Instruction Manual
Part Number D301772X012
August 2015

ControlWave® Micro Distributed I/O System

EMERSON. Process Management

IMPORTANT! READ INSTRUCTIONS BEFORE STARTING!

Be sure that these instructions are carefully read and understood before any operation is attempted. Improper use of this device in some applications may result in damage or injury. The user is urged to keep this book filed in a convenient location for future reference.

These instructions may not cover all details or variations in equipment or cover every possible situation to be met in connection with installation, operation or maintenance. Should problems arise that are not covered sufficiently in the text, the purchaser is advised to contact Emerson Process Management, Remote Automation Solutions for further information.

EQUIPMENT APPLICATION WARNING

The customer should note that a failure of this instrument or system, for whatever reason, may leave an operating process without protection. Depending upon the application, this could result in possible damage to property or injury to persons. It is suggested that the purchaser review the need for additional backup equipment or provide alternate means of protection such as alarm devices, output limiting, fail-safe valves, relief valves, emergency shutoffs, emergency switches, etc. If additional information is required, the purchaser is advised to contact Remote Automation Solutions.

RETURNED EQUIPMENT WARNING

When returning any equipment to Remote Automation Solutions for repairs or evaluation, please note the following: The party sending such materials is responsible to ensure that the materials returned to Remote Automation Solutions are clean to safe levels, as such levels are defined and/or determined by applicable federal, state and/or local law regulations or codes. Such party agrees to indemnify Remote Automation Solutions and save Remote Automation Solutions harmless from any liability or damage which Remote Automation Solutions may incur or suffer due to such party's failure to so act.

ELECTRICAL GROUNDING

Metal enclosures and exposed metal parts of electrical instruments must be grounded in accordance with OSHA rules and regulations pertaining to "Design Safety Standards for Electrical Systems," 29 CFR, Part 1910, Subpart S, dated: April 16, 1981 (OSHA rulings are in agreement with the National Electrical Code).

The grounding requirement is also applicable to mechanical or pneumatic instruments that include electrically operated devices such as lights, switches, relays, alarms, or chart drives.

EQUIPMENT DAMAGE FROM ELECTROSTATIC DISCHARGE VOLTAGE

This product contains sensitive electronic components that can be damaged by exposure to an electrostatic discharge (ESD) voltage. Depending on the magnitude and duration of the ESD, this can result in erratic operation or complete failure of the equipment. Read supplemental document S14006 for proper care and handling of ESD-sensitive components.

Contents

Chapter 1 – Introduction

The ControlWave Micro Distributed I/O System (DIOS) provides additional I/O in a separately mounted rack for an existing ControlWave Micro process automation controller.

This manual focuses on the hardware aspects of the ControlWave Micro Distributed I/O System. For information about the software used, refer to the *ControlWave Designer Programmer's Handbook* (D5125), and the online help in ControlWave Designer.

This chapter details the structure of this manual and provides an overview of the ControlWave Micro and its components.

In This Chapter

ControlWave products have been designed and integrated as a highly adaptable, high performance distributed open controller family with exceptional networking capability that provides a complete process automation management solution for the natural gas, water, and wastewater industries. The ControlWave Micro Distributed I/O System was designed with an emphasis on providing high performance with low power consumption, scalability, and modularity.

Features ControlWave Micro Distributed I/O Systems have the following key features:

- Exceptional performance and low power consumption through use of the ARM microprocessor
- Small size (enabling panel- or wall-mount installations)
- Two RS-232 and one RS-485 asynchronous serial communication ports
- One 10/100 MB Ethernet port
- Optional Expansion Communication modules (ECOMs) with optional built-in modem and/or radio or additional ports.
- 3-, 4- and 8-slot base housings with 2-, 4-, or 8-slot I/O expansion housings

Note: The 3-slot base housing does not include a plug-in connection to any expansion housings.

- Wide operating temperature range: (–40 to +70°C) (–40 to 158°F)
- Variety of I/O modules (including mixed I/O) for cost-effective small RTU applications
- LED status indicators on the CPU, PSSM, and I/O modules
- Lithium coin cell battery (located on the CPU module) provides battery backup for the real-time clock and the system's static RAM (SRAM)
- CE and Class I, Division 2 Hazardous Location approvals

1.1 Scope of the Manual

This manual contains the following chapters:

Chapter 1 Introduction	Provides an overview of the hardware and general specifications for the ControlWave Micro Distributed I/O System.
Chapter 2 Installation	Provides information on the base and expansion housings, the Power Supply/Sequencer module (PSSM), the CPU module, the Expanded Communications module (ECOM), and related peripherals such as the optional keypad.
Chapter 3 I/O Modules	Provides general information and wiring diagrams for the I/O modules.
Chapter 4 Operation	Provides information on day-to-day operation of the ControlWave Micro Distributed I/O System.
Chapter 5 Service and Troubleshooting	Provides information on service and troubleshooting procedures.

1.2 Physical Description

Each ControlWave Micro Distributed I/O System has a printed circuit board (PCB) backplane mounted in an aluminum housing, a Power Supply/Sequencer Module (PSSM), a CPU module, and—depending on the backplane and housing size—from zero to six I/O modules. See *Figure 1-1*. Expansion housings (in 2-, 4-, or 8-slot configurations) attach to the base housing and enable you to add up to eight more I/O modules.

You can insert optional expansion communication modules (ECOMs) in slots #3 and #4 of the base housing in place of I/O modules.

Refer to the following sections in this chapter or to other chapters in this manual for further information:

- Base and expansion housings (chassis) with backplanes (see *Section 1.3* and *Chapter 2)*
- Power Supply/Sequencer module (PSSM) (see *Section 1.5* and *Chapter 2)*

- CPU module (see *Section 1.4* and *Chapter 2*)
- One or more I/O modules (see *Section 1.7* and *Chapter 3*)
- Optional Expansion Communication modules (ECOMs) (see *Section 1.6* and *Chapter 2*)
- Peripheral components (such as keypad) (see *Chapter 2*)

Figure 1-1 shows an 8-slot base housing with PSSM and CPU modules installed.

