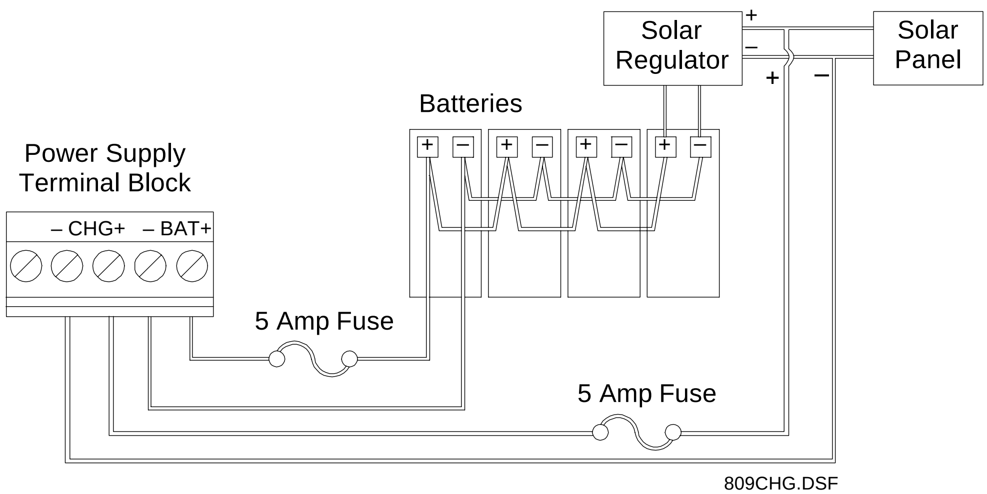


Figure 3-6. 12 VDC Power Supply and CHG+ / CHG– Wiring

10. Replace all other power sources (if necessary) to the ROC800-Series unit.

11. Refer to Section 2.8.5, After Removing Power from the ROC800-Series unit, on page 2-38 and perform the restore procedure.

❖ **NOTE:** Refer to Table 3-2 concerning LEDs.

3.5.2 How to Wire the External Batteries

External batteries can be used as the main source of power for the ROC800-Series unit with the 12 volts dc Power Input Module. The maximum voltage that can be applied to the BAT+ / BAT– terminals is 16 volts dc before damage may occur. The recommended maximum voltage is 14.5 volts dc.   Refer to Table 3-2 concerning LEDs.

It is important that you use good wiring practiced when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes. Use 12 American Wire Gauge (AWG) or smaller wire for all power wiring.

Batteries should be rechargeable, sealed, gel-cell, lead-acid batteries.

Connect batteries in parallel to achieve the required capacity. Refer to Figure 3-6. The amount of battery capacity required for a particular installation depends upon the power requirements of the equipment and days of reserve (autonomy) desired. Calculate battery requirements based on power consumption of the ROC800-Series unit and all devices powered by the batteries.

Battery reserve is the amount of time that the batteries can provide power without discharging below 20% of their total output capacity. The battery reserve should be a minimum of five days, with ten days of reserve preferred. Add 24 hours of reserve capacity to allow for overnight discharge. Space limitations, cost, and output are all factors that determine the actual amount of battery capacity available.

To determine the system capacity requirements, multiply the system current load on the batteries by the amount of reserve time required. The equation is as follows:

System Requirement = Current Load in Amps * Reserve Hours = _____ Amp Hours

CAUTION

Apply in-line fusing when using batteries to avoid damaging the unit.

To make battery connections:

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.
2. Remove the BAT+ / BAT– terminal block connector from the socket.
3. Install a fuse at the input power source.
4. Insert each bared wire end into the clamp beneath the BAT+ / BAT– termination screws. Refer to Figure 3-5.
5. Screw each wire into the terminal block.
6. Plug the terminal block connector back into the socket.
7. Refer to Section 2.8.5, After Removing Power from the ROC800-Series unit, on page 2-38 and perform the restore procedure.

❖ **NOTE:** Refer to Table 3-2 concerning LEDs.

3.5.3 How to Replace the Internal Battery

The internal Sanyo 3 volt CR2430 lithium backup battery provides backup of the data and the Real-Time Clock when the main power is not connected. The battery has a one-year minimum backup life while the battery is installed and no power is applied to the ROC800-Series unit. The battery has a ten-year backup life while the backup battery is installed and power is applied to ROC800-Series unit or when the battery is removed from the ROC800-Series unit. Refer to Figure 2-5.

❖ **NOTE:** Remove the internal backup battery if you intend to store the ROC800-Series unit for an extended period.

CAUTION

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Refer to Section 2.8.2, Backup Procedure Before Removing Power, on page 2-36 and perform the backup procedure.
2. Remove all power from the ROC800-Series unit.
3. Remove the two screws on the CPU faceplate.
4. Remove the CPU faceplate.

5. Insert a plastic screwdriver behind the battery and gently push the battery out of the battery holder taking note of the orientation of the battery. The negative side of the battery (–) is placed against the CPU and the positive (+) towards the + label on the battery holder.
6. Insert the new battery in the battery holder paying close attention to install the battery with the correct orientation.
7. Replace the CPU faceplate.
8. Replace the two screws to secure the CPU faceplate.
9. Apply power to the ROC800-Series unit.
10. Refer to Section 2.8.5, After Removing Power from the ROC800-Series unit, on page 2-38 and perform the restore procedure.

SECTION 4 – INPUT / OUTPUT MODULES

This section describes the Input/Output (I/O) modules used with the ROC800-series controller and contains information on installation, specifications, wiring, and removal of the I/O modules.

4.1 Overview

The I/O modules consist of a terminal block for field wiring and connectors to the backplane. The ROC800-series supports up to nine I/O modules. The ROC can accommodate a wide range of process inputs and outputs. Each I/O module electrically connects to field wiring by a removable terminal block. Refer to Figure 4-1 and Figure 4-2.

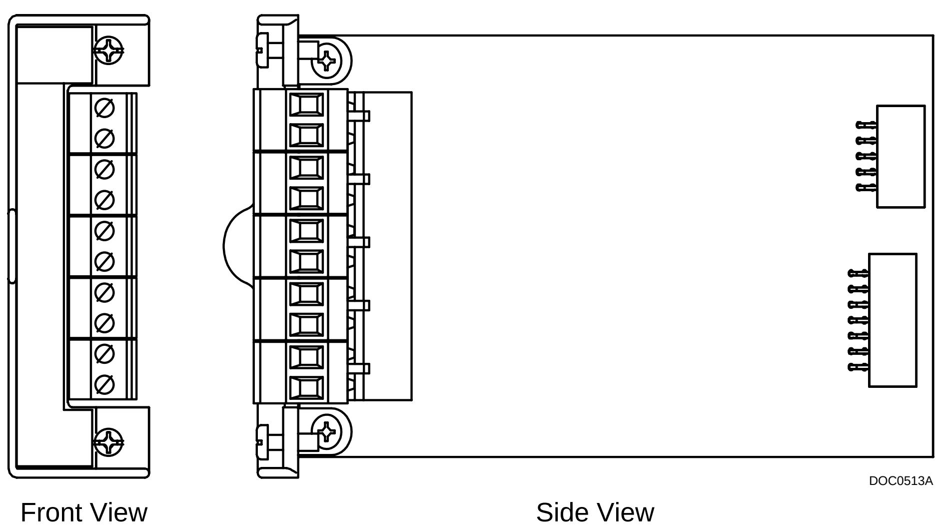


Figure 4-1. Typical I/O Module

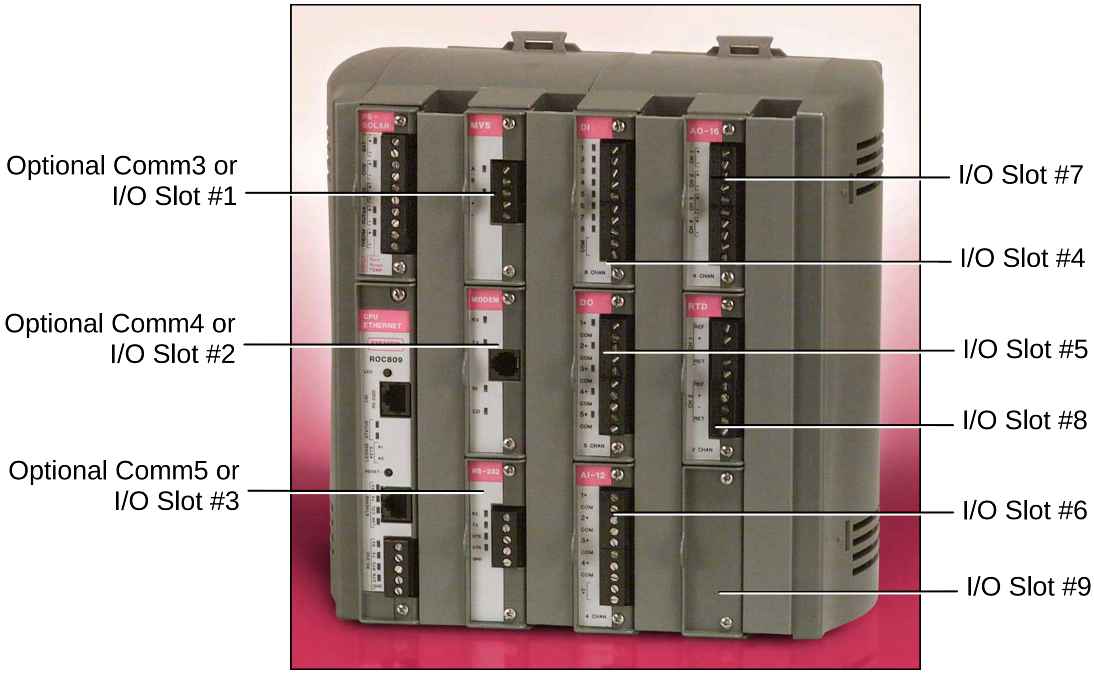


Figure 4-2. Optional I/O Module Locations

I/O modules for the ROC800-series Remote Operations Controllers include:

- Analog Input (AI) modules that provide the ability to monitor various analog field values.
- Discrete Input (DI) and Pulse Input (PI) modules that provide the ability to monitor various discrete and pulse input field values.
- Analog Output (AO), Discrete Output (DO), and Discrete Output Relay (DOR) modules that provide the ability to control various control devices.
- The RTD Input and Thermocouple Input (T/C) modules that provide the ability to monitor various analog temperature field values.
- The HART interface modules that enable the ROC to communicate with HART devices using the Highway Addressable Remote Transducer (HART) protocol as either Analog Inputs or Analog Outputs.

Each module rests in a module slot at the front of the ROC800-series housing. I/O modules easily install into and remove from the module slots. You can install and remove modules while the ROC800-series controller is powered up (hot-swappable). Modules may be installed directly into unused module slots (hot-pluggable), and modules are self-identifying in the software. All modules have removable terminal blocks to make servicing easy. I/O modules can be added in any module slot.

The I/O modules acquire power from the backplane. Each module has an isolated DC/DC converter that provides logic, control, and field power as required. The ROC800-series controller has eliminated the need for fuses on the I/O modules through the extensive use of current-limited short-circuit protection and over voltage circuitry. Isolation is provided from other modules and the backplane, power, and signal isolation. The I/O modules are self-resetting after a fault clears.

4.2 Installation

Each I/O module installs in the ROC800-series controller in the same manner. Any I/O module can be installed into any module socket, whether empty or in place of another module.

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Installation in a hazardous area could result in personal injury or property damage.

The I/O modules may be inserted or removed while power is connected to the ROC800-series controller. If power is connected to the ROC800-series controller, exercise caution while performing the following steps to install a module.

- **NOTE:** After installing a new I/O module or replacing an existing I/O module, it may be necessary to reconfigure the ROC800-series controller. To change configuration parameters, use ROCLINK 800 software to make changes to the new module. Any added modules (new I/O points) start up with default configurations. Refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

4.2.1 How to Install an I/O Module

1. Remove the wire channel cover.
2. To install a module, perform one of the following:
   - If there was previously a module in the slot, unscrew the captive screws and remove that module.
   - If the slot was previously unused, remove the module cover.
3. Insert the new I/O module through the module slot on the front of the ROC800-series housing. Make sure the label on the front of the module is facing right side up. Refer to Figure 4-3. Gently glide the module in place until it contacts properly with the connectors on the backplane.

   If the module stops and will not go any further, do not force the module. Remove the module and see if the pins are bent. If so, gently straighten the pin and re-insert the module. The back of the module must connect fully with the connectors on the backplane.

   If the wiring channel cover has not been removed, it can prevent the module from entering the socket on the backplane.

Figure 4-3. Installing an I/O Module

4. Tighten the captive screws on the front of the module.
5. Replace the wire channel cover and wire the I/O module.

⚠ CAUTION

Never connect the sheath surrounding shielded wiring to a signal ground terminal or to the common terminal of an I/O module. Doing so makes the I/O module susceptible to static discharge, which can permanently damage the module. Connect the shielded wiring sheath to a suitable earth ground only.

6. Connect to ROCLINK 800 software and login. The I/O modules are self-identifying after re-connecting to ROCLINK 800 software.
7. Configure the I/O point.

4.2.2 How to Remove an I/O Module

To remove an I/O module:

1. Remove the wire channel cover.
2. Unscrew the two captive screws holding the module in place.
3. Gently pull the module's lip out and remove the module from the slot. You may need to gently wiggle the module.
4. Install a new module or install the module cover.
5. Screw the two captive screws to hold the module or cover in place.
6. Replace the wire channel cover.

4.2.3 How to Wire I/O Modules

All modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks can accommodate a wide range of wire gauges (12 AWG or smaller).

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

The ROC800-series controller should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

❖ **NOTE:** All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept 12 AWG or smaller wire.

4.3 Analog Input Modules

The four Analog Input (AI) channels are scalable, but typically measure either:

- ♦ 4 to 20 mA analog signal, with the use of a precision resistor (supplied).
- ♦ 1 to 5 volts dc signal.

If required, you can calibrate the low end of the analog signal to zero.

The AI (+T) is module selectable as 12 or 24 volts dc via jumper J4 on the I/O module. The AI modules can provide isolated +12 volts dc or +24 volts dc field transmitter power on a per module basis. For example, one module can provide +12 volts dc for powering low power analog transmitters, while another module in the same ROC800-series controller can provide +24 volts dc for powering conventional 4-20 mA transmitters. Refer to Figure 4-4.

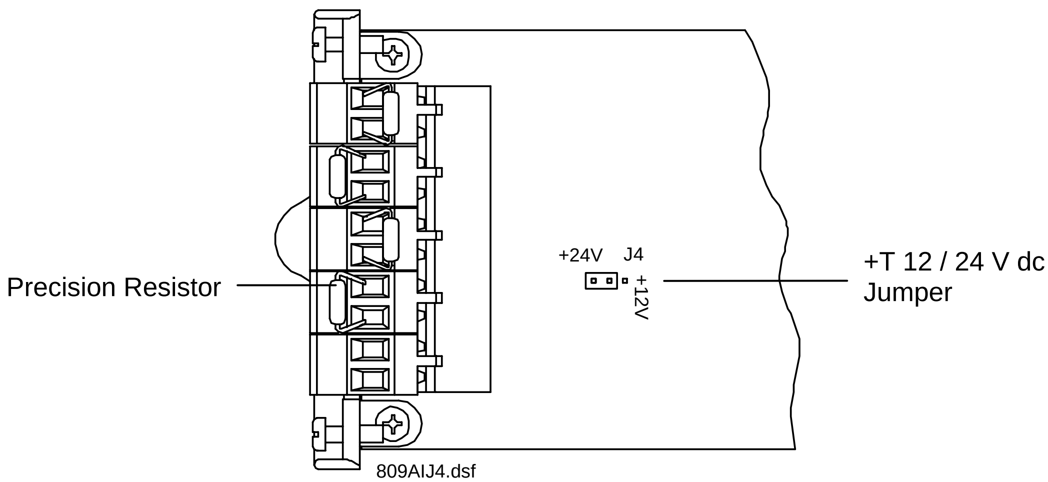


Figure 4-4. Analog Input Jumper J4 – Set to +24V

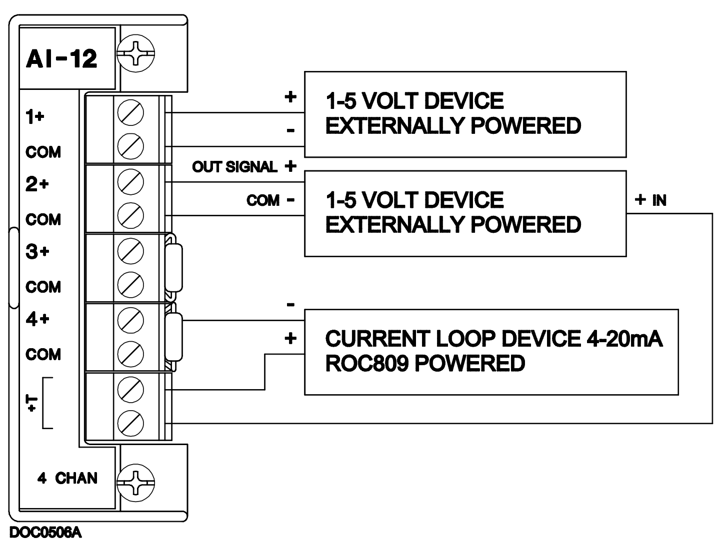


Figure 4-5. Analog Input Module Field Wiring

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying commons from various modules together.

4.4 Analog Output Modules

The 16-bit Analog Output (AO) module has four channels that provide a current output for powering analog devices. Analog Outputs are analog signals generated by the ROC800-series controller to regulate equipment, such as control valves or any device requiring analog control.

Each channel on this module provides a 4 to 20 mA current signal for controlling analog current loop devices. The AO module isolation includes the power supply connections.

❖ **NOTE:** AO modules (Part Number W38199) with front labels that read AO-16 are an earlier version that control the low side. AO modules (Part Number W38269) with front labels that read AO are the newer version (January 2005 and later) that control the high side.

The AO module is selectable as 12 or 24 volts dc via jumper J4 on the I/O module. The AO module can provide isolated +12 volts dc or +24 volts dc field transmitter power on a per module basis. For example, one module can provide +12 volts dc for powering low power analog transmitters, while another module in the same ROC800-series controller can provide +24 volts dc for powering conventional 4-20 mA transmitters. Refer to Figure 4-6.

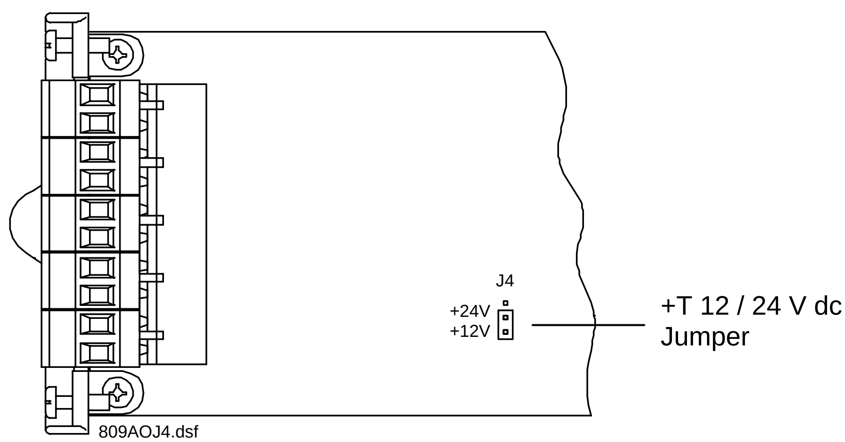


Figure 4-6. Analog Output Jumper J4 (Shown Set to +12V)

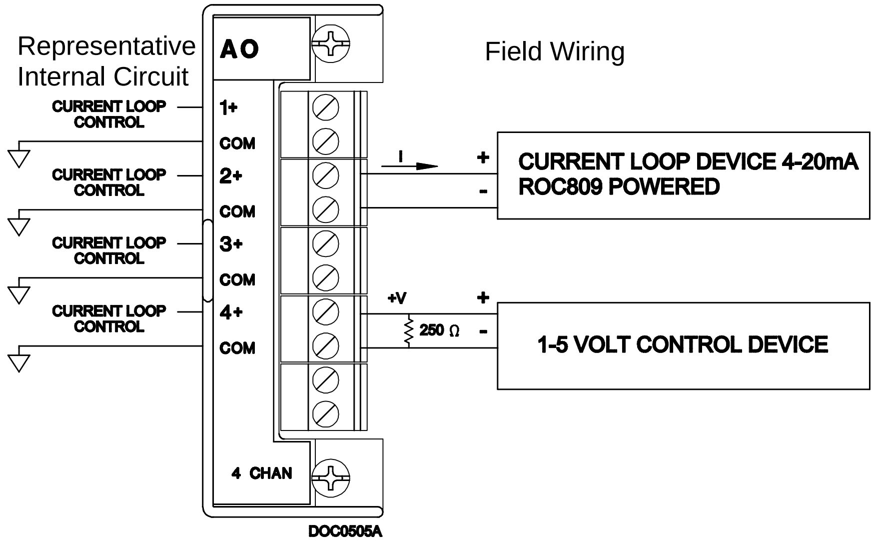


Figure 4-7. Analog Output Module Field Wiring

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying module commons together.

4.5 Discrete Input Modules

The eight channel Discrete Input (DI) modules monitor the status of relays, open collector/open drain type solid-state switches, and other two-state devices. Discrete Inputs come from relays, switches, and other devices, which generate an on/off, open/close, or high/low signal.

The DI module provides a source voltage for dry relay contacts or for an open-collector solid-state switch.

The DI module's LEDs light when each input is active.

Each DI channel can be software configured to function as a momentary or latched DI. A latched DI remains in the active state until reset. Other parameters can invert the field signal and gather statistical information on the number of transitions and the time accumulated in the on or off state.

⚠ CAUTION

The Discrete Input module operates with non-powered discrete devices, such as "dry" relay contacts or isolated solid-state switches. Use of the DI module with powered devices may cause improper operation or damage.

The DI module senses the current flow, which signals the ROC800-series unit electronics that the relay contacts have closed. When the contacts open, current flow interrupts, and the DI module signals the ROC800-series unit electronics that the relay contacts have opened. The fastest time that a DI can be read is 250 times per second.

In Figure 4-8, the left side of the diagram displays the internal circuitry while the right side of the diagram displays possible field wiring.

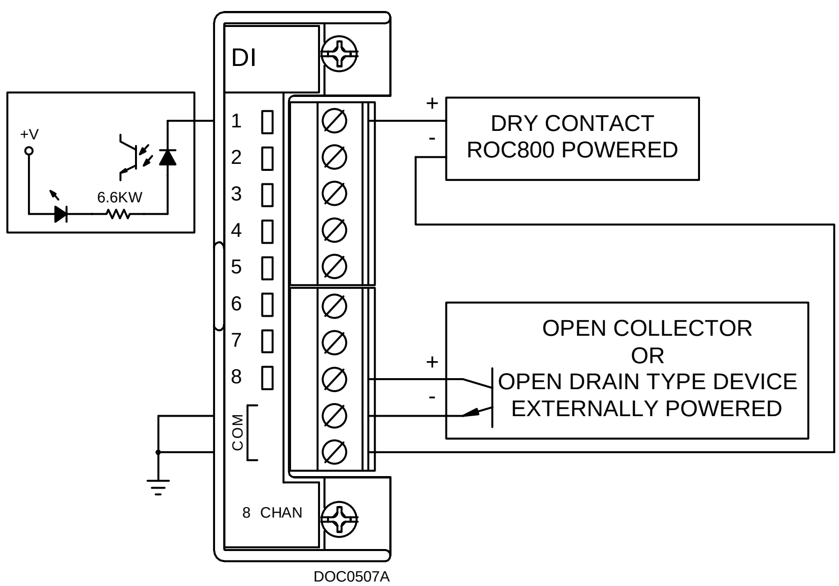


Figure 4-8. Discrete Input Module Field Wiring

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying module-to-module commons together.

4.6 Discrete Output Modules

The five channel Discrete Output (DO) module provides two-state outputs to energize solid-state relays and power small electrical loads. These are solid-state relays. A Discrete Output may be set to send a pulse to a specified device. Discrete Outputs are high/low outputs used to turn equipment on/off.

DO modules can be software configured as latched, toggled, momentary, or Timed Duration Outputs (TDO). The DO can be configured to either retain the last value on reset or use a user-specified fail-safe value.

The DO module provides LEDs that light when each output is active.

When a request is made to change the state of a DO, the request is immediately sent to the DO module. There is no scan time associated with a DO. Under normal operating conditions, the DO channel registers the change within 2 milliseconds.

If the DO is in momentary or toggle mode, the minimum time on that can be entered is 4 milliseconds.

Figure 4-9 displays the field wiring connections to the output circuit of the DO module.

CAUTION

The Discrete Output module only operates with non-powered discrete devices, such as relay coils or solid-state switch inputs. Using the module with powered devices may cause improper operation or damage.

The DO modules draw power for the active circuitry from the backplane. The DO module is fused for protection against excessive current.

❖ **NOTE:** When using the Discrete Output module to drive an inductive load, such as a relay coil, place a suppression diode across the input terminals to the load. This protects the module from the reverse Electro-Motive Force (EMF) spike generated when the inductive load is switched off.

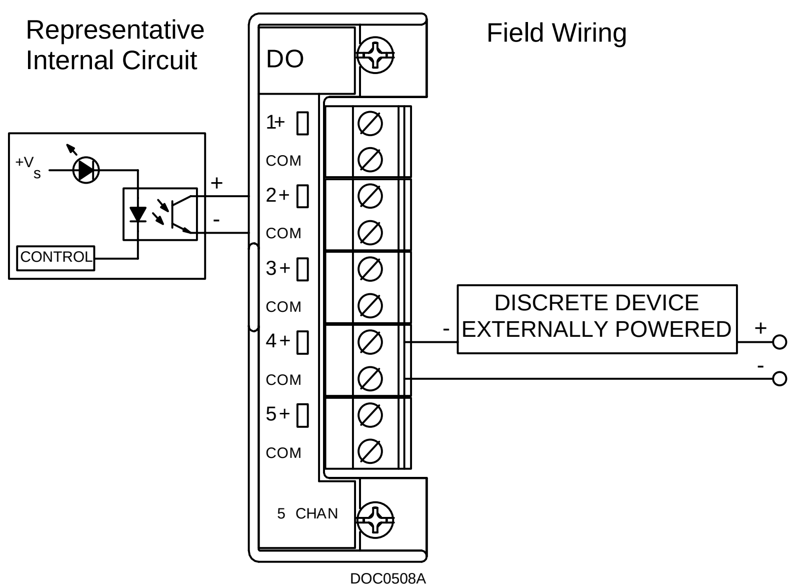


Figure 4-9. Discrete Output Module Field Wiring

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying module-to-module commons together.

4.7 Discrete Output Relay Modules

The five channel DO Relay (DOR) module provides LEDs that light when each output is active. DOR modules use dual-state latching relays to provide a set of normally open, dry contacts capable of switching 2 A at 32 volts dc across the complete operating temperature. The module can be software configured as latched, toggled, momentary, or Timed Duration Outputs (TDO). You can configure the DOR either to retain the last value on reset or to use a user-specified fail-safe value.

Figure 4-10 displays the field wiring connections to the output circuit of the DO Relay module.

❖ **NOTE:** The Discrete Output Relay module operates only with discrete devices having their own power source.

When a request is made to change the state of a DOR, the request is immediately sent to the DOR module. There is no scan time associated with a DOR. Under normal operating conditions, the DOR channel registers the change within 12 msecs. If the DOR is in momentary or toggle mode, DOR channels register the change within 48 msecs.

The DOR modules draw power for the active circuitry from the backplane.

❖ **NOTE:** On power up or reset, the DO Relay module's LEDs enter indeterminate state for a few seconds as the module self-identifies. The LEDs may flash, stay on, or stay off for a few seconds.

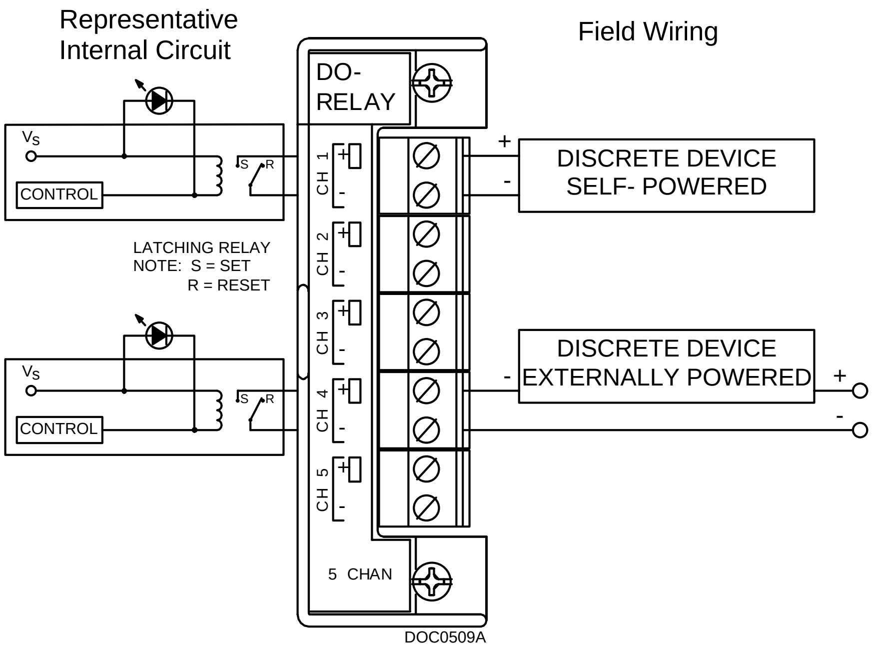


Figure 4-10. Discrete Output Relay Module Field Wiring

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying module-to-module commons together.

4.8 Pulse Input Modules

The Pulse Input (PI) module provides two channels for measuring either a low speed or high speed pulse signal. The PI module processes signals from pulse-generating devices and provides a calculated rate or an accumulated total over a configured period. Functions supported are: slow-counter input, slow rate input, fast counter input, and fast rate input.

The PI is most commonly used to interface to relays or open collector/open drain type solid-state devices. The Pulse Input can be used to interface to either self-powered or ROC800-series powered devices.

The high speed input supports signals up to 12 KHz while the low speed input is used on signals less than 125 Hz.

The PI module is selectable as 12 or 24 volts dc via jumper J4 on the I/O module. The PI modules can provide isolated +12 volts dc or +24 volts dc field transmitter power on a per module basis. For example, one module can provide +12 volts dc power, while another module in the same ROC800-series controller can provide +24 volts dc power. Refer to Figure 4-11.

The PI module provides LEDs that light when each input is active.

⚠ CAUTION

The Pulse Input module only operates with non-powered devices, such as "dry" relay contacts or isolated solid-state switches. Use of the PI module with powered devices may cause improper operation or damage.

The PI modules draw power for the active circuitry from the backplane. Input signals are optically isolated.

❖ **NOTE:** Do not connect wiring to both the Low and High speed selections for a given channel. Unpredictable operation of the PI module will result.