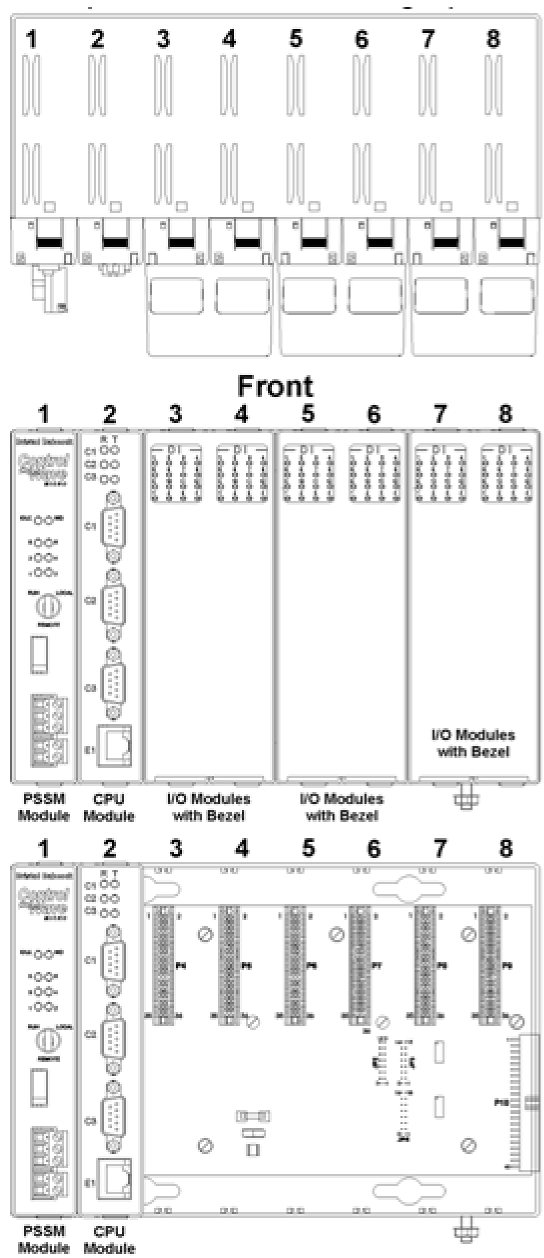


Figure 1-1. 8-slot Base Housing (without 6 I/O Modules

1.3 Housings

ControlWave housings (whether base or expansion) are gold irridite-plated aluminum designed either for wall, DIN rail, or panel-mounting. They contain the printed circuit board (PCB) backplane that provides connections for the PSSM, the CPU module, any ECOMs, and any I/O modules.

Base Three base housings are available:

- 3-slot base backplane supports one PSSM, one CPU, and one I/O module.
- 4-slot base backplane supports one PSSM, one CPU, and two I/O modules.
- 8-slot base housing supports one PSSM, one CPU, and up to six I/O modules.

You can substitute one or two ECOMs for I/O modules in slots 3 and 4 (if present) of the base housing.

Expansion Three optional expansion housings enable you to add an additional two, four, or eight I/O modules to either a 4-slot base or 8-slot base housing. However, you **cannot** install ECOMs in an expansion housing.

Note: For complete technical details on housings, refer to the ControlWave Micro technical specification (*CWM*).

1.4 CPU Module

The CPU (central processing unit) module houses the multi-layer PCB, which contains the ControlWave Micro CPU, I/O monitor/control, memory, and communication functions.

The CPU module includes:

- Sharp LH7A400 System-on-Chip ARM microprocessor with 32-bit ARM9TDMI Reduced Instruction Set Computer (RISC) core, operating at 1.8V with a system clock speed of 33 MHz or 150 MHz.
- Two RS-232 communication ports
- One RS-485 communication port
- One 10/100baseT Ethernet port
- 2 MB of battery backed Static RAM (SRAM),
- 64MB of Synchronous Dynamic RAM (SDRAM),
- 512KB boot/downloader Flash,
- 16MB simultaneous read/write Flash memory
- transmit (TX) and receive (RX) LEDs for each communication port
- configuration DIP switches (described in *Chapter 2*.)

Note: Do not confuse the CPU module (which has communication components) with the Expansion Communication module (ECOM), which **does not** have a CPU component or a battery backup but **does** have additional communication components.

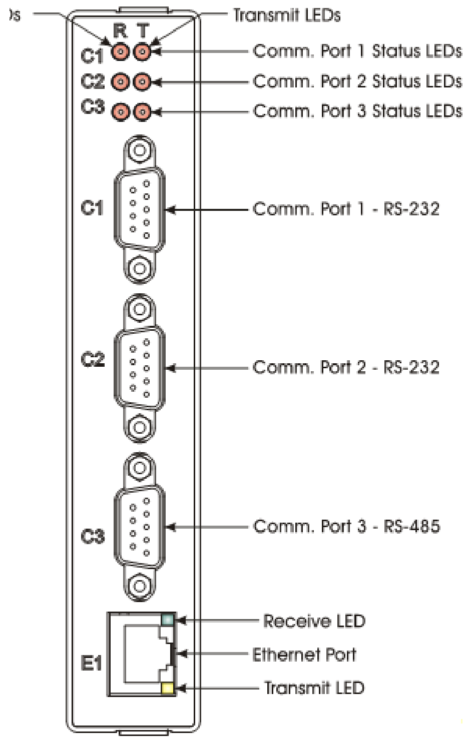


Figure 1-2. CPU Module with Three Serial Ports and One Ethernet Port

CPU Backup Battery CPU modules have a coin cell socket that accepts a 3.0V, 220 mA-hr lithium battery. This battery provides backup power for the real-time clock and the system's Static RAM (SRAM).