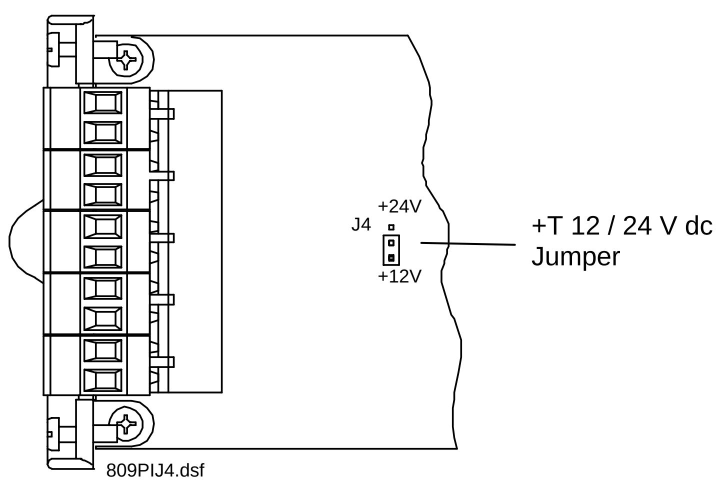


Figure 4-11. Pulse Input J4 Jumper(Set to +12 V)

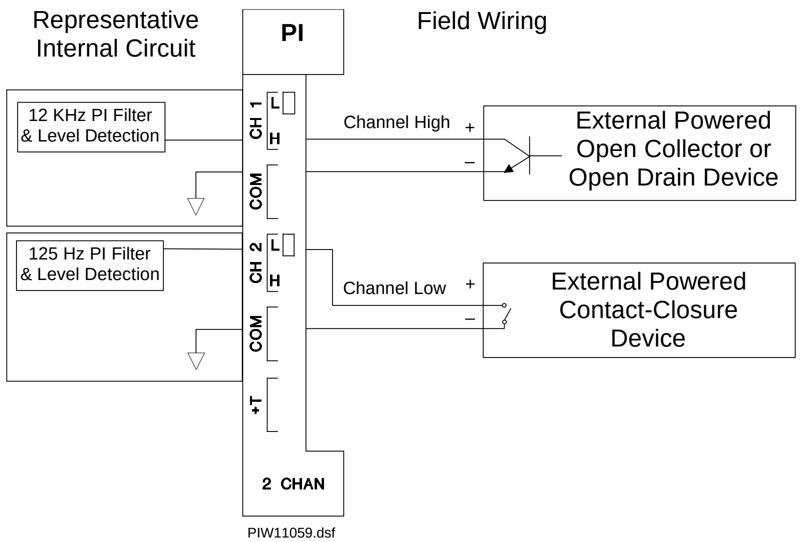


Figure 4-12. Externally Powered Pulse Input Module Field Wiring

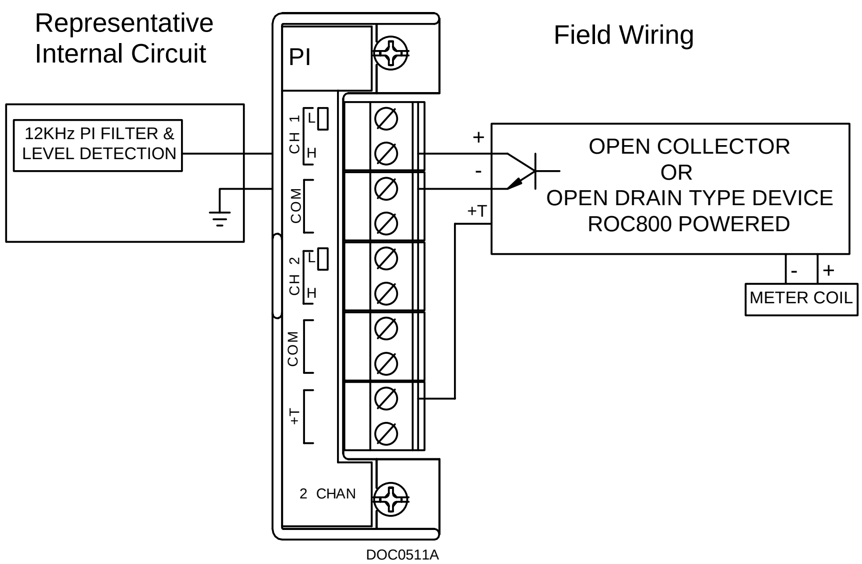


Figure 4-13. ROC800-series Powered Pulse Input Module Field Wiring

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying commons together.

4.9 RTD Input Modules

The Resistance Temperature Detector (RTD) module monitors the temperature signal from an RTD source. The module can accommodate input from a two-, three-, or four-wire RTD source.

The active element of an RTD probe is a precision, temperature-dependent resistor, made from a platinum alloy. The resistor has a predictable positive temperature coefficient, meaning its resistance increases with temperature. The RTD input module works by supplying a small consistent current to the RTD probe and measuring the voltage drop across it. Based on the voltage curve of the RTD, the signal is converted to temperature by the ROC800-series firmware.

The RTD input module monitors the temperature signal from a resistance temperature detector (RTD) sensor or probe. A 2-channel 16-bit RTD module is available. The RTD module isolation includes the power supply connections.

The RTD modules draw power for the active circuitry from lines on the backplane.

It may be more convenient to perform calibration before connecting the field wiring. However, if the field wiring between the ROC800-series controller and the RTD probe is long enough to add a significant resistance, then perform calibration in a manner that considers this.

4.9.1 Connecting the RTD Wiring

Temperature can be input through the Resistance Temperature Detector (RTD) probe and circuitry. An RTD temperature probe mounts directly to the piping using a thermowell. Protect RTD wires either by a metal sheath or by conduit connected to a liquid-tight conduit fitting. The RTD wires connect to the four screw terminals designated “RTD” on the RTD module.

The ROC800-series controller provides terminations for a four-wire 100-ohm platinum RTD with a DIN 43760 curve. The RTD has an alpha equal to 0.00385 or 0.00392Ω/Ω°C. A two-wire or three-wire RTD probe can be used instead of a four-wire probe; however, they may produce measurement errors due to signal loss on the wiring.

Wiring between the RTD probe and the ROC800-series controller must be shielded wire, with the shield grounded only at one end to prevent ground loops. Ground loops cause RTD input signal errors.

Table 4-1. RTD Signal Routing

Signal	Terminal	Designation
CH 1 (REF)	1	Constant Current +
CH 1 (+)	2	V+ RTD
CH 1 (–)	3	V– RTD
CH 1 (RET)	4	Constant Current –
Not Connected	5	N/A
CH 2 (REF)	6	Constant Current +
CH 2 (+)	7	V+ RTD
CH 2 (–)	8	V– RTD
CH 2 (RET)	9	Constant Current –
Not Connected	10	N/A

❖ **NOTE:** All I/O modules are isolated on the field side. Be aware that you can induce ground loops by tying commons together.

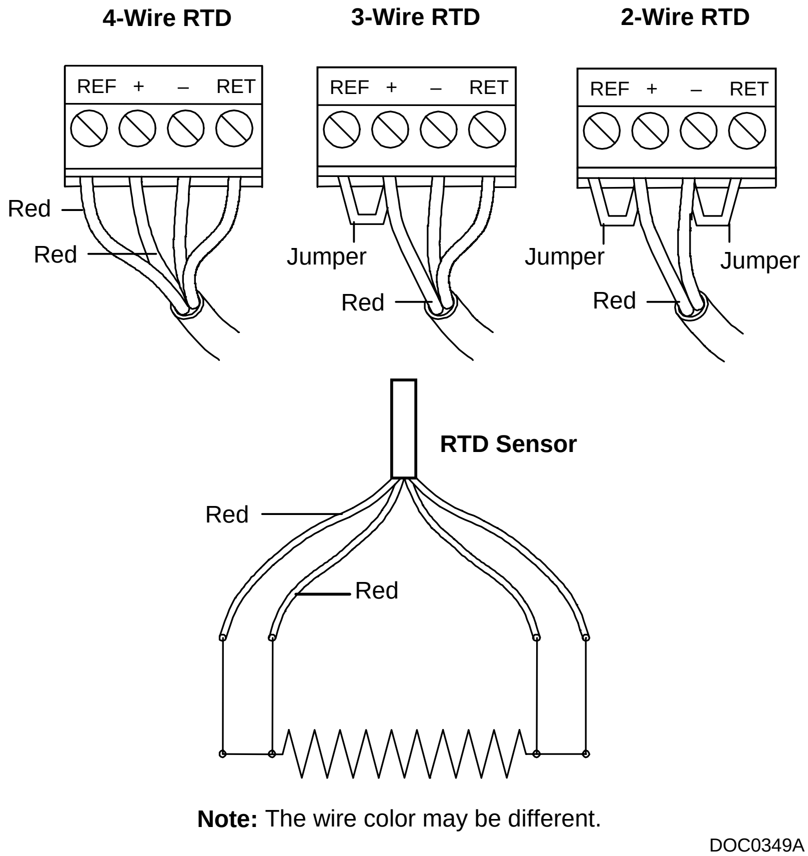


Figure 4-14. RTD Sensor Wiring Terminal Connections

Figure 4-14 and Table 4-2 display the connections at the RTD terminals for the various RTD probes.

Table 4-2. RTD Wiring

Terminal	4-Wire RTD	3-Wire RTD	2-Wire RTD
REF	Red	Jumper to +	Jumper to +
+	Red	Red, Jumper to REF	Red, Jumper to REF
–	White	White	White, Jumper to RET
RET	White	White	Jumper to –

❖ **NOTE:** The wire colors for the RTD being used may differ.

4.10 J and K Type Thermocouple Input Modules

The five channel J and K Type Thermocouple input module monitors either J or K Type Thermocouple (T/C). J and K refer to the type of material used to make a bimetallic junction: Type J (Iron / Constantan) and Type K (Chromel / Alumel). These dissimilar junctions in the thermocouple junction generate different millivolt levels as a function of the heat to which they are exposed.

The J and K Type Thermocouple module measures the voltage of the thermocouple to which it is connected. The T/C voltage is measured and a Cold Junction Compensation (CJC) correction factor is applied to compensate for errors due to any voltage inducted at the wiring terminals by the junction between the different metal of the T/C wiring and the T/C module's terminal blocks.

- **NOTE:** The use of dissimilar metals is not supported. It will not provide the correct results, as CJC is applied at module level.

Thermocouples are self-powered and require no excitation current. The thermocouple modules use integrated short-circuit protected isolated power supplies and completely isolates the field wiring side of the module from the backplane.

⚠ CAUTION

If using the Type J above 750°C (1382°F), abrupt magnetic transformation causes permanent de-calibration of the T/C wires.

De-calibration can occur in thermocouple wires. De-calibration is the process of unintentionally altering the makeup of the thermocouple, usually caused by the diffusion of atmospheric particles into the metal at the extremes of the operating temperature range. Impurities and chemicals can cause de-calibration from the insulation diffusing into the thermocouple wire. If operating at high temperatures, check the specification of the probe insulation. It is advised to use thermocouples with insulated junctions to protect against oxidation and contamination.

Thermocouples use thin wire (typically 32 AWG) to minimize thermal shunting and increase response times. Wire size used in the thermocouple depends upon the application. Typically, when longer life is required for the higher temperatures, select the larger size wires. When sensitivity is the prime concern, use smaller size wiring. Thin wire causes the thermocouple to have a high resistance that can cause errors due to the input impedance of the measuring instrument. If thermocouples with thin leads or long cables are required, keep the thermocouple leads short and use a thermocouple extension wire to run between the thermocouple and measuring instrument.

The thermocouple wires directly to the module's removable terminal block. No special terminal or isothermal block is required.

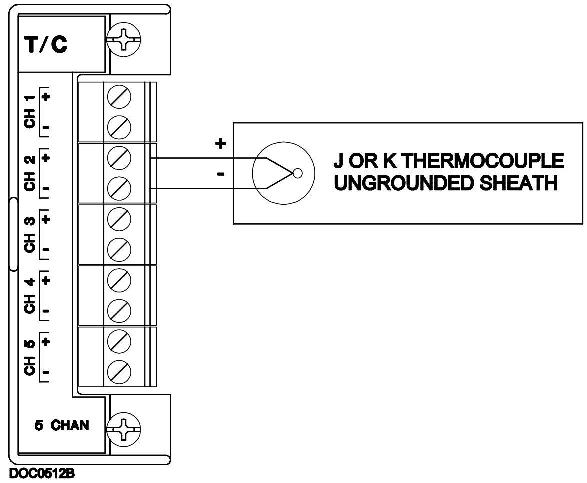


Figure 4-15. Type J and K Thermocouple Wiring

Be sure to use the correct type of thermocouple wire to connect the thermocouple to the ROC800-series controller. Minimize connections and make sure connections are tight. If you use any dissimilar metals (for instance using copper wire) to connect a thermocouple to the ROC800-series controller, you create junction of dissimilar metals that can generate millivolt signals and increase reading errors.

Ensure any plugs, sockets, or terminal blocks used to connect the extension wire are made from the same metals as the thermocouples and observe correct polarity.

The thermocouple probe must have sufficient length to minimize the effect of conduction of heat from the hot end of the thermocouple. Unless there is insufficient immersion, readings will be low. It is suggested the thermocouple be immersed for a minimum distance equivalent to four times the outside diameter of a protection tube or well.

Use only ungrounded thermocouple constructions. Grounded thermocouples are susceptible to the creation of ground loops. In turn, ground loops can cause interaction between thermocouple channels on the thermocouple module.

❖ **NOTE:** Use thermocouples as individual sensing devices. All modules are isolated on the field side. Be aware that you can induce ground loops by tying module-to-module commons together.

Millivolt signals are very small and are very susceptible to noise. Noise from stray electrical and magnetic fields can generate voltage signals higher than the millivolt levels generated from a thermocouple. The T/C modules can reject common mode noise (signals that are the same on both wires), but rejection is not perfect, so minimize noise where possible.

Take care to properly shield thermocouple wiring from noise by separating the thermocouple wiring runs from signals that are switching loads and AC signals. Route wires away from noisy areas and twist the two insulated leads of the thermocouple cable together to help ensure both wires pickup the same noise. When operating in an extremely noisy environment, use a shielded extension cable.

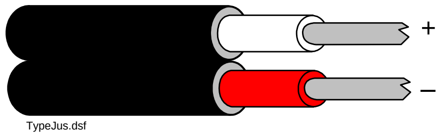


Figure 4-16. Type J Thermocouple Shielded Wiring – United States Color Coding

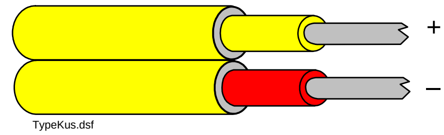


Figure 4-17. Type K Thermocouple Shielded Wiring – United States Color Coding

United States color-coding for the Type J Thermocouple shielded wiring is black sheathing, the positive lead is white, and the negative lead is red.

United States color-coding for the Type K Thermocouple shielded wiring is yellow sheathing, the positive lead is yellow, and the negative lead is red.

Shielded wiring is recommended. Ground shields only on one end, preferably at the end device unless you have an excellent ground system installed at the ROC800-series controller. Do not tie the thermocouple module to ground.

❖ **NOTE:** It is highly recommended that you use shielded wiring.

Sheathed thermocouple probes are available with one of three junction types: grounded, ungrounded, or exposed.

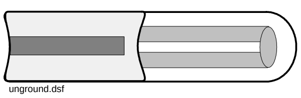


Figure 4-18. Ungrounded – Sheathed

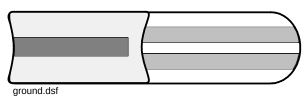


Figure 4-19. Grounded

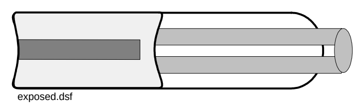


Figure 4-20. Exposed, Ungrounded – Unsheathed

In an **ungrounded** probe, the thermocouple junction is detached from the probe wall. Response time slows down from the grounded style, but the ungrounded probe offers electrical isolation of 1.5 M ½ at 500 volts dc in all diameters. The wiring may or may not be sheathed.

❖ **NOTE:** Only **ungrounded** probes are supported. It is highly recommended that you use sheathed probes.

Use an ungrounded junction for measurements in corrosive environments where it is desirable to have the thermocouple electronically isolated from and shielded by the sheath. The welded wire thermocouple is physically insulated from the thermocouple sheath by MgO powder (soft).

At the tip of a **grounded** junction probe, the thermocouple wires physically attach to the inside of the probe wall. This results in good heat transfer from the outside, through the probe wall to the thermocouple junction. **Grounded wiring is not supported.**

The thermocouple in the **exposed** junction protrudes out of the tip of the sheath and is exposed to the surrounding environment. This type offers the best response time, but is limited in use to non-corrosive and non-pressurized applications. **Exposed junction thermocouples are not supported.**

❖ **NOTE:** Avoid subjecting the thermocouple connections and measurement instrument to sudden changes in temperature.

4.11 HART Interface Modules

The HART interface module allows a ROC800-series controller to communicate with HART devices using the Highway Addressable Remote Transducer (HART) protocol. The HART module can receive signals from HART transmitters or receive and transmit signals from HART transducers. LEDs provide a visual indication of the status of each HART channel. Refer to Figure 4-21.

The module has four analog channels. When configured as an input, the channel can be configured for use in point-to-point or multi-drop mode and typically connects to some type of transmitter, such as for a temperature reading. When configured as an output, the channel can be configured for use in point-to-point mode only. The output supports a Digital Valve Controller (DVC).

In point-to-point mode, digital communications are superimposed using the Frequency Shift Keying (FSK) technique on the 4 to 20 milliAmp analog signal (which can still measure the process variable). This mode allows communications with one HART device per analog channel.

In multi-drop mode, up to five HART devices can be connected (in parallel) to each analog input channel. As with the point-to-point mode, digital communications are superimposed on the 4 to 20 milliAmp signal. However, the analog signal is used only to measure the current consumed by the multi-drop loop. When all four analog inputs are in the multi-drop mode, the ROC can support a maximum of 20 HART devices. The number of devices per channel is limited by the static current draw of the devices.

A ROC800-series controller equipped with a HART module is considered to be a HART Host (primary master) interface with a Class 1 Conformance classification. Most Universal and some Common Practice commands are supported. For a list of the commands, refer to the HART Interface Module specification table on page 4-30. The supported commands conform to HART Universal Command Specification Revision 5.1 and Common Practice Command Specification Revision 7, (HCF SPEC 127 & 151). Refer to www.hartcomm.org for more information on the specifications.

The HART module polls the channels simultaneously. If more than one device is connected to a channel in a multi-drop configuration, the module polls one device per channel at a time. The HART protocol allows one second per poll for each device, so with five devices per channel the maximum poll time for the channel would be five seconds.

- ❖ **NOTE:** Burst mode is not supported by the ROC800-Series HART module. The device should not be configured in Burst mode when connected to the ROC. If a device is in Burst mode, use a Hand-Held Communicator to turn off Burst mode. The indication that the device is in Burst mode is a quick flashing of the Channel's receive LCD.

The HART module provides "loop source" power (+T) and four channels for communications (1+ through 4+). The +T power is current limited.

When powered by the ROC, terminal +T is connected in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected. Channel 1+ is wired to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of the devices. Likewise, channel 2+ is wired to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of a second group of HART devices.

When powered by an external device, the positive (+) terminal from the power source is connected in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected. Channel 1+ on the HART module is wired to the positive (+) terminal of the HART device. The power source negative (–) terminal is connected to the channel's COM terminal and to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of the HART devices.

Switches on the module board allow channel-by-channel selection as an Analog Input (IN) or Analog Output (OUT). The switches for **Channel 2 and 4** are located on the **front of the module**, while the switches for **channel 1 and 3** are located on the **back of the module.** Refer to Figure 4-22 and Figure 4-23. Use a pin to move the switches to the desired state.

❖ **NOTE:** Always set the IN or OUT switches before wiring the switch or applying power.

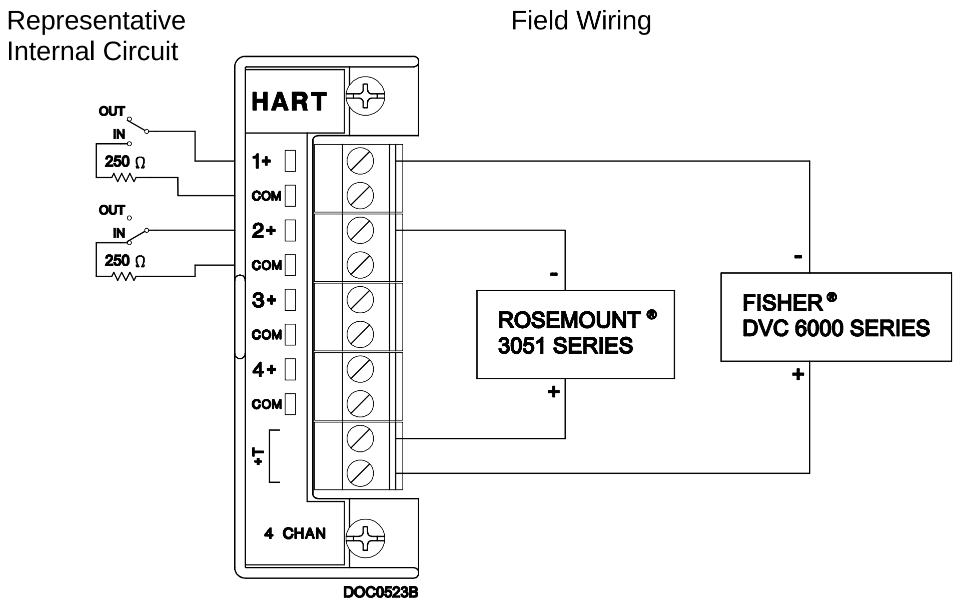


Figure 4-21. HART Interface Module Field Wiring

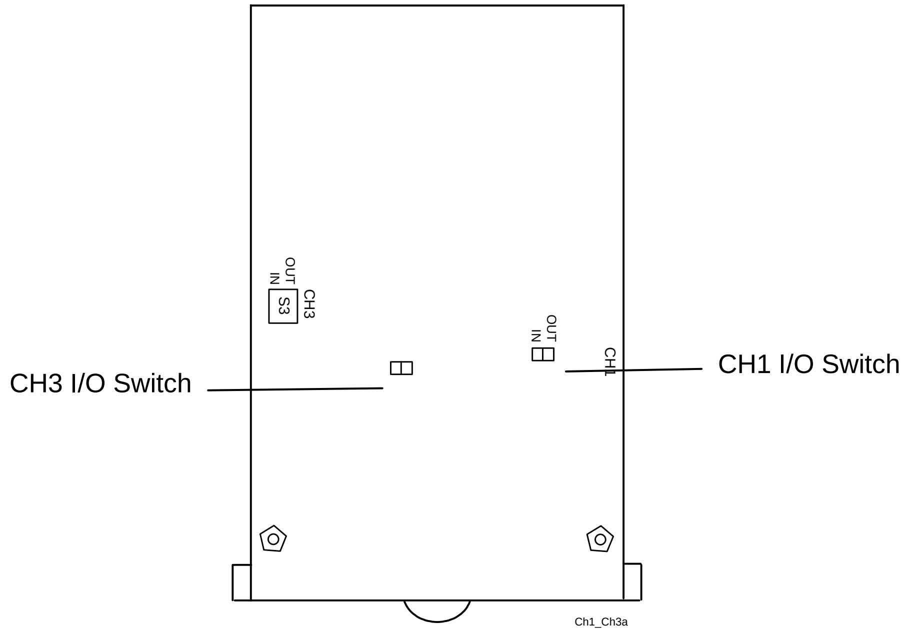


Figure 4-22. HART Channels 1 and 3 (On back side of board)

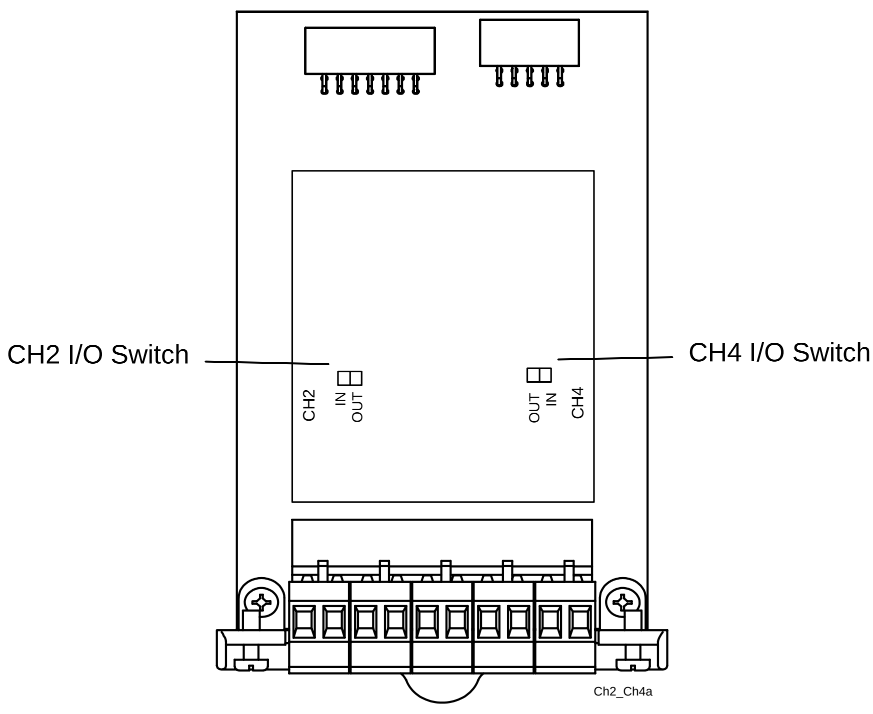


Figure 4-23. HART Channels 2 and 4 (On front side of board)

4.12 I/O Module Specifications

This section details the specifications for the various I/O modules.

4.12.1 Analog Input Modules

Analog Input Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	1+	Positive Analog Input
2	COM	Common Analog Input
3	2+	Positive Analog Input
4	COM	Common Analog Input
5	3+	Positive Analog Input
6	COM	Common Analog Input
7	4+	Positive Analog Input
8	COM	Common Analog Input
9	+T	Loop Power
10	+T	Loop Power

INPUT (AI-12 MODULE)

Quantity: 4 channels.

Type: Single-ended, voltage sense. 12-bit resolution, uses 16-bit A/D converter.

Voltage: 0-5 V dc, 1.22 mV/count.

Impedance: 10 Megohms typical (without scaling resistor).

Maximum Overload Voltage: ±24V continuous.

Absolute Accuracy[1] at 25°C (77°F): ±0.10%.

Absolute Accuracy[1] Over Operating Temp: ±0.15%.

Minimum Scan Period: 50 msec for all channels.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 volts dc): 84mA typical.

Additional loading that may apply:

+T @ 12V: 1.25 multiplied by Measured Current Draw at +T Terminal

+T @ 24V: 2.5 multiplied by Measured Current Draw at +T Terminal

WIRING

12 AWG or smaller at the removable terminal block.

LOOP POWER

+T Sensor Supply Voltage: Jumper selectable between 12 V dc and 24 V dc.

+T Sensor Supply Current: 85 mA at nominal 12 or 24 V dc.

ISOLATION

Field to Logic: 2500 V dc, 1 minute minimum.

Field to Power: 2500 V dc, 1 minute minimum.

Module to Module: 2500 V dc, 1 minute minimum.

WEIGHT

56.7 g (2.0 oz).

ENVIRONMENTAL

Same as the ROC800-Series unit in which it is installed.

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

APPROVALS

Same as the ROC800-Series unit in which it is installed.

1. Absolute Accuracy Includes: Linearity, Hysteresis, Repeatability, Stability, Gain, and Offset error.

4.12.2 Analog Output Module

Analog Output Module Specifications

FIELD WIRING TERMINALS[1]

Terminal	Label	Definition
1	CH 1+	Positive Analog Output
2	COM	Analog Output Return
3	CH 2+	Positive Analog Output
4	COM	Analog Output Return
5	CH 3+	Positive Analog Output
6	COM	Analog Output Return
7	CH 4+	Positive Analog Output
8	COM	Analog Output Return
9	N/A	Not Used
10	N/A	Not Used

OUTPUT

Quantity: 4 channels.

Type: Single-ended, current control. 16-bit resolution.

Maximum Input Overload Voltage: ±24 V dc, continuous.

Output Load at 12 Volts DC[2]**:** 300 ohms maximum.

Output Load at 24 Volts DC[2]**:** 750 ohms maximum.

Absolute Accuracy[3] **at 25°C (77°F) with full load:**

Loop Power set for +12 V dc = 0.045%.
Loop Power set for +24 V dc = 0.200%.

Absolute Accuracy[3] **Over Operating Temp with full load:**

Loop Power set for +12 V dc = 0.25%.
Loop Power set for +24 V dc = 0.35%.

Reset Action: User selectable between outputs going to software-configured value or to last value on power-up (on restart).

Minimum Scan Period: 50 msec on all channels.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 V dc): 100 mA maximum over operating temperature range.

Additional loading that may apply:

Output @ 12V: 1.25 multiplied by Measured Current Draw per channel output.

Output @ 24V: 2.5 multiplied by Measured Current Draw per channel output.

WIRING

12 AWG or smaller at the removable terminal block.

LOOP POWER

Sensor Supply Voltage: Jumper selectable between 12 V dc and 24 V dc.

Sensor Supply Current: 0-20.83 mA per channel.

ISOLATION

Field to Logic: 2500 V dc, 1 minute minimum.

Field to Power: 2500 V dc, 1 minute minimum.

Module to Module: 2500 V dc, 1 minute minimum.

WEIGHT

54.4 g (1.92 oz).

ENVIRONMENTAL

Same as the ROC800-Series unit in which it is installed.

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

APPROVALS

Same as the ROC800-Series unit in which it is installed.

1. AO modules W38199 with front labels that read AO-16 are an earlier version that control the low side. AO modules W38269 with front labels that read AO are the newer version (January 2005 and later) that control the high side.
2. If all channels are at 100% output and R load is <100 ohms on each channel, then the unit's operating temperature range must be reduced by 1 degree/channel when maximum battery voltage is applied to the unit.
3. Absolute Accuracy Includes: Linearity, Hysteresis, Repeatability, Stability, Gain, and Offset error.

4.12.3 Discrete Input Module

Discrete Input Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	CH 1	CH1 Positive
2	CH 2	CH 2 Positive
3	CH 3	CH 3 Positive
4	CH 4	CH 4 Positive
5	CH 5	CH 5 Positive
6	CH 6	CH 6 Positive
7	CH 7	CH 7 Positive
8	CH 8	CH 8 Positive
9	COM	Common
10	COM	Common

INPUT

Quantity: 8 channels.

Type: Optically isolated inputs, common voltage source.

Minimum Scan Period: 4 msec.

Input Impedance: 6.6 KΩ.

Maximum Input Overload Voltage: ±24 Volts DC, continuous.

Minimum On-state Input Current: 1.1 mA.

Maximum Off-state Input Current: 0.35 mA.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 Volts DC):

No Channels Active: 19mA

Additional loading that may apply:

Per Active Channel: 3.2 mA

Per Active LED: 1.5mA

WIRING

12 AWG at the removable terminal block.

LEDS

8 green LEDs indicate the status of the channels.

ISOLATION

Field to Logic: 2500 Volts DC, 1 minute minimum.

Field to Power: 2500 Volts DC, 1 minute minimum.

Module to Module: 2500 Volts DC, 1 minute minimum.

WEIGHT

49.9 g (1.76 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

4.12.4 Discrete Output Modules

Discrete Output Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	CH 1+	CH 1 Positive
2	CH 1-	Common
3	CH 2+	CH 2 Positive
4	CH 2-	Common
5	CH 3+	CH 3 Positive
6	CH 3-	Common
7	CH 4+	CH 4 Positive
8	CH 4-	Common
9	CH 5+	CH 5 Positive
10	CH 5-	Common

OUTPUT

Quantity: 5-channel

Type: Isolated, solid-state switch.

Output Voltage Range: 0 to +32 Volts DC.

Maximum On-State Current: 0.2 A @ 32 Volts DC per output across complete operating temperature.

Maximum Off-State Leakage: 0.01 mA @ 32 Volts DC.

Over Current Protection: Self-resetting circuitry on each channel.

Minimum Channel Activation Time: 4 msec.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 Volts DC):

No Channels Active: 20mA

Additional loading that may apply:

Per Active Channel: 1.5 mA

Per Active LED: 1.5mA

WIRING

12 AWG at the removable terminal block.

LEDS

5 green LEDs indicate the status of the channel.

ISOLATION

Field to Logic: 2500 Volts DC, 1 minute minimum.

Field to Power: 2500 Volts DC, 1 minute minimum.

Module to Module: 2500 Volts DC, 1 minute minimum.

WEIGHT

52.2 g (1.84 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

4.12.5 Discrete Output Relay Module

Discrete Output Relay Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	CH 1+	CH 1 Positive
2	CH 1-	CH 1 Negative
3	CH 2+	CH 2 Positive
4	CH 2-	CH 2 Negative
5	CH 3+	CH 3 Positive
6	CH 3-	CH 3 Negative
7	CH 4+	CH 4 Positive
8	CH 4-	CH 4 Negative
9	CH 5+	CH 5 Positive
10	CH 5-	CH 5 Negative

OUTPUT

Quantity: 5-channel.

Type: Isolated, dual latching relay.

Contact Rating: 0 to 32 Volts DC.

Maximum Current: 2.0 A, @ 32 Volts DC per output across complete operating temperature.

Minimum Channel Activation Time: 48 msec.

LEDS

5 green LEDs indicate the status of the channel.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 Volts DC):

No Channels Active: 6.8 mA

Additional loading that may apply:

During Active Transition: 150 mA for 10 mSec.