CPU Memory There are several different types of memory used on the CPU module:

Boot/Downloader FLASH

Boot/download code is contained in a single 512 Kbyte FLASH chip. Boot FLASH also holds the value of soft switches, audit/archive file configurations, and user account and port information.

FLASH Memory

The CPU module contains 16 MB of FLASH memory. The FLASH memory holds the system firmware. The FLASH does not support hardware write protection.

System Memory (SRAM)

The CPU module has 2 MB of static random access memory (SRAM). During power loss periods, SRAM enters data retention mode (powered by a lithium backup battery). Critical system information that must be retained during power outages or when the system has been disabled for maintenance is stored here. This includes the last states of all I/O points, the values of any variables marked RETAIN and the values of any variables assigned to the static memory area.

SDRAM

The CPU module contains 64MB of synchronous dynamic random access memory (SDRAM). SDRAM holds a copy of system firmware and the current values of any variables not marked RETAIN or stored in the static memory area. This allows the system to run faster than it will from the SRAM memory. SDRAM is not battery-backed.

1.5 Power Supply/ Sequencer Module (PSSM)

The Power Supply/Sequencer module (PSSM) takes power from an external bulk DC power supply and then provides power through the ControlWave Micro Distributed I/O housing/backplane to all installed modules.

The PSSM operates from +10.7 to +30 Vdc or from +21.7 to +30 Vdc. You configure the nominal input supply configuration (12V or 24V) using configuration jumper switches on the PSSM.

The PSSM includes:

- a wide input range Vin to 3.3V DC to DC Converter
- 1200 msec good power detection circuitry
- Vin out-of-specifications detection circuitry
- Watchdog output connector
- Status LEDs
- Vin 12-bit serial analog to digital converter

Note: The two versions of the PSSM currently available for use with the ControlWave Micro Distributed I/O System are identical to those used with the ControlWave Micro Process Automation Controller. One version has a watchdog connector (see *Figure 1-3*) the other does not (see *Figure 1-4*).

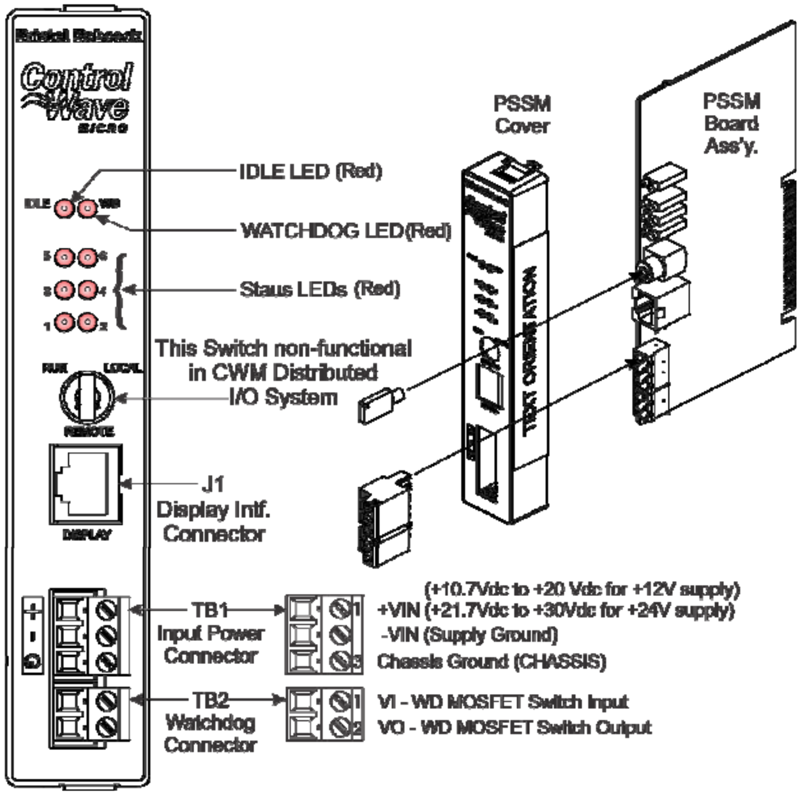


Figure 1-3. PSSM (with watchdog connector)

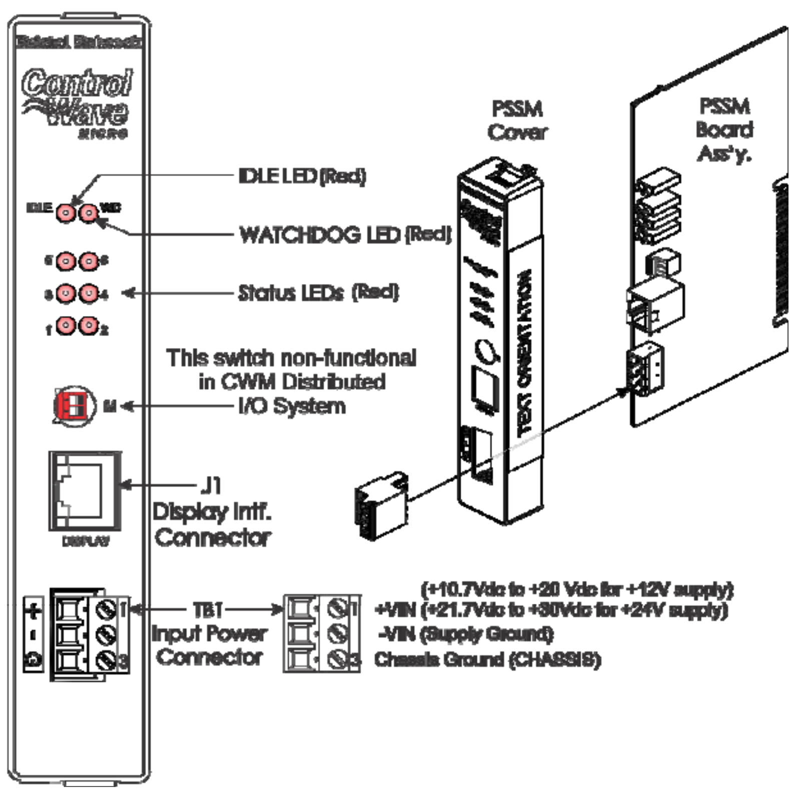


Figure 1-4. PSSM (no watchdog connector)

Board Fuse The PSSM is fused to protect the entire system using a 5x20mm slow blow fuse F1 rated at 3 Amps.