Per Active LED: 1.5mA

WIRING

12 AWG at the removable terminal block.

ISOLATION

Field to Logic: 1500 Volts DC, 1 minute minimum.

Field to Power: 1500 Volts DC, 1 minute minimum.

Module to Module: 1500 Volts DC, 1 minute minimum.

WEIGHT

59.0 g (2.08 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

4.12.6 Pulse Input Module

Pulse Input Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	CH1 L	CH1 Low Speed
2	CH1 H	CH 1 High Speed
3	COMM	CH 1 Common
4	COMM	CH 1 Common
5	CH2 L	CH 2 Low Speed
6	CH2 H	CH 2 High Speed
7	COMM	CH 2 Common
8	COMM	CH 2 Common
9	+T	Loop Power
10	+T	Loop Power

INPUT

Quantity: 2-channels.

Type: Optically isolated inputs, common voltage source, and terminal selectable high/low speed hardware filter on each channel.

Filter Cutoff Frequency:
High Speed Input: 12 KHz.
Low Speed Input: 125 Hz.

Input Impedance: 2 KΩ.typical

Minimum On-State Input Current: 2.00 mA.

Maximum Off-State Input Current: 1.7 mA.

LEDS

2 green LEDs indicate the status of the channels.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 Volts DC):

No Channels Active: 21mA

Additional loading that may apply:

Per Active Channel: 7.4 mA

Per Active LED: 1.5mA

+T @ 12V: 1.25 * Measured Current Draw at +T Terminal

+T @ 24V: 2.5 * Measured Current Draw at +T Terminal

WIRING

12 AWG at the removable terminal block.

ISOLATION

Field to Logic: 2500 Volts DC, 1 minute minimum.

Field to Power: 2500 Volts DC, 1 minute minimum.

Module to Module: 2500 Volts DC, 1 minute minimum.

WEIGHT

56.7 g (2.0 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

4.12.7 RTD Input Module

RTD Input Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	REF	CH1 Constant Current +
2	+	CH1 Positive RTD
3	–	CH1 Negative RTD
4	RET	CH1 Constant Current –
5	N/A	Not Used
6	REF	CH2 Constant Current +
7	+	CH2 Positive RTD
8	–	CH2 Negative RTD
9	RET	CH2 Constant Current –
10	N/A	Not Used

INPUT

Quantity: 2 channels.

Type: 2, 3 or 4-wire, 100 Ω, platinum type RTD, using a 24 bit A/D connector.

Sensing Range: -50 to 350°C (-58 to 662°F).

Full Range Deflection: DIN 43760 standard.

Maximum Overload: (Input + to Input -) ±6 Volts DC, continuous.

Temperature Coefficient: alpha of 0.00385 or 0.00392 (software selectable).

INPUT

Minimum Scan Period: 64 msec, both channels.

Absolute Accuracy[1] at 25°C (77°F): 0.03% of reading, maximum.

Absolute Accuracy[1] Over Operating Temp: 0.38% of full scale.

POWER CONSUMPTION

Main power supply loading at 13.25 Volts DC at the Battery Terminals: 65 mA maximum.

WIRING

12 AWG at the removable terminal block.

ISOLATION

Field to Logic: 2500 Volts DC, 1 minute minimum.

Field to Power: 2500 Volts DC, 1 minute minimum.

Module to Module: 2500 Volts DC, 1 minute minimum.

WEIGHT

70 g (2.47 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

4.12.8 J and K Type Thermocouple Input Module

J and K Type Thermocouple Input Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	CH 1+	CH1 Positive
2	CH 1-	CH1 Negative
3	CH 2+	CH2 Positive
4	CH 2-	CH2 Negative
5	CH 3+	CH3 Positive
6	CH 3-	CH3 Negative
7	CH 4+	CH4 Positive
8	CH 4-	CH4 Negative
9	CH 5+	CH5 Positive
10	CH 5-	CH5 Negative

INPUT

Quantity: 5 channels.

Type: J & K Type ungrounded Thermocouple sensors. Software selectable on a per channel basis.

Input Temperature Range:
J Type: -200 to 1200°C (-328 to 2192°F).
K Type: -100 to 1372°C (-121 to 2500°F).

Maximum Overload: (Input + to Input -) ±6 Volts DC, continuous.

Minimum Scan Period: 150 mSec for all channels.

Absolute Accuracy[1] at 25°C (77°F): 1°C typical.

Absolute Accuracy[1] at 25°C (77°F): 2°C maximum.

Absolute Accuracy[1] Over Operating Temp: 6°C maximum.

COLD JUNCTION COMPENSATION

Cold junction is measured and corrected on a per channel basis.

OPEN CIRCUIT DETECTION

On detection of no thermocouple present, the reading is forced above 1500 °C (2732 °F).

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 Volts DC):

Typical : 84 mA.

WIRING

12 AWG at the removable terminal block.

ISOLATION

Field to Logic: 2500 Volts DC, 1 minute minimum.

Field to Power: 2500 Volts DC, 1 minute minimum.

Module to Module: 2500 Volts DC, 1 minute minimum.

WEIGHT

59.0 g (2.08 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

1. Absolute Accuracy Includes: Linearity, Hysteresis, Repeatability, Stability, Gain, and Offset error.

4.12.9 HART Interface Module

HART Interface Module Specifications

FIELD WIRING TERMINALS

+: Signal Positive.
COM: Common.
+T: Transmitter Power.

CHANNELS

Four channels per module, which communicate via Analog/Digital signals.

Mode: Half-duplex.
Data Rate: 1200 bps.
Parity: Odd.
Modulation: Phase coherent, Frequency Shift Keyed (FSK) per Bell 202.
Carrier Frequencies: Mark 1200 Hz, Space 2200 Hz, ±0.1%.

SUPPORTED HART COMMANDS

Universal Commands: Read unique identifier; read primary variable; read primary variable and current; read dynamic variable and current; write polling addresses; read unique identifier associated with tag; read message; read tag; descriptor and date; read primary variable sensor information; read device information; write message; write tag, descriptor and date.

Common Practice Command: Read transmitter variables.

ACCURACY

Analog Output:
Absolute accuracy at 25°C (77°F): 0.2%.
Absolute accuracy over operating temperature range: 1.5%.

Analog Input:
Absolute accuracy at 25°C (77°F): 1.5%.
Absolute accuracy over operating temperature range: 3.0%

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 V dc): 110 mA maximum over operating temperature range.

Additional loading that may apply for each device configured: 2.5 multiplied by Measured Current Draw at +T terminal.

LOOP POWER

Total power supplied through the module for HART devices is 20 mA per channel at 24 V dc. Each HART device typically uses 4 mA in multi-drop mode and uses 4-20 mA in point-to-point mode.

OVER-VOLTAGE PROTECTION

±25 V dc, continuous on any terminal.

ISOLATION

Field to Logic: 2500 V dc, 1 minute minimum.

Field to Power: 2500 V dc, 1 minute minimum.

Module to Module: 2500 V dc, 1 minute minimum.

WIRING

12 AWG or smaller at the removable terminal block.

WEIGHT

76 g (2.8 oz).

DIMENSIONS

26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL

Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS

Meets the same approvals as the ROC800-Series unit in which it is installed.

SECTION 5 – COMMUNICATIONS

This section describes the built-in communications and the optional communication modules used with the ROC800-Series Remote Operations Controllers.

5.1 Communication Ports and Modules Overview

The built-in communications and the optional communication modules provide communications between the ROC800-Series unit and a host system or external devices.

The ROC800-Series unit allows up to six communication ports. Three communication ports are built-in on the CPU and up to three additional ports may be added with communication modules. Table 5-1 displays the types of communications available for the ROC800-Series.

Table 5-1. Built-in Communications and Optional Communication Modules

Communications	Built-in on CPU	Optional Module
EIA-232 (RS-232D) Local Operator Interface (LOI)	Local Port	
Ethernet (use with DS800 Configuration Software)	Comm1	
EIA-232 (RS-232C) Serial Communications	Comm2	Comm3 to Comm5
EIA-422/485 (RS-422/485) Serial Communications		Comm3 to Comm5
Modem Communications		Comm3 to Comm5
MVS Sensor Interface		Comm3 to Comm5

The communication modules consist of a communications module (card), a communications port, wiring terminal block, LEDs, and connectors to the backplane. The ROC800-Series unit can hold up to three communication modules in the first three module slots. Refer to Figure 5-1.

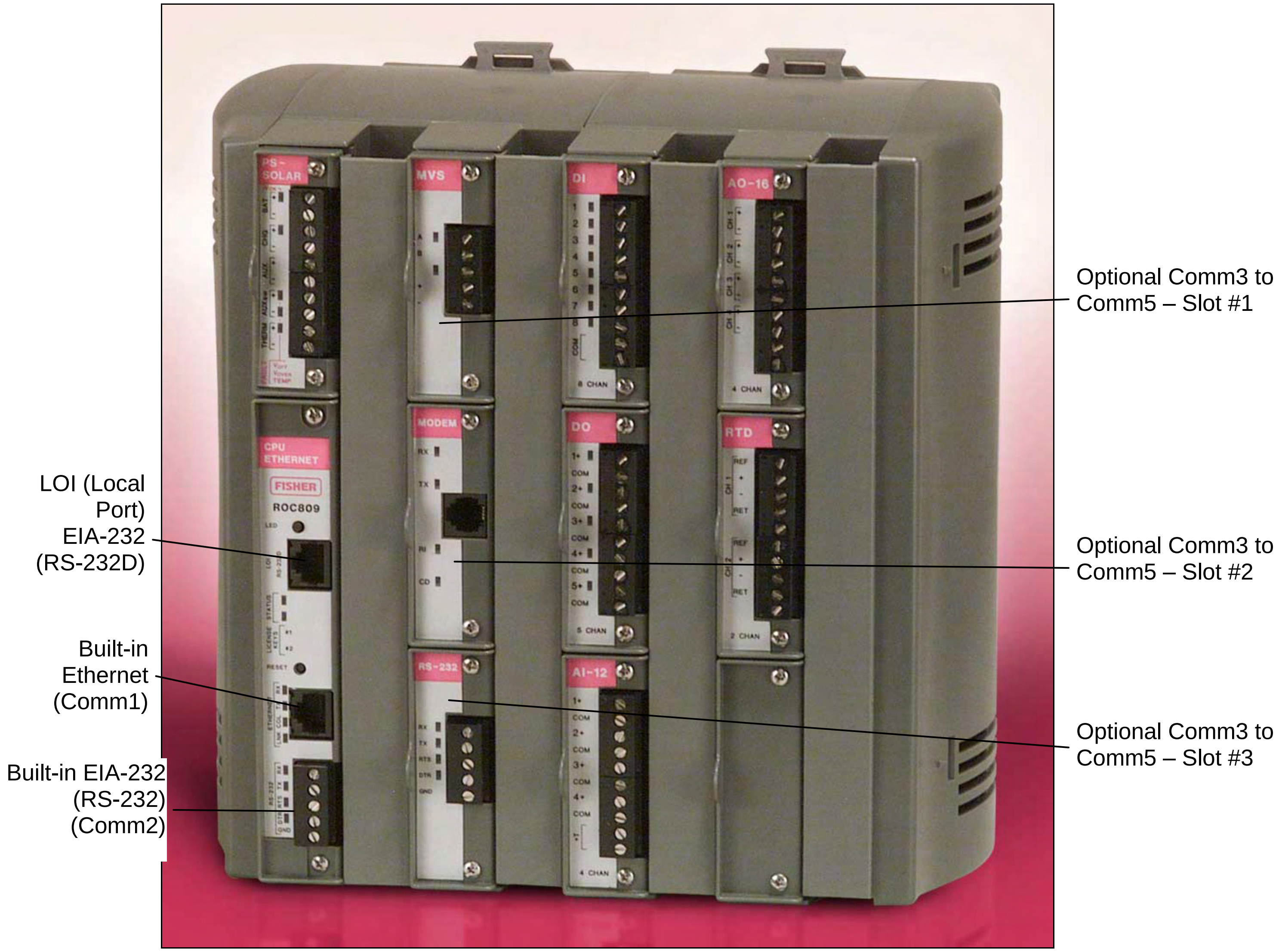


Figure 5-1. Communication Ports

Table 5-2. Communication LED Indicator Definitions

Signals	Action
CTS	**Clear To Send** indicates the modem is ready to send.
CD	Data **Carrier Detect** (DCD) indicates a valid carrier signal tone detected.
DSR	**Data Set Ready** for ring indicator communication signal.
DTR	**Data Terminal Ready** to answer an incoming call. When the DTR goes off, a connection disconnects.
RTS	**Ready To Send** indicates ready to transmit.
RX	**Receive Data** (RD) signal is being received.
TX	**Transmit Data** (TD) signal is being transmitted.

Each communications module has surge protection in accordance with the CE certification EN 61000. Each communications module is completely isolated from other modules and the backplane, including power and signal isolation, with the exception of the EIA-232 (RS-232) module. The field interface has been designed to protect the electronics in the module. Filtering is provided on each module to reduce communication errors.

5.2 How to Install Communication Modules

All communication modules install into the ROC800-Series unit in the same manner. You can install or remove communication modules while the ROC800-Series unit is powered up (hot-swappable), modules may be installed directly into unused module slots 1, 2, or 3 (hot-pluggable), and modules are self-identifying in the software. All modules are self-resetting after a fault clears.

❖ **NOTE:** The dial-up modem module is not hot-swappable or hot-pluggable.

⚠ CAUTION

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing procedures in a hazardous area could result in personal injury or property damage.

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

1. Remove the wire channel cover.
2. To install a module, perform one of the following:
   - If there was previously a module in the slot, unscrew the captive screws and remove that module.
   - If the slot was previously unused, remove the module cover.

     ❖ **NOTE:** When installing a dial-up modem module, you must remove power from the ROC800-Series.
3. Insert the new module through the module slot on the front of the ROC800-Series housing. Make sure the label on the front of the module is facing right side up. Gently glide the module in place until it contacts properly with the connectors on the backplane.
   - If the module stops and will not go any further, do not force the module. Remove the module and see if the pins are bent. If so, gently straighten the pins and re-insert the module. The back of the module must connect fully with the connectors on the backplane.
   - If the wiring channel cover has not been removed, it can prevent the module from entering the socket on the backplane.

   ❖ **NOTE:** Communication modules can only be installed in slot 1, 2, or 3. Refer to Figure 5-1.
4. Plug the module into its mating connectors on the backplane, pressing gently until the connectors firmly seat.
5. Install the retaining captive screws to secure the module.
6. Wire the module.

- ❖ **NOTE:** All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept 12 AWG or smaller wire.

7. For dial-up modem communications, connect the cable to the RJ-11 connector on the communications module.

   - ❖ **NOTE:** If you are installing a modem module, it is recommended that you install a surge protector between the RJ-11 jack and the outside line.

8. Replace the wire channel cover.
9. Connect to ROCLINK 800 software and login. The modules are self-identifying after re-connecting to ROCLINK 800 software.

5.3 How to Remove a Communications Module

To remove a communications module:

1. Remove the wire channel cover.
2. Unscrew the two captive screws holding the module in place.
3. Gently pull out the lip of the module and remove the module from the slot. You may need to gently wiggle the module.
4. Install a new module or install the module cover.
5. Screw the two captive screws to hold the module in place.
6. Replace the wire channel cover.

5.4 How to Wire the Communications

Signal wiring connections to the communications are made through the communications port removable terminal bock connectors and through RJ-11 and RJ-45 connectors. All modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks can accommodate a wide range of wire gauges (12 AWG or smaller).

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

The ROC800-Series should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

❖ **NOTE:** All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept 12 AWG or smaller wire.

5.5 Local Operator Interface (LOI)

The Local Operator Interface port, also called the LOI port, provides direct communications between the ROC800-Series and the serial port of an operator interface device, such as an IBM compatible computer. The interface allows you to access the ROC800-Series with a direct connection using ROCLINK 800 software for configuration and transfer of stored data.

Local Operator Interface uses the Local Port in ROCLINK 800 software.

The LOI terminal (RJ-45) on the CPU provides wiring access to a built-in EIA-232 (RS-232) serial interface, which is capable of 57.6K baud operation. The RJ-45 connector pin uses the data terminal equipment (DTE) in the IEEE standard.

The LOI port supports ROC Plus and Modbus protocol communications. The LOI also supports the log-on security feature of the ROC800-Series if the Security on LOI is Enabled in ROCLINK 800 software.

Table 5-3 shows the signal routing of the CPU connections. Figure 5-2 shows the RJ-45 pin out.

Table 5-3. Built-in LOI EIA-232 Signal Routing

Signal	LOI Function	RJ-45 Pins on ROC800-Series	Description
DTR	Data Terminal Ready	3	Originated by the ROC800-Series Data Terminal Equipment (DTE) to instruct the Data Communication Equipment (DCE) to setup a connection. DTE is running and ready to communicate.
GND	Ground (Common)	4	Reference ground between a DTE and a DCE and has a value 0 volts dc.
RX	Receive	5	Data received by the DTE.
TX	Transmit	6	Data sent by the DTE.
RTS	Request to Send	8	Originated by the DTE to initiate transmission by the DCE.

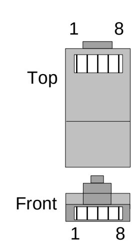


Figure 5-2. RJ-45 Pin Out

The LOI terminal requires a D-Sub 9 pin (F) to RJ-45 modular converter installed between the ROC800-Series and personal computer (PC). Refer to Table 5-4.

Table 5-4. RJ-45 to EIA-232 (RS-232) Null-modem Cable Signal Routing

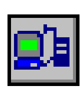
EIA-232 (RS-232) DTE	ROC800-Series	RJ-45 Pins on ROC800-Series
4	–	1
1	–	2
6	DTR	3
5	GND	4
3	TX	5
2	RX	6
7	–	7
8	RTS	8

Table 5-5. Using Cable Warehouse 0378-2 D-Sub to Modular Converter 9-Pin to RJ-45 Black

Pin	Wire Color	RJ-45 Pins on ROC800-Series
1	Blue	4
2	Orange	1
3	Black	6
4	Red	5
5	Green	3
6	Yellow	2
7	Brown	7
8	Gray	8

5.5.1.1 How to Use the LOI

1. Plug the LOI cable into the **LOI RJ-45** connector of the ROC800-Series.
2. Connect the LOI cable to the D-Sub 9 pin (F) to RJ-45 modular converter.
3. Plug the modular converter into the COM Port of the personal computer.
4. Launch ROCLINK 800 software.
5. Click **Direct Connect**.



6. Configure communications for the other built-in and modular communications, I/O modules, AGA meter parameters, and other configuration parameters.

5.6 Ethernet Communications

The Ethernet communications port in the ROC800-Series allows TCP/IP protocol communications using the IEEE 802.3 10Base-T standard. One application of this communications port is for downloading programs from DS800 Development Suite Configuration Software.

The Ethernet communications port uses a 10BASE-T Ethernet interface with an RJ-45 connector. Each Ethernet-equipped unit is called a station and operates independently of all other stations on the network without a central controller. All attached stations connect to a shared media system. Signals are broadcast over the medium to every attached station. To send an Ethernet packet, a station listens to the medium (Carrier Sense) and when the medium is idle, the station transmits the data. Each station has an equal chance to transmit (Multiple Access).

Access to the shared medium is determined by the Medium Access Control (MAC) mechanism embedded in each station interface. The MAC mechanism is based on Carrier Sense Multiple Access with Collision Detection (CSMA/CD). If two stations begin to transmit a packet at the same instant, the stations stop transmitting (Collision Detection). Transmission is rescheduled at a random time interval to avoid the collision.

Link Ethernet networks together to form extended networks using bridges and routers.

Table 5-6. Ethernet Signal LEDs

Signal	Function
RX	Lit when currently receiving.
TX	Lit when currently transmitting.
COL	Lit when Ethernet Packet Collision detected.
LNK	Lit when Ethernet has linked.

Use a rugged industrial temperature HUB when connecting Ethernet wiring in an environment that requires it.

The IEEE 802.3 10BASE-T standard requires that 10BASE-T transceivers be able to transmit over a link using voice grade twisted-pair telephone wiring that meets EIA/TIA Category four wire specifications. Generally, links up to 100 meter (328 feet) long are achievable for unshielded twisted-pair cable.

For each connector or patch panel in the link, subtract 12 meters (39.4 feet) from the 100-meter limit. This allows for links of up to 88 meters (288 feet) using standard 24 AWG UTP (Unshielded Twisted-Pair) wire and two patch panels within the link. Higher quality, low attenuation cables may be required when using links greater than 88 meters.

The maximum insertion loss allowed for a 10BASE-T link is 11.5 dB at all frequencies between 5.0 and 10.0 MHz. This includes the attenuation of the cables, connectors, patch panels, and reflection losses due to impedance mismatches to the link segment.

Intersymbol interference and reflections can cause jitter in the bit cell timing, resulting in data errors. A 10BASE-T link must not generate more than 5.0 nanoseconds of jitter. If your cable meets the impedance requirements for a 10BASE-T link, jitter should not be a concern.

The maximum propagation delay of a 10BASE-T link segment must not exceed 1000 nanoseconds.

Crosstalk is caused by signal coupling between the different cable pairs contained within a multi-pair cable bundle. 10BASE-T transceivers are designed so that you do not need to be concerned about cable crosstalk, provided the cable meets all other requirements.

Noise can be caused by crosstalk of externally induced impulses. Impulse noise may cause data errors if the impulses occur at very specific times during data transmission. Generally, do not be concerned about noise. If you suspect noise related data errors, it may be necessary to either reroute the cable or eliminate the source of the impulse noise.

Multi-pair, PVC 24 AWG telephone cables have an attenuation of approximately 8 to 10 dB/100 m at 200°C (392°F). The attenuation of PVC insulted cable varies significantly with temperature. At temperatures greater than 400°C (752°F), use plenum rated cables to ensure that cable attenuation remains within specification.

When connecting two twisted-pair MAUs (Medium Attachment Units) or repeaters together over a segment, wire the transmit data pins of one eight-pin connector to the receive data pins of the other connector, and vice versa. There are two methods for accomplishing 10BASE-T crossover wiring:

- ♦ Special cable.
- ♦ Wire the 10BASE-T crossover inside the hub.

For a single segment connecting only two devices, provide the signal crossover by building a special crossover cable, wire the transmit data pins of one eight-pin connector to the receive data pins of the other connector, and vice versa. Refer to Figure 5-3.

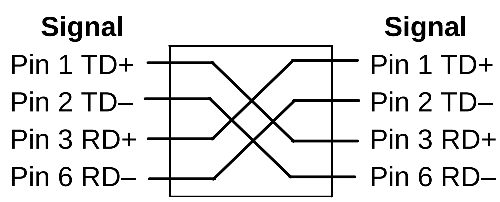


Figure 5-3. 10BASE-T Crossover Cable

5.7 EIA-232 (RS-232) Serial Communications

The built-in EIA-232 (RS-232), the LOI, and the communication modules meet all EIA-232 (RS-232) specifications for single-ended, asynchronous data transmission over distances of up to 15 meters (50 feet). EIA-232 (RS-232) communication provides transmit, receive, and modem control signals. The LOI port also meets EIA-232D (RS-232D) specifications.

The EIA-232 (RS-232) communications have the following communication port designations in ROCLINK 800.

- ♦ **LOI –** Local Port EIA-232 (RS-232D). Refer to Section 5.5, Local Operator Interface (LOI), on page 5-5.
- ♦ **Built-in –** Comm2 EIA-232 (RS-232C).
- ♦ **Module** – Comm3 to Comm5 EIA-232 (RS-232C).

EIA-232 (RS-232) uses point-to-point asynchronous serial communications and is commonly used to provide the physical interface for connecting serial devices, such as gas chromatographs and radios to the ROC800-Series. The EIA-232 (RS-232) communication provides essential hand-shaking lines required for radio communications, such as DTR and RTS.

The EIA-232 (RS-232) communications includes LED indicators that display the status of the Receive (RX), Transmit (TX), Data Terminal Ready (DTR), and Ready To Send (RTS) control lines.

Table 5-7 defines the built-in EIA-232 (RS-232) terminals at the Comm2 port and their function signals.

Table 5-7. Built-in EIA-232 (RS-232) Signal Routing – Comm2

Signal	LED Function	Terminal
RX	Lit when Comm2 is currently receiving.	1
TX	Lit when Comm2 is currently transmitting.	2
RTS	Lit when Comm2 ready to send is not active.	3
DTR	Lit when Comm2 data terminal ready is active.	4
GND	Common.	5

The EIA-232 (RS-232) communications module provides for EIA-232 (RS-232C) signals on the Comm3, Comm4, or Comm5 port depending on where the module is installed. Refer to Table 5-8.

Table 5-8. EIA-232 (RS-232) Communication Module Signal Routing – Comm3, Comm4, and Comm5

Signal	LED Function	Terminal
RX	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
TX	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	2
RTS	Lit when module (Comm3, Comm4, or Comm5) is ready to send is not active.	3
DTR	Lit when module (Comm3, Comm4, or Comm5) data terminal ready is active.	4
GND	Common.	5

5.8 EIA-422/485 (RS-422/485) Serial Communications Module

EIA-422/485 (RS-422/485) communication modules meet all EIA-422/485 (RS-422/485) specifications for differential, asynchronous serial communication transmissions of data over distances of up to 1220 meters (4000 feet). EIA-485 (RS-485) communications are commonly used to multi-drop units on a serial network over long distances using inexpensive twisted-pair wiring.

EIA-422 (RS-422) drivers are designed for party-line applications where one driver is connected to, and transmits on, a bus with up to ten receivers. EIA-422 (RS-422) allows long distance point-to-point communications and the drivers are designed for true multi-point applications with up to 32 drivers and 32 receivers on a single bus.

The default values for the EIA-422/485 (RS-422/485) communications are: 19200 Baud Rate, 8 Data Bits, 1 Stop Bit, and No Parity. The maximum rate is 57.6K bps.

EIA-422/485 (RS-422/485) communication modules include LED indicators that display the status of receive and transmit activity. Refer to Table 5-9 and Table 5-10.

Table 5-9. EIA-422 (RS-422) Signal Routing – Comm3, Comm4, and Comm5

Signal	RS-422	Function	Terminal
A	RX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX -	None.	2
Y	TX +	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	3
Z	TX -	None.	4
COM	Common	Ground.	5

Table 5-10. EIA-485 (RS-485) Signal Routing – Comm3, Comm4, and Comm5

Signal	RS-485	Function	Terminal
A	RX / TX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX / TX -	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	2
Y	No Connect	None.	3
Z	No Connect	None.	4
COM	Common	Ground.	5

- ❖ **NOTE:** The EIA-422/485 (RS-422/485) modules are isolated on the field side. Be aware that you can induce ground loops by tying commons together.

EIA-422/485 (RS-422/485) communications provides EIA-422/485 (RS-422/485) signals on the Comm3, Comm4, or Comm5 port depending on where the module is installed. Wiring should be twisted-pair cable, one pair for transmitting, and one pair for receiving. The EIA-422 (RS-422) module uses four wires and the EIA-485 (RS-485) uses two wires for connectivity.

5.8.1 EIA-422/485 (RS-422/485) Jumpers and Termination Resistors

Four jumpers are located on the EIA-422/485 (RS-422/485) communications module: J3, J4, J5, and J6. These jumpers determine in which mode the module runs (RS-422 or RS-485) and if the module is terminated.

Terminations are required on the two EIA-422/485 (RS-422/485) communication modules located at the extremities of the circuit. That is to say, the two outside modules require terminations in order to complete the communications circuit.

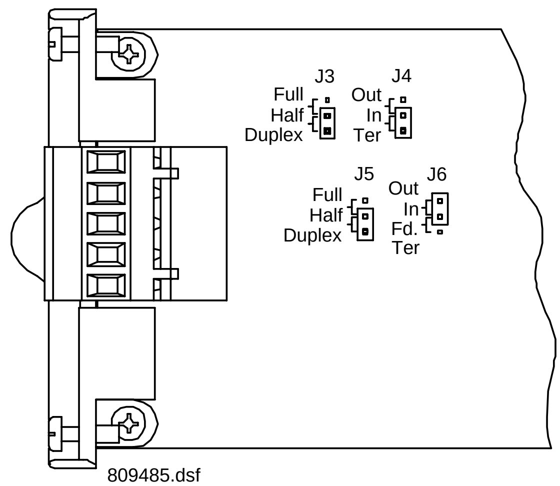


Figure 5-4. EIA-422/485 (RS-422/485) J4 Jumper

Table 5-11. EIA-422 (RS-422) Module

Jumper	Terminated				Not Terminated			
	TER	Out	Half	Full	TER	Out	Half	Full
J3				x				x
J4	x					x		
J5				x				x
J6	x					x		

Table 5-12. EIA-485 (RS-485) Module

Jumper	Terminated				Not Terminated			
	TER	Out	Half	Full	TER	Out	Half	Full
J3			x				x	
J4	x					x		
J5			x				x	
J6		x				x		

5.9 Dial-up Modem Communications Module

The dial-up modem module interfaces to a Public-Switched Telephone Network (PSTN) line. The dial-up modem module provides for a telephone interface on the host port that is capable of both answering and originating telephone calls. The dial-up modem module also provides electronics that conserve power when the phone line is not in use. The dial-up modem module requires a telephone line connection.

❖ **NOTE:** When installing a dial-up modem module, you must remove power from the ROC800-Series.

The dial-up modem provides communications with speeds up to 14.4K bps with V.42 bis and V.42, MNP2-4 and MNP10 error correction.

The dial-up modem module is FCC Part 68 approved for use with PSTNs. The FCC label on the module provides the FCC registration number and the ringer equivalent. The dial-up modem module supports data compression, error correction, and nonvolatile RAM for permanent storage of the modem configuration.

The dial-up modem module interfaces to two-wire, full-duplex telephone lines using asynchronous operation. The module interfaces to a PSTN through an RJ-11 jack.

The dial-up modem can be controlled using industry-standard AT command software. A 40-character command line is provided for the AT command set, which is compatible with EIA document TR302.2/88-08006.

The dial-up modem automatically hangs up after a configured period of communications inactivity. The dial-up modem provides automated dial-up alarm reporting capabilities. Refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

Table 5-13. RJ-11 Field Connections

Signal	Pin
Tip	3
Ring	4

LED indicators on the module show the status of the Receive (RX), Transmit (TX), Ring (RI), and Carrier Detect (CD) control lines.

Table 5-14 displays connector signals and their functions.

Table 5-14. Modem Signal Routing – Comm3, Comm4, and Comm5

Signal	Function	Terminal
RX	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
TX	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting (Tip).	3
RI	Lit when module (Comm3, Comm4, or Comm5) on ring (Ring).	7
CD	Lit when module (Comm3, Comm4, or Comm5) on carrier detect.	9

- ❖ **NOTE:** If you are installing a modem module, it is recommended that you install a surge protector between the RJ-11 jack and the outside line.
- ❖ **NOTE:** The dial-up modem is not hot-swappable or hot-pluggable.

5.10 Multi-Variable Sensor (MVS) Interface Modules

The Multi-Variable Sensor (MVS) provides differential pressure, static pressure, and temperature inputs to the ROC800-Series unit for orifice flow calculation.

The MVS module consists of interface electronics that provide the communications link between the ROC800-Series and the MVS. The interface electronics controls communications with the sensor module, provides scaling of process variables, aids calibration, stores operating parameters, performs protocol conversion, and responds to requests from the ROC800-Series unit.

The ROC800-Series unit can handle up to two MVS interface modules. Each MVS module provides the communications interface for up to six sensora and the isolated, short-circuit current-limited power required to connect up to five MVS sensors.

The MVS modules create six points automatically for each of the six MVS channels possible. The points include 1 through 6 and if you have a second MVS module installed, points 7 through 12 are available. Points are assigned based on which module is in the first slot. For example, if an MVS module is in slot three, it automatically assigns the points 1 through 6. If you then install an MVS module into slot one, the points are re-assigned so that slot one holds 1 through 6 and slot three holds 7 through 12.

The ROC800-Series allows six MVS devices to be connected on its communications bus in a multi-drop connection scheme. **The address of each MVS must be set prior to final wiring of multiple MVS devices.** For proper operation of multiple MVS devices, each MVS device must have a unique address and none of the addresses can be 240. For details on MVS configuration, refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

Once a unique address is set for each MVS, connect the MVS units in a multi-drop arrangement. The only requirement for wiring multi-drop devices is that all like terminals be tied together. This means all the "A" terminals on the devices are electrically connected to the ROC800-Series "A" terminal and so on. The wiring can be done by wiring in parallel (daisy-chaining) through each remote MVS.