1.6 Expansion Communications Modules

An optional Expansion Communications module (see *Figure 1-5*) provides two additional serial communications ports and optionally a piggy-backed dial-up modem. Two basic versions of the module are available. Both serial communication ports support speeds of up to 115.2 KB. The top communication port (labeled C1) supports RS-232 operation while the second port (labeled C2) supports RS-485 operation. Additionally, you can order the RS-485 port with isolation to 500 Vdc.

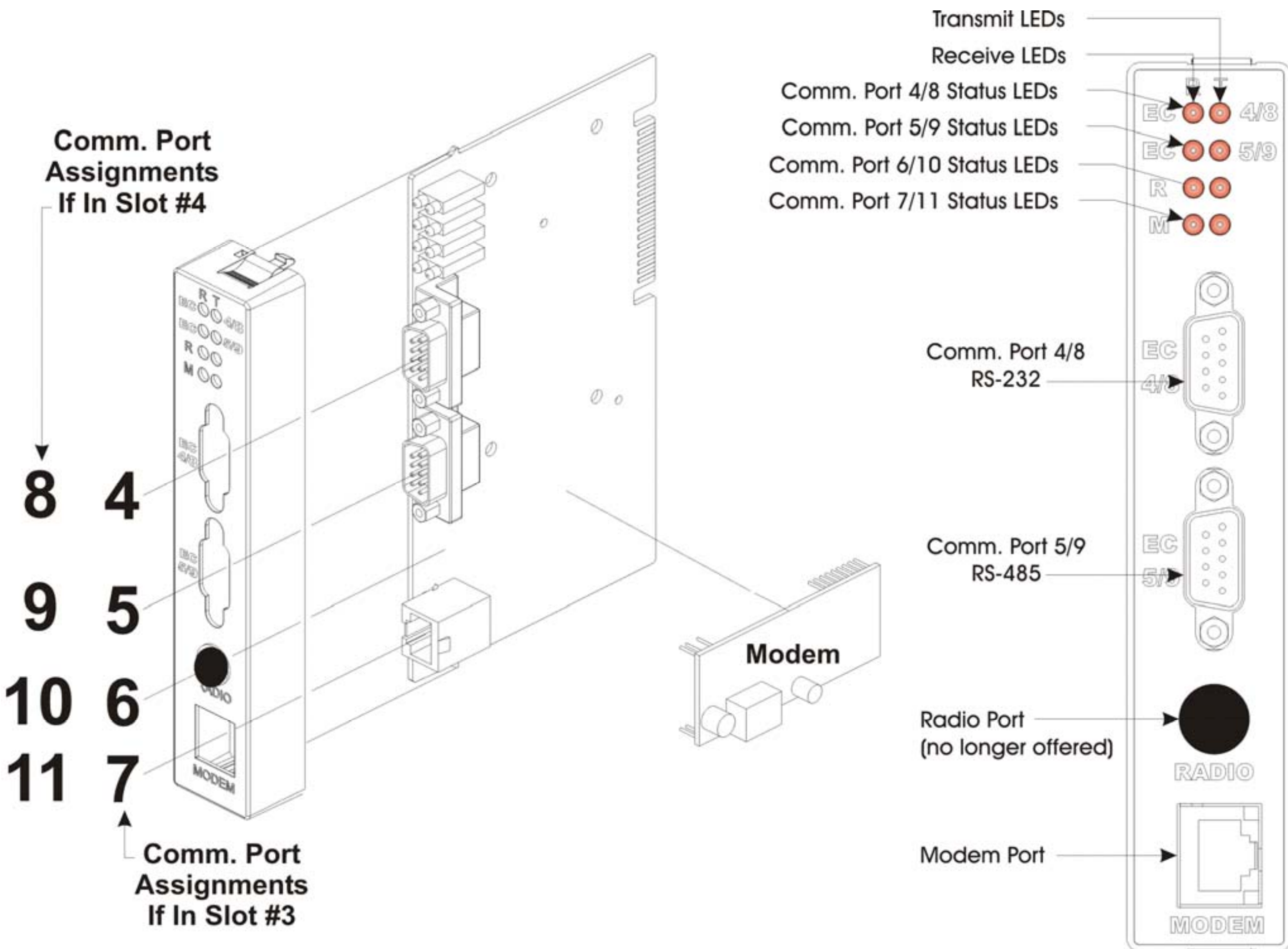


Figure 1-5. Expansion Communications (ECOM) Module

1.7 I/O Modules

The ControlWave Micro Distribution I/O System supports a wide array of factory-configured I/O modules including analog I/O, digital I/O, high speed counter, and several others for either local or remote field device wiring termination.

Refer to *Chapter 3* for information on specific I/O modules. *Figure 1-6* shows a typical I/O module housing.

Configuration jumpers on I/O modules accommodate individual field I/O user configuration. Terminations are pluggable and accept a maximum wire size of #14 AWG. All I/O modules have surge protection that meets C37.90-1978 and IEC 801-5 specifications. Each I/O module connects to the backplane using a 36-pin male card-edge connector. All I/O modules are provided with two 10-point terminal block assemblies (for local termination) or two 14-pin mass Termination headers (for remote termination).

All digital (or discrete) I/O modules have individual point LED status indicators that you can enable either with a jumper on the module or through a software setting.

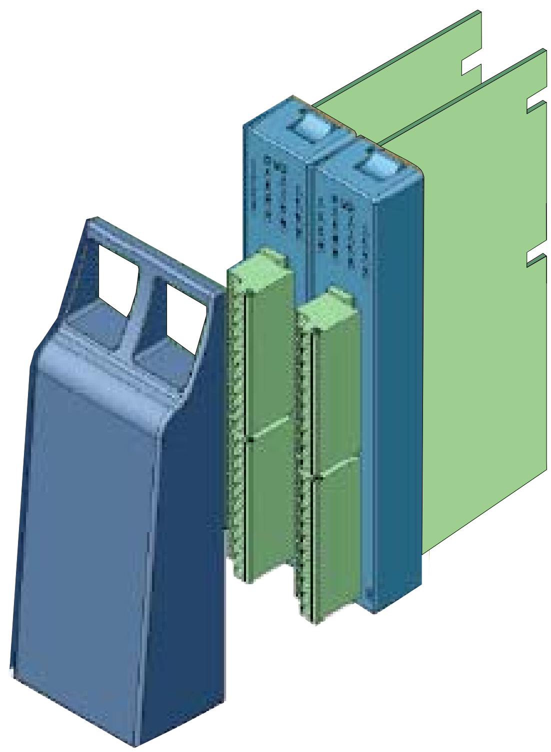


Figure 1-6. Two ControlWave Micro I/O Modules (with Bezel)

1.8 Secure Gateway

For enhanced data security when using an IP/Ethernet connection, Emerson Remote Automation Solutions recommends adding an industrial router with VPN and firewall security. Recommended solutions include the MOXA EDR-810, the Hirschman Eagle One, or the Phoenix mGuard rs4000 (or equivalents). An example of how to install one of these devices to the RTU can be found in the Emerson Remote Automation Solutions *MOXA® Industrial Secure Router Installation Guide* (part number D301766X012). For further information, contact your Local Business Partner or the individual vendor’s website.

Chapter 2 – Installation

This chapter discusses the physical configuration of the ControlWave Micro Distributed I/O system, considerations for installation, and instructions for setting switches and jumpers on the CPU, PSSM, and ECOM modules.

In This Chapter

2.1 Site Considerations

When choosing an installation site, check all clearances. Ensure that the ControlWave Micro Distributed I/O System is accessible for wiring and service.

⚠ Caution

To ensure safe use of this product, please review and follow the instructions in the following supplemental documentation:

- **Supplement Guide - ControlWave Site Considerations for Equipment Installation, Grounding, and Wiring (S1400CW)**
- **ESDS Manual – Care and Handling of PC Boards and ESD Sensitive Components (S14006)**

Specifications for Temperature, Humidity and Vibration

- See document CWMICRO available on our website for detailed technical specifications for temperature, humidity, and vibration for the ControlWave Micro family (including the distributed I/O system). This document is available on our website at **http://www.emersonprocess.com/remote.**
- Ensure that the ambient temperature and humidity at the installation site remains within these specifications. Operation beyond the specified ranges could cause output errors and erratic performance. Prolonged operation under extreme conditions could also result in failure of the unit.
- Check the mounted enclosure, panel, or equipment rack for mechanical vibrations. Make sure that the ControlWave Micro Distributed I/O system is not exposed to a level of vibration that exceeds that provided in the technical specifications.

Caution

Placement of the ControlWave Micro Distributed I/O System in Class 1, Division 2 (Group A, B, C, and D) hazardous locations requires that you select an appropriate enclosure that meets NEMA Type 3X or 4X specifications.

2.1.1 Class I, Div 2 Installation Considerations

Underwriters Laboratories (UL) lists the ControlWave Micro Distributed I/O System as non-incendive and suitable **only** for use in Class I, Division 2, Group A, B, C, and D hazardous locations and non-hazardous locations. Read this chapter and *Appendix A* carefully before you install a ControlWave Micro Distributed I/O System in a hazardous location.

Perform all power and I/O wiring in accordance with Class I, Division 2 wiring methods as defined in *Article 501-4 (b)* of the *National Electrical Code, NFPA 70* (for installations within the United States) or as specified in *Section 18-152* of the *Canadian Electrical Code* (for installation in Canada).

WARNING

EXPLOSION HAZARD

Substitution of components may impair suitability for use in Class I, Division 2 environments.

When the ControlWave Micro Distributed I/O System is situated in a hazardous location, turn off power before servicing or replacing the unit and before installing or removing I/O wiring.

Do not disconnect equipment unless the power is switched off or the area is known to be non-hazardous.

2.2 Installation Overview

Installing a ControlWave Micro Distributed I/O System involves several general steps:

1. Unpacking, assembling, and configuring the hardware
2. Installing PC-based software (ControlWave Designer)
3. Establishing communications
4. Creating an application-specific control strategy (ControlWave project) for the ControlWave Micro **host controller** that references I/O modules in the distributed I/O system
5. Creating application-specific web pages (optional)
6. Adding the ControlWave Micro to an OpenBSI network
7. Downloading the application-specific ControlWave project into the ControlWave Micro host controller

Note: Steps 2 through 7 require that you install and use ControlWave Designer software on your PC. This manual focuses on hardware installation and preparation. Software installation and configuration is beyond the scope of this manual. Refer to the *ControlWave Micro Quick Setup Guide* (D5124) for information related to software installation and use.

2.2.1 Unpacking Components

Packaging

Depending upon how you order it, the ControlWave Micro Distributed I/O System may arrive pre-assembled, or in a number of separate boxes. If you did not order it pre-assembled, you must identify, unpack, and assemble the components. Unless otherwise noted, you can place modules in any slot in a base or expansion housing.

Note: Do **not** install modules in the base or expansion housings until you have mounted and grounded those housings at the designated installation site.

Delivered boxes may include:

- Housing assemblies (3-, 4- or 8-slot base housings and 2-, 4-, or 8-slot expansion housings)
- Power Supply/Sequencer module (PSSM)

  Note: The PSSM must reside in slot #1 in the base housing.

- CPU module

  Note: The CPU module must reside in slot #2 in the base housing.

- Expansion Communication Module (ECOM).

Note: The first ECOM must reside in slot #3 in the base housing; a second ECOM can reside in slot #4 in the base housing.

- I/O Modules

Note: There are many different types of I/O modules available. *Chapter 3* contains detailed instructions on each I/O module.

- One or more bezel assemblies; each bezel covers two I/O modules.

Housing The base housing (or chassis) for the ControlWave Micro Distributed I/O System is an open-faced aluminum assembly. In use, you install a blue plastic cover ("bezel") over each pair of installed I/O modules, as shown in *Figure 2-1*.).

Figure 2-1. 8-Slot Base Housing with Bezel

Keyed cutouts in the housing's rear wall (see *Figure 2-2* through *Figure 2-7*) permit wall or panel mounting. The base housing has the following components:

- Built-in guides on the top and bottom of the housing permit easy installation and removal of modules
- Built-in ground lug (on right bottom corner of housing)
- Printed circuit board (PCB) attached to interior back of housing provide seating and electrical interface for modules
- Built-in interface connector (available only on 4-slot and 8-slot housings) for expansion housings

Composed of aluminum (plated with gold irridite), the base housing has three configurations (3-slot, 4-slot, or 8-slot backplane). Optional I/O expansion housings (also gold irridite-plated aluminum) accommodate additional I/O modules in three configurations (2-slot, 4-slot, or 8-slot backplanes), and can be either wall- or panel-mounted or rack mounted with a DIN-rail. Refer to *Figure 2-2* through *Figure 2-7* for dimensional drawings of the three base housings and three expansion housings.

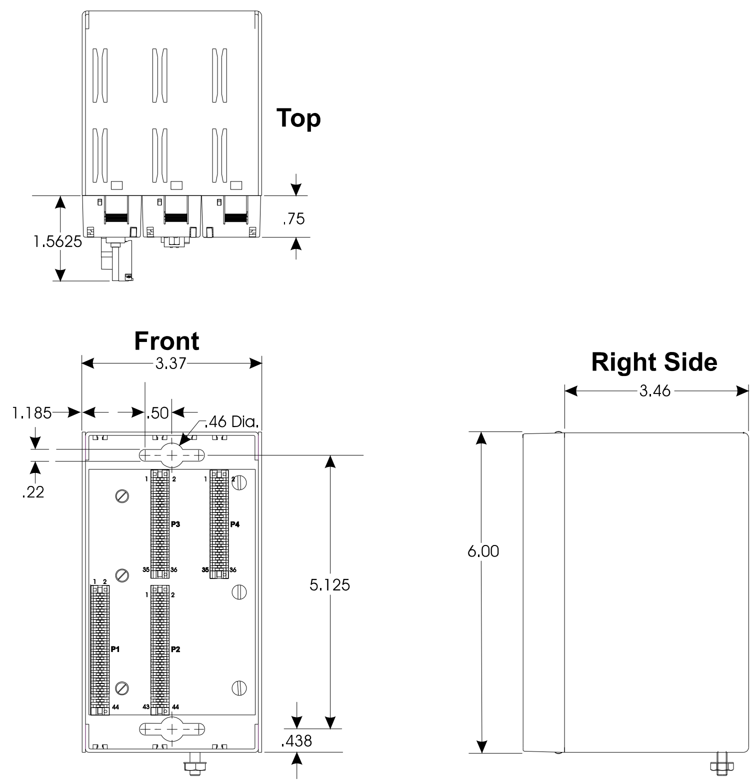


Figure 2-2. 3-Slot Base Housing

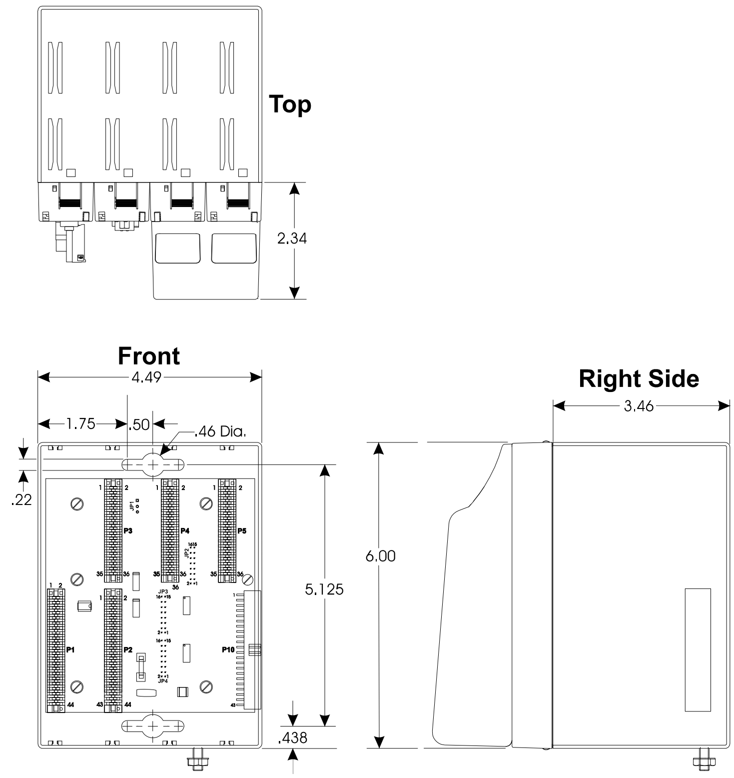


Figure 2-3. 4-Slot Base Housing

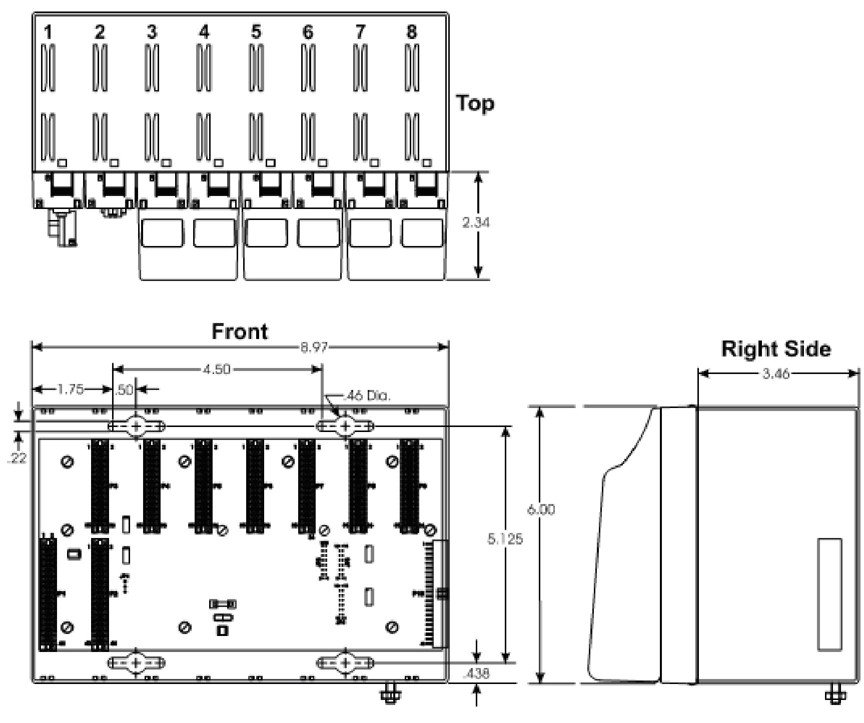


Figure 2-4. 8-Slot Base Housing

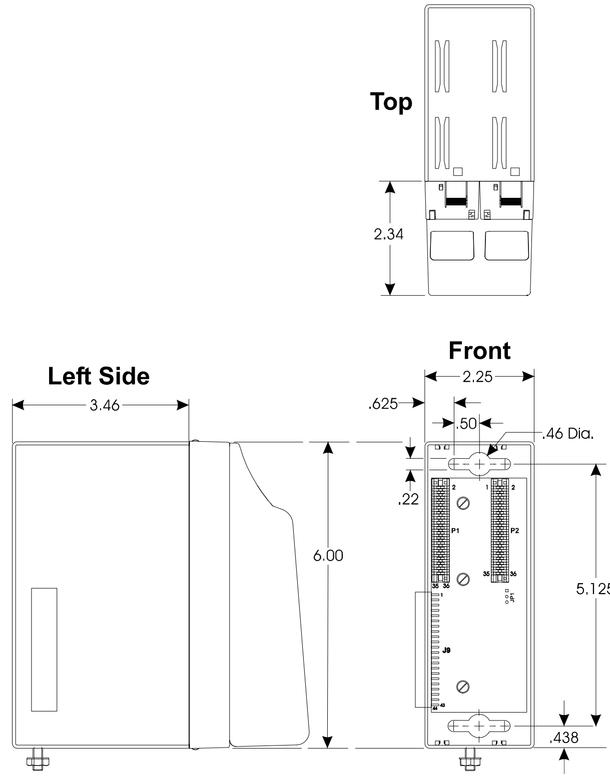


Figure 2-5. 2-Slot Expansion Housing

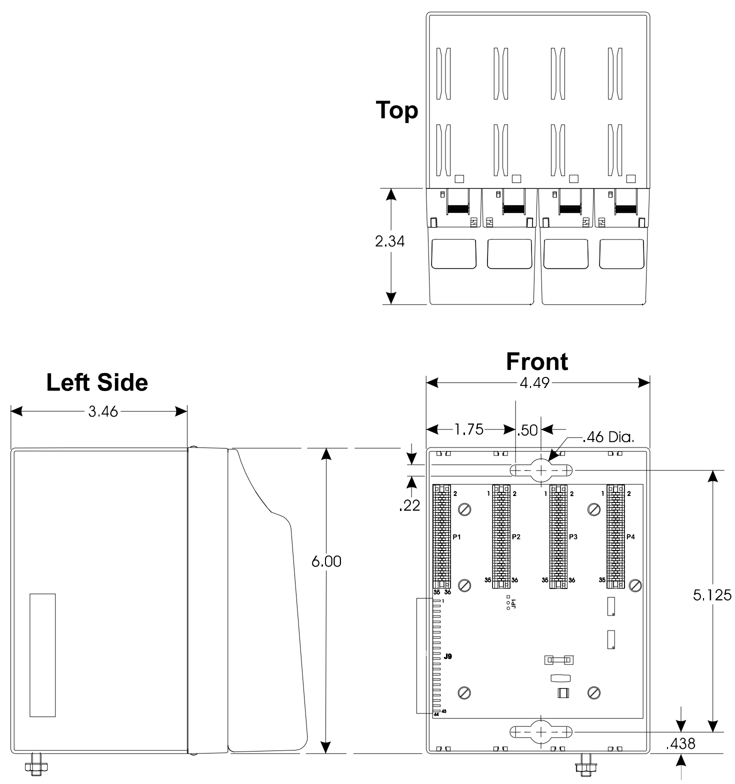


Figure 2-6. 4-Slot Expansion Housing

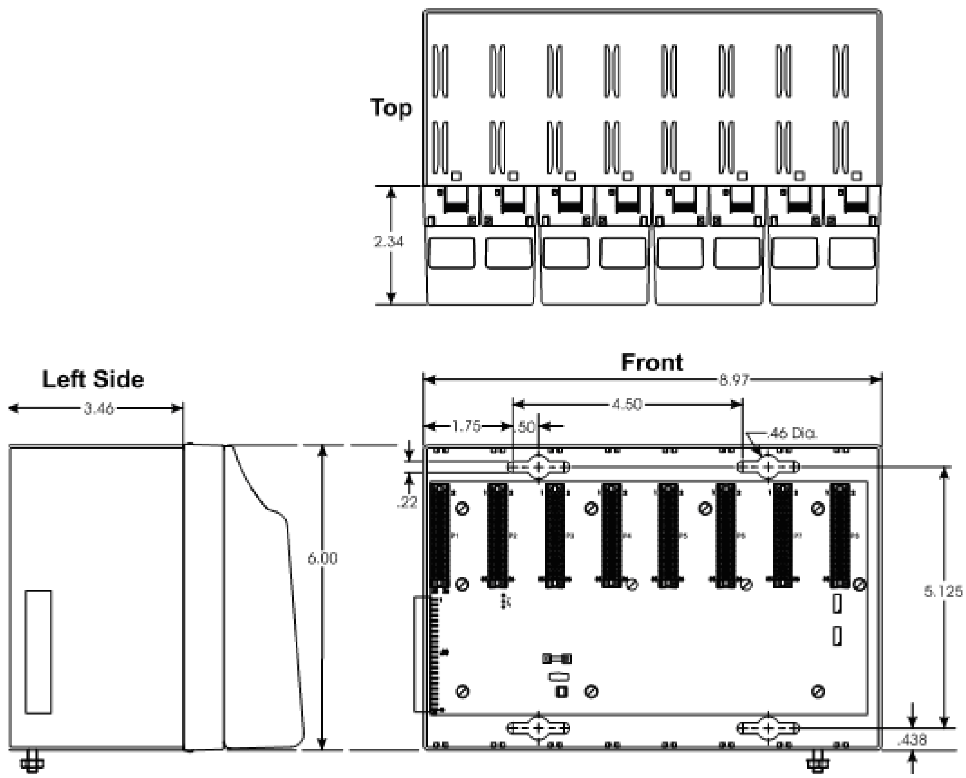


Figure 2-7. 8-Slot Expansion Housing

2.2.2 Mounting the Housing

You can mount base or expansion housings to a panel or a wall. When mounting one of these units to a panel or wall, place it according to the following guidelines:

- Ensure that the front of the ControlWave Micro Distributed I/O System is visible and accessible for service (for example, so you can easily install or remove modules).
- Use the mounting holes provided in the base and expansion housings (see *Figure 2-2* through *Figure 2-7).*

Remove the base housing and any applicable expansion housings from their cartons and install them at the assigned work site.

Note: If you are attaching an expansion housing to a 4-slot or 8-slot base housing, remove the three bus terminators JP2, JP3, and JP4 (see *Figure 2-8*) from the backplane on the 4-slot or 8-slot base housings. You also may need to remove the paper label over the connector on the right back edge of the base housing.

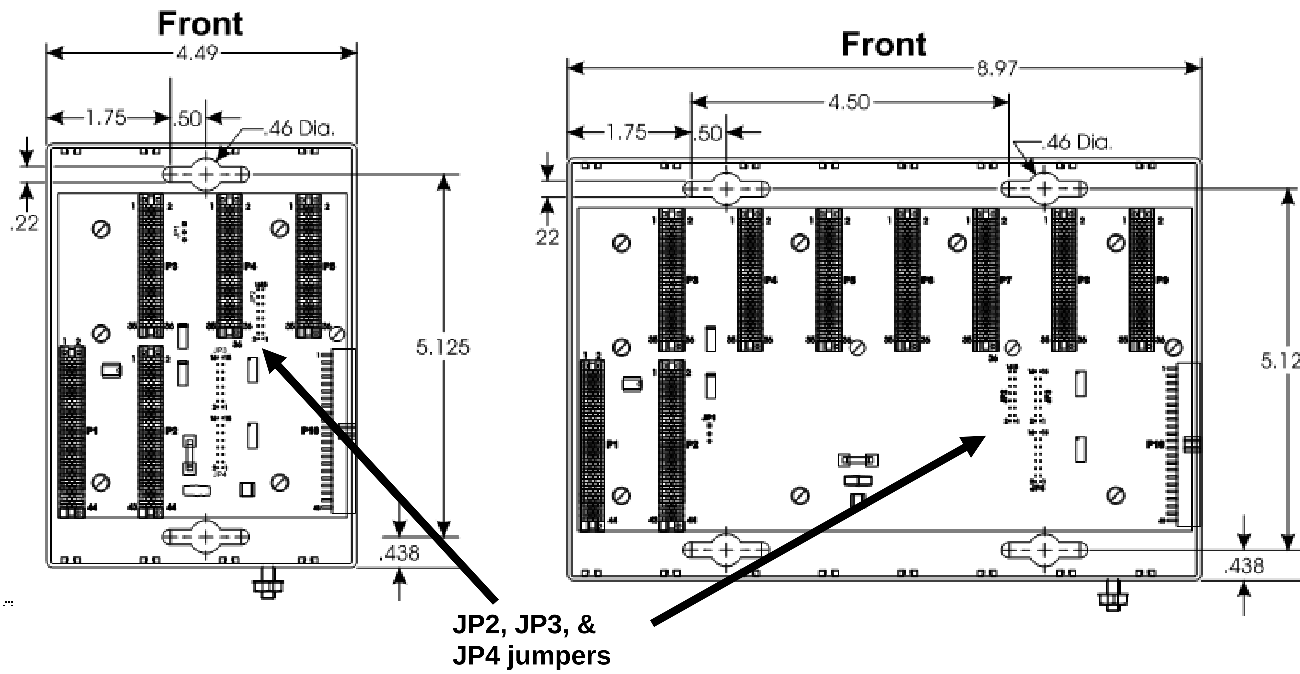


Figure 2-8. JP2, JP3, and JP4 Jumpers on Base Housing

Face the housings and mount the base housing on the left and the expansion housing on the right so that the connector on the right back edge of the base housing (P10) seats firmly with the connector on the left back edge of the expansion housing (P9).

2.2.3 Grounding the Housing

Caution **Do not install any modules in the base or expansion housings