Terminations are required on the two MVS modules located at the extremities of the circuit. That is to say, the two outside modules require terminations in order to complete the communications circuit. The MVS termination jumper is located at J4 on the module. Refer to Table 5-15.

Table 5-15. MVS Termination

Jumper	Terminated		Not Terminated	
	TER	Out	TER	Out
J4	x			x

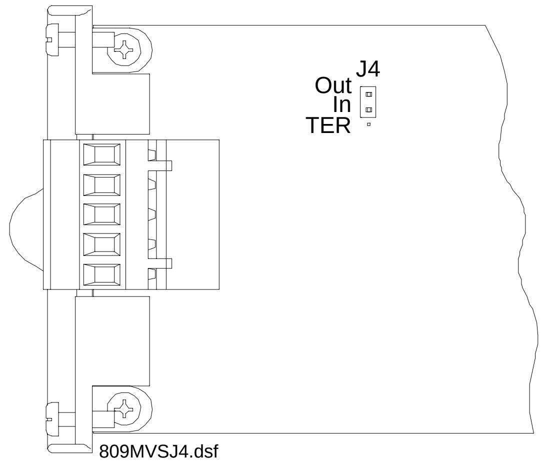


Figure 5-5. MVS Jumper J4 (Shown Not Terminated)

Four wires run from the MVS module terminal block and connect to the sensor. The wires should be a minimum size of 22 AWG and a maximum length of 1220 m (4000 ft).

❖ **NOTE:** Insulated, shielded, twisted-pair wiring is required when using MVS signal lines.

Two of the terminal blocks provide power and the other two terminals provide a communication path. The terminals are identified in Table 5-16.

Table 5-16. MVS Signal Routing – Comm3, Comm4, and Comm5

Label	MVS	LED	Terminal
A	RX / TX +	Lit green when receiving	1
B	RX / TX -	N/A	2
None	No Connect	Lit green when transmitting	3
+	Sensor Power	N/A	4
–	Common	N/A	5

Pay close attention and do not reverse the power wires. These connections should always be made with power removed from the ROC800-Series. Double-check for proper orientation before applying power. If the connections are reversed and power is applied, the MVS and the ROC800-Series processor board will be damaged.

❖ **NOTE:** MVS modules are isolated on the field side. Be aware that you can induce ground loops by tying commons together.

5.11 Communications Specifications

The following tables list the specifications for each type of communications port and module.

Communications (Built-in and Module) Common Specifications

DIMENSIONS
26 mm W by 133 mm H by 75 mm D (1.04 in. W by 5.25 in. H by 2.96 in. D).

ENVIRONMENTAL
Meets the same environmental specifications as the ROC800-Series unit in which it is installed.

APPROVALS
Meets the same approvals as the ROC800-Series unit in which it is installed.

Ethernet Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	RX	Receive
2	TX	Transmit
3	COL	Ethernet Packet Collision
4	LNK	Ethernet has linked

COMMUNICATIONS
Type: 10BASE-T twisted-pair. IEEE multi-segment 10 MB/second baseband Ethernet. Comm1.

LED INDICATORS
RX (Receive), TX (Transmit), COL (Ethernet Packet Collision), and LNK (Ethernet Link).

MAXIMUM SEGMENT
100 m (330 ft).

EIA-232 (RS-232) Communications Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	RX	Receive
2	TX	Transmit
3	RTS	Request to Send
4	DTR	Data Terminal Ready
5	GND	Common

COMMUNICATIONS
Type: Single Comm Port per module.
Meets EIA-232 and RS-232 Standard.
57.6K bps maximum data rate.

LOI: Local Port – EIA-232D and RS-232D.

Built-in: Comm2 – EIA-232C and RS-232C.

Module: Comm3 to Comm5 – EIA-232C and RS-232C.

OVER-VOLTAGE PROTECTION
±25 volts dc, continuous on any terminal.

POWER CONSUMPTION
Main power supply loading at the Battery Terminals (at 12.0 volts dc):

Typical: 4 mA.

Additional loading that may apply:

Per Active LED: 1.5 mA.

WIRING
12 AWG or smaller at the removable terminal block.

LED INDICATORS
RX (Receive), TX (Transmit), RTS (Ready To Send), and DTR (Data Terminal Ready).

WEIGHT
47.6 g (1.68 oz).

EIA-422/485 (RS-422/485) Communications Module Specifications

FIELD WIRING TERMINALS – EIA-422 (RS-422)

Terminal	Label	Definition
1	A	Receive +
2	B	Receive –
3	Y	Transmit +
4	Z	Transmit –
5	COM	Floating EIA-422 Common

FIELD WIRING TERMINALS – EIA-485 (RS-485)

Terminal	Label	Definition
1	A	Receive / Transmit +
2	B	Receive / Transmit –
3	Y	No Connect
4	Z	No Connect
5	COM	Floating EIA-485 Common

COMMUNICATIONS

Type: Single Comm Port per module. Comm3 to Comm5.
Meets EIA-422/485 and RS-422/485 Standards.
57.6K bps maximum data rate.

OVER-VOLTAGE PROTECTION

±14 volts dc, continuous on any terminal.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 volts dc):

Typical: 112 mA.

WIRING

12 AWG or smaller at the removable terminal block.

LED INDICATORS

A: On when currently receiving.

Y: On when transmitting.

ISOLATION

Field to Logic: 1500 volts dc, 1 minute.
Field to Power: 1500 volts dc, 1 minute.
Module to Module: 1500 volts dc, 1 minute.

WEIGHT

49.9 g (1.76 oz).

Dial-Up Modem Module Specifications

FIELD WIRING TERMINALS

Connector: RJ-11 type.

OPERATION

Type: Single Comm Port per module. Comm3 to Comm5.
14.4 K bps with V.42 bis. Providing up to 57.6K bps throughput.
Mode: 2-wire for dial-up PSTN (Bell 212A and 103 compatible).
Data Rate: Up to 57.6K bps asynchronous.
Error Correction: V.42, MNP2-4 and MNP10.
Certification: FCC Part 68 approved.
Ring Voltage Detected: 38 to 150 RMS, type B ringer.
Ring Frequency Detected: 15.3 to 68 Hz, type B ringer.
Telephone Loop Current: 20 to 100 mA when off-hook.
Data Transmit Level: -12 to -9.0 dBm, -10.5 typical.
DTMF Transmit Level: -2.5 to 0 dBm, average over 3 second interval.
Surge Protection: Conforms to FCC Part 68.

OVER-VOLTAGE PROTECTION

±14 volts dc, continuous on any terminal.

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 volts dc):

Typical: 95 mA.

Additional loading that may apply:

Per Active LED: 1.5 mA.

WIRING

12 AWG or smaller at the removable terminal block.

LED INDICATORS

TX (Transmit), RX (Receive), RI (Ring), and CD (Carrier Detect).

ISOLATION

Per FCC Part 68.

WEIGHT

113.4 g (4.0 oz).

Multi-Variable Sensor (MVS) Module Specifications

FIELD WIRING TERMINALS

Terminal	Label	Definition
1	A	RX / TX +
2	B	RX / TX –
3	N/A	No Connection
4	+	Sensor Power
5	–	Common

COMMUNICATIONS

Provides communications interface for up to six MVS sensors. One second updates occur for each of the three variables for each of the sensors attached.

POWER

Provides isolated, short-circuit current-limited power required to connect up to five MVS sensors.

OVER-VOLTAGE PROTECTION

±14 volts dc, continuous on any terminal.

WIRING

12 AWG or smaller at the removable terminal block.

WEIGHT

61.2 g (2.16 oz).

POWER CONSUMPTION

Main power supply loading at the Battery Terminals (at 12.0 volts dc):

Typical: 112 mA.

Additional loading that may apply:

Per Active LED: 1.5 mA.
+ @ 12V: 1.25 * Measured Current Draw at + Terminal.

LED INDICATORS

A: On when currently receiving.

None: On when transmitting.

ISOLATION

Field to Logic: 1500 volts dc, 1 minute.
Field to Power: 1500 volts dc, 1 minute.
Module to Module: 1500 volts dc, 1 minute.

SECTION 6 – TROUBLESHOOTING

This section provides generalized guidelines for troubleshooting of the ROC809. The procedures in this chapter should be performed before removing power for any reason, after restoring power, and if the unit is disassembled.

The following tools are required for troubleshooting:

- IBM-compatible personal computer.
- ROCLINK 800 software.
- Flat-head (size 1/10-inch) and Philips (size 0) screwdrivers.

6.1 Troubleshooting Guidelines

When you are attempting to diagnose a problem with the ROC809:

- Remember to write down what steps you have taken,
- Note the order in which you remove components,
- Note the orientation of the components before you alter or remove them,
- Save the configuration and log data (see Section 6.3.1),
- Read and follow all Cautions in this manual.

When you are done troubleshooting, perform the restart procedure in Section 6.3.2.

6.2 Troubleshooting Checklists

If the **LED**s do not display

♦ By default, LEDs on the communication modules and I/O modules enter Sleep mode after five minutes.

♦ To turn the LEDs on, press the LED button located on the CPU for one second.

  ❖ NOTE: This feature can be disabled via ROCLINK 800 software. If disabled, the LEDs always remain on.

If you are experiencing troubles with a **serial communications** connection (LOI, EIA-232, EIA-422, or EIA-485):

- Check to make sure power is applied to the FloBoss unit. Check the ON/OFF jumper, the wiring connections at CHG+ and CHG-, and the wiring at the power source.
- Check the wiring to the termination block or connector. Refer to Section 4.
- Check the communication port settings in ROCLINK 800 Configuration Software. Refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).

If you are experiencing troubles with an **I/O point** (Analog Input, Analog Output, Discrete Input, Discrete Output, Pulse Input, RTD Input, or Thermocouple Input):

- Check to see how the channel is configured using ROCLINK 800 software.
- If the configuration looks correct, then follow the procedure for troubleshooting that type of I/O in Sections 6.3.3 through 6.3.10.
- If a module does not function correctly, determine if the problem is with the field device or the module.
- Check a module suspected of being faulty for a short circuit between its input or output terminals. If a terminal not directly connected to ground reads 0 (zero) when measured with an ohmmeter, the module is defective and must be replaced.

❖ **NOTE**: Return faulty modules to your local sales representative for repair or replacement.

If you are experiencing problems with the ROC809 that appear to be **software**-related, try resetting the ROC809.

- Use a Warm Start to restart without losing configuration or log data. To perform a Warm Start, open ROCLINK 800 software, connect to the ROC809 unit and select ROC > **Flags**. Refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).
- Use a Cold Start to restart without a portion of the configuration, log data, or programming that may be the trouble. To perform a Cold Start, open ROCLINK 800 software, connect to the ROC809 unit and select ROC > **Flags**. Refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).
- Use the RESET button on the CPU to restore the unit to factory defaults without connecting to ROCLINK 800 software.

❖ **NOTE:** If these methods do not solve the problem, contact your local sales representative.

If you are experiencing trouble with **powering** up the ROC809:

- Check the wiring connections at terminations on the Power Input Module and the wiring at the power source.
- Check the internal battery for voltage. Refer to Section 3.
- Check the external batteries, if applicable, for voltage.

❖ **NOTE:** If these methods do not solve the problem, contact your local sales representative.

If you are experiencing trouble with the **MVS** Module:

- ♦ If more than one MVS is connected to the ROC809, ensure that each has a unique Address, as set in ROCLINK 800 Configuration Software.
- ♦ Reset the MVS module back to factory defaults, refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

❖ **NOTE:** If you believe an MVS module is damaged or faulty, contact your sales representative for repair or replacement.

6.3 Procedures

6.3.1 How to Preserve Configuration and Log Data

Before removing power to the ROC809 for repairs, troubleshooting, or upgrades, perform this backup procedure. This procedure preserves the current ROC809 configuration and log data held in SDRAM.

⚠ CAUTION

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Launch ROCLINK 800 software.
2. Select ROC menu > Flags > **Save Configuration**. This saves all configuration settings, including the current states of the ROC809 Flags and calibration values. Click **OK**.
3. Select ROC menu > **Collect Data**. Select all check boxes and click **OK**. This saves event logs, alarm logs, report data, hourly logs, and daily logs (you can specify your own file name and path if desired).
4. Select File > **Save Configuration**. The Save As dialog box appears.
5. Type the desired File name of the backup file.
6. Select the Directory where you desire to store the configuration file.
7. Click **Save**.

6.3.2 How to Restart the ROC809

After removing power to the ROC809 and installing components, perform the following steps to start your ROC809 and reconfigure your data. The procedure assumes you are using ROCLINK 800 software.

⚠ CAUTION

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power. An unsafe state could result in property damage.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Reconnect power to the ROC809 unit.
2. Wait 30 seconds.
3. Launch ROCLINK 800 software, log in, and connect to the ROC809.
4. Verify that the configuration is correct. If major portions or the entire configuration needs to be reloaded, perform the remaining steps.
5. Select File > **Download**.
6. Select the backup configuration file (with file extension *.800) from the Open dialog box.
7. Select the portions of the configuration you desire to download (restore).
8. Click **Download** to restore the configuration.
9. Configure other required parameters.

6.3.3 Troubleshooting Analog Input Modules

Equipment Required: Multimeter
PC running ROCLINK 800 software

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

To determine if an Analog Input module is operating properly, its configuration must first be known. Table 6-1 shows typical configuration values for an Analog Input:

Table 6-1. Analog Input Module Typical Configuration Values

Parameter	Value	Value Read
Adjusted A/D 0 %	819	1 volt dc across the + and the COM terminal by a multimeter
Adjusted A/D 100 %	4095	5 volts dc across the + and the COM terminal by a multimeter
Low Reading EU	0.0000	EU value with 1 volt dc
High Reading EU	100.0	EU value with 5 volts dc
Value	xxxxx	Value read by AI module

1. Connect a multimeter across the scaling resistor connected to the **+** and **COM** terminals of the module and set the multimeter to measure voltage.
2. Connect to ROCLINK 800 software.
3. Select Configuration > I/O > **AI Points**.
4. Select the correct **Analog Input Point Number**.

5. Verify the following readings:

- When the Value is –25% of span as configured in Table 6-1, it is an indication of no current flow (0 mA), which can result from open field wiring or a faulty field device. The multimeter should show 0 (zero) volts dc.
- When the Value is in excess of 100% of span as configured in Table 6-1, it is an indication of maximum current flow, which can result from shorted field wiring or a faulty field device. The multimeter should show 5 volts dc.
- When the Value is between the Low Reading EU and the High Reading EU, verify the accuracy of the reading by measuring the voltage across the terminals with the multimeter.

6. Convert this reading to the Value value:

$$\text{Value} = [((V_{multimeter} - 1) \div 4) * \text{Span}] + \text{Low Reading EU}$$

where Span = High Reading EU – Low Reading EU

This calculated value should be within one-tenth of one percent of the Filter value measured by the ROC809.

7. Verify an accuracy. Read the loop current with a multimeter, set the multimeter to measure current in mAmps and connect it in series with current loop. Be sure to take into account that input values can change rapidly, which can cause a greater error between the measured value and the calculated value.

8. Calculate the Value from the mAmp reading of the multimeter:

$$\text{Value} = [((\text{mAmp}_{multimeter} * R_{scaling\ resistor} - 1) * 4) * \text{Span}] + \text{Low Reading EU}$$

where Span = High Reading EU – Low Reading EU

and $R_{scaling\ resistor}$ should be 250 ohms (factory installed scaling resistor value)

If the calculated value and the measured value are the same, the AI module is operating correctly.

9. Remove the test equipment.

6.3.4 Troubleshooting Analog Output Modules

Equipment Required: Multimeter
PC running ROCLINK 800 software

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

Calibrate the module:

1. Connect a multimeter between the **+** and **–** channel terminals of the module and set the multimeter to measure current in milliamps.
2. Connect to ROCLINK 800 software.
3. Select Configuration > I/O > **AO Points**.

4. Select the correct **Analog Output Point Number**.
5. Select **Scanning Manual** and click **Apply**.
6. Set the output to the **High Reading EU** value.
7. Verify a **20 mA reading** on the multimeter.
8. Set the output to the **Low Reading EU** value and click **Apply**.
10. Verify a **4 mA** reading on the multimeter.
11. Calibrate the **Low Reading EU** value by increasing or decreasing the **Adjusted D/A 0%** units value.
12. Select **Scanning Enabled** and click **Apply**.
13. Remove the test equipment, and reconnect the field device.
14. If possible, verify the correct operation of the AO module by setting the High Reading EU and Low Reading EU values as before (Scanning Disabled) and observing the field device.

6.3.5 Troubleshooting Discrete Input Modules

Equipment Required: Jumper wire
PC running ROCLINK 800 software

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

1. Disconnect the field wiring at the DI module terminations.
2. Connect to ROCLINK 800 software.
3. Select Configuration > I/O > **DI Points**.
4. Select the correct **Discrete Input Point Number**.
5. Place a **jumper** across a channel input terminal **(1-8)** and **COM**.
6. The **Status** should change to **On**. With no jumper on the channel terminal and COM, the Status should change to Off.
7. Remove the test equipment, and reconnect the field device.

6.3.6 Troubleshooting Discrete Output Modules

Equipment Required: Multimeter
PC running ROCLINK 800 software

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

1. Verify the load current requirement does not exceed the current limit value of the module.
2. Verify the module is wired correctly.
3. Remove all wiring from the DO module.
4. Connect the multimeter set up to measure ohms to the channel that you are testing.
5. Measure the resistance with the **DO Status OFF**. It should be over 2 megohms.
6. Measure the resistance with the **DO Status ON**. It should be approximately 1 ohm.

6.3.7 Troubleshooting Discrete Output Relay Modules

Equipment Required: Multimeter
PC running ROCLINK 800 software

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

1. Connect the multimeter set up to measure ohms to the channel that you are testing.
2. Set the **Status** to **On** and click **Apply**.
3. **Measure** the resistance across terminals **+** and **–**. A reading of 0 (zero) ohms should be obtained. No continuity should be indicated.
4. **Measure** the **resistance** across the terminals **+** and **–**. The reading should indicate an open circuit.

6.3.8 Troubleshooting Pulse Input Modules

Equipment Required: Pulse Generator
Voltage Generator
Frequency Counter
Jumper wire
PC running ROCLINK 800 software

CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

To verify high-speed operation:

1. Disconnect the field wiring at the PI module terminations.
2. Connect to ROCLINK 800 software.
3. Select Configuration > I/O > **PI Points**.
4. Select the correct Pulse Input **Point Number**.
5. Connect a pulse generator having sufficient output to drive the module to **terminals L+ or H+ and COM**. The pulse generator must synthesize a square wave signal of 50% for every cycle.
6. Connect a frequency counter across terminals **L+ or H+** and **COM**.
7. Set the pulse generator to a value equal to, or less than **10 KHz**.
8. Set the frequency counter to count pulses.
9. Verify the **count** read by the counter and the count read by the ROC809 unit are the same, using the ROCLINK 800 software.
10. Remove the test equipment, and reconnect the field device.

6.3.9 Troubleshooting RTD Input Modules

The RTD module is similar in operation to an RTD module and uses the same troubleshooting and repair procedures.

Equipment Required: Multimeter
PC running ROCLINK 800 software

CAUTION

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

1. **Disconnect** the **field wiring** at the RTD module terminations.
2. Connect to the **ROCLINK** 800 software.
3. Select Configuration > I/O > **RTD Point**.
4. Select the correct **RTD Point Number**.
5. If any of the input wires are broken or not connected, the ROCLINK 800 software indicates the **Raw A/D Input** value is either at minimum (less than 47974) or maximum (greater than or equal to 61958) as follows:
   - An open at terminal + gives a maximum reading.
   - An open at terminal – gives a minimum reading.
   - An open at terminal RET gives a minimum reading.

To verify the operation of the RTD module:

1. Connect to the ROCLINK 800 software.
2. Select Configuration > I/O > RTD Point.
3. Disconnect the RTD and connect a jumper between terminals – and RET of the RTD module.

4. Connect either an accurate resistor or decade resistance box with a value to give a low end reading across terminals + and –. The temperature-to-resistance conversion chart can determine the resistance value required for the type of RTD being used.
5. Verify that the Raw A/D Input value changed and reflects the Adjusted A/D 0% value.
6. Change the resistance to reflect a high temperature as determined by the temperature-to-resistance conversion chart.
7. Verify that the Raw A/D Input value changed and reflects the Adjusted A/D 100% value.
8. Remove the test equipment, and reconnect the field device.

6.3.10 Troubleshooting J and K Type Thermocouple Input Modules

Equipment Required: Multimeter
PC running ROCLINK 800 software

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

Many digital multimeters can generate and measure thermocouple signals. Check your documentation to see if your multimeter supports thermocouples and how to correctly use the feature if so equipped. You may require an optional T/C adaptor to use the multimeter.

To test a thermocouple, do not parallel the voltage meter on a thermocouple that is connected to a ROC809, as it will distort the signal.

Do not try to verify a thermocouple that is connected and actively being monitored by a ROC809 by measuring the voltage at the ROC809 terminal blocks.

It is suggested that you independently verify the process temperature, by using a certified thermometer in an adjacent thermowell, and then compare it to what the ROC809 is reading.

To test the thermocouple module:

1. Disconnect the thermocouple from the thermocouple module.
2. Generate the correct J or K signal using a multimeter and connect the wiring from the multimeter to the T/C module in the ROC809.
3. Verify the ROC is reading the generated temperature form the multimeter.
4. Remove the test equipment, and reconnect the field device.

To test the thermocouple:

1. Disconnect the thermocouple from the ROC809.
2. Connect the thermocouple directly to the multimeter and verify the reading is correct as compared to a certified temperature measurement device connected to the process temperature the T/C is measuring.
3. Remove the test equipment, and reconnect the field device.

Unintentional thermocouple junctions cause many measurement errors. Remember that any junction of two different metals will cause a junction. To increase the length of the leads from the thermocouple, use the correct type of thermocouple extension wire. Any connector must be made of the correct thermocouple material and correct polarity must be observed.

If the reading is off:

1. The type J or K thermocouples are selected on a per channel basis on the thermocouple module. Verify each channel on the ROC809 and make sure it is set for the type of thermocouple that you are using.
2. Ensure any plugs, sockets, or terminal blocks used to connect the extension wire are made from the same metals as the thermocouples and correct polarity is observed.
3. Verify all connections are tight.
4. Verify the thermocouples have the correct construction (ungrounded) and are NOT grounded by other means.
5. Verify you are using the correct thermocouple wire all the way from the thermocouple to the ROC809 with minimal connections.
6. Verify the wiring run is adequately protected from noise.
7. Test the thermocouple reading from the thermocouple to a meter, and then generate a signal into the ROC809 as described previously.
8. Finally, connect a thermocouple of the same type directly to the ROC809. If it reads correctly, the problem is likely to be in the wiring to the field or may be related to a ground loop.

SECTION 7 – CALIBRATION

This section provides information about calibration procedures for the Analog Inputs, HART Inputs, RTD Inputs, and Multi-Variable Sensor Inputs. For the full calibration procedure, refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

This section contains the following information:

7.1 Calibration

Use ROCLINK 800 software to perform initial calibration or re-calibration of the inputs on the AI, HART, RTD, and MVS modules. Re-calibration would occur, for example, after a change in an orifice plate in the meter run handled by the ROC809 unit. Calibration can be performed on sensor inputs from either orifice meter runs or turbine meter runs.

The AI, RTD and MVS calibration routines support five point calibration, with the three mid-points calibrated in any order. The low-end or zero reading is calibrated first, followed by the high-end or full-scale reading. The three mid-points can be calibrated next, if desired.

The HART calibration routine supports two point calibration. The low-end or zero reading is calibrated first, followed by the high-end or full-scale reading.

The diagnostic System Analog Inputs are not designed to be calibrated.

7.2 How to Prepare for a Calibration

Before calibrating the inputs from a sensor, HART device, or other device, you should prepare the ROC809 unit.

- Verify the inputs are correctly wired. For information on wiring the inputs, refer to Sections 4 and 5.
- If calibrating a pressure sensor input, be sure to remove the sensor from the flow as directed in the calibration procedure in the *ROCLINK 800 Configuration Software User Manual* (Form A6121).
- Verify that any external monitoring devices, such as multimeters, are connected to the ROC809 unit, if they are required for the calibration.

GLOSSARY

A

A/D – Analog to Digital.
ABS – Acrylonitrile Butadiene Styrene.
ADC – Analog to Digital Converter.
AGA – American Gas Association.
AWG – American Wire Gauge.
AI – Analog Input.
AO – Analog Output.
Analog – Analog data is represented by a continuous variable, such as an electrical current signal.
AP – Absolute Pressure.
API – American Petroleum Institute.
ASCII – American Standard Code for Information Interchange.
Attribute – A parameter that provides information about an aspect of a database point. For example, the alarm attribute is an attribute that uniquely identifies the configured value of an alarm.

B

BPS – Bits Per Second.
BTU – British Thermal Unit, a measure of heat energy.

C

COL – Ethernet Packet Collision.
COM – Communications port on the Personal Computer (PC).
COMM – Communications port on the ROC809.
Configuration – Refers either to the process of setting up the software for a given system or the result of performing this process. The configuration activity includes editing the database, building schematic displays and reports, and defining user calculations. Typically, the software setup of a device that can often be defined and changed. Can also mean the hardware assembly scheme.
CPU – Central Processing Unit.
CRC – Cyclical Redundancy Check.
Crosstalk – The amount of signal that crosses over between the receive and transmit pairs, and signal attenuation, which is the amount of signal loss encountered on the Ethernet segment.
CSA – Canadian Standards Association.
CSMA/CD – Carrier Sense Multiple Access with Collision Detection.
CTS – Clear to Send modem communications signal.

D

D/A – Digital to Analog.
DB – Database.
dB – Decibel. A unit for expressing the ratio of the magnitudes of two electric signals on a logarithmic scale.
DCD – Data Carrier Detect modem communications signal. In addition, **Discrete Control Device –** A discrete control device energizes a set of discrete outputs for a given setpoint and matches the desired result against a set of discrete inputs.
DCE – Data Communication Equipment.

Deadband – A value that is an inactive zone above the low limits and below the high limits. The purpose of the deadband is to prevent a value such as an alarm from being set and cleared continuously when the input value is oscillating around the specified limit. This also prevents the logs or data storage location from being over-filled with data.
DI – Discrete Input.
Discrete – Input or output that is non-continuous, typically representing two levels such as on/off.
DO – Discrete Output.
DP – Differential Pressure.
DSR – Data Set Ready modem communications signal.
DTE – Data Terminal Equipment.
DTR – Data Terminal Ready modem communications signal.
Duty Cycle – Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, and such.

E

EFM – Electronic Flow Metering or Measurement.
EIA-232 (RS-232) – Serial Communications Protocol using three or more signal lines, intended for short distances. Concerning RS232D and RS232C, the letters C or D refer to the physical connector type. D specifies the RJ-11 connector where a C specifies a DB25 stype connector.
EIA-422 (RS-422) – Serial Communications Protocol using four signal lines.
EIA-485 (RS-485) – Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion.
EMF – Electro-motive force.
EMI – Electro-magnetic interference.
ESD – Electrostatic Discharge.
EU – Engineering Units. Units of measure, such as MCF/DAY.

F

Firmware – Internal software that is factory-loaded into a form of ROM. In the ROC809, the firmware supplies the software used for gathering input data, converting raw input data values, storing values, and providing control signals.
Flash ROM – A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory (requires no backup power). Also called Flash memory.
Force – Write an ON/OFF, True/False, or 1/0 value to a coil.
FPV – Compressibility Factor.
FST – Function Sequence Table, a type of program that can be written by the user in a high-level language.
Ft – Foot or feet.

G

GFA – Ground Fault Analysis.
GND – Electrical ground, such as used by the ROC power supply.
GP – Gauge Pressure.

H

Holding Register – Analog output number value to be read.
Hw – Differential pressure.
Hz – Hertz.

I, J

ID – Identification.
IEC – Industrial Electrical Code.
IEEE – Institute of Electrical and Electronic Engineers. The Open System Interconnection (OSI) reference model and an international standard for the organization of local area networks (LANs) established by the International Standards Organization (ISO) and the IEEE.
IMV – Integral Multiplier Value.
Input – Digital input, a bit to be read.
Input Register – Input numeric value to be read.
I/O – Input/Output.
I/O Module – Module that plugs into an I/O slot on a ROC to provide an I/O channel.
IRQ – Interrupt Request. Hardware address oriented.
IV – Integral Value.

K

KB – Kilobytes.
KHz – KiloHertz.

L

LED – Light-emitting diode.
LNK – Ethernet has linked.
LOI – Local Operator Interface. Refers to the serial EAI-232 (RS-232) port on the ROC or FloBoss through which local communications are established, typically for configuration software running on a PC.
LRC – Longitudinal Redundancy Checking error checking.

M

m – Meter.
mA – Milliamp(s); one thousandth of an ampere.
MAU – Medium Attachment Unit.
Modbus – A popular device communications protocol developed by Gould-Modicon.
mm – Millimeter.
MMBTU – Million British Thermal Units.
msec – millisecond.
MVS – Multi-Variable Sensor. The MVS provides differential pressure, static pressure, and temperature inputs to the ROC809 for orifice flow calculation.
mV – Millivolts, or 0.001 volt.
mW – Milliwatts, or 0.001 watt.

N

NEC – National Electrical Code.
NEMA – National Electrical Manufacturer's Association.

O

OH – Off-Hook modem communications signal.
Off-line – Accomplished while the target device is not connected (by a communications link). For example, off-line configuration is configuring a ROC in a electronic file that is later loaded into the ROC unit.

Ohms – Units of electrical resistance.
On-line – Accomplished while connected (by a communications link) to the target device. For example, on-line configuration is configuring a ROC809 while connected to it, so that current parameter values are viewed and new values can be loaded immediately.
OP – Operator Port; see LOI.
Opcode – Type of message protocol used by the ROC809 to communicate with the configuration software, as well as host computers with ROC driver software.

P, Q

Parameter – A property of a point that typically can be configured or set. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.
Pf – Flowing pressure.
PC – Personal Computer.
P/DP – Pressure /Differential Pressure.
PI – Pulse Input.
PID – Proportional, Integral, and Derivative control feedback action.
PIT – Periodic Timer Interrupt.
Point – Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.
Point Number – The location of an I/O point as installed in the ROC system.
Point Type –Defines the database point to be a specifice type of point available to the system. The point type determines the basic functions of a point.
Preset – Number value previously determined for an register.
PRI – Primary PID control loop.
PSTN – Public switched telephone network.
PT – Process Temperature.
PTT – Push-to-talk signal.
Pulse – Transient variation of a signal whose value is normally constant.
PV – Process variable or process value.

R

RAM – Random Access Memory. In a ROC809, it is used to store history, data, most user programs, and additional configuration data.
RBX – Report-by-exception. In a ROC809, it always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
RFI – Radio Frequency Interference.
RI – Ring Indicator modem communications signal.
ROC – Remote Operations Controller microprocessor-based unit that provides remote monitoring and control.
ROCLINK 800 – Configuration software used to configure ROC809 units to gather data, as well as most other functions.
ROM – Read-only memory. Typically used to store firmware. Flash memory.
RTC – Real-time clock.
RTD – Resistance Temperature Detector.
RTS – Ready to Send modem communications signal.
RTU – Remote Terminal Unit.
RX or RXD – Received data communications signal.

S

Script – A uncompiled text file (such as keystrokes for a macro) that is interpreted by a program to perform certain functions. Typically, scripts can be easily created or edited by the end-user to customize the software.

Soft Points – A type of ROC point with generic parameters that can be configured to hold data as desired by the user.

SP – Setpoint, or Static Pressure.

SPI – Slow Pulse Input.

SRAM – Static Random Access Memory. Stores data as long as power is applied; typically backed up by a lithium battery or supercapacitor.

SRBX – Spontaneous Report-By-Exception. See RBX.

SVA – Signal Value Analog.

SVD – Signal Value Discrete.

T-U

T/C – Thermocouple Input.

TDI –Time Duration Input.

TDO – Time Duration Output.

Tf – Flowing temperature.

TLP – Type (of point), Logical (or point) number, and Parameter number.

TX or TXD – Transmitted data communications signal.

V-Z

V – Volts.

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

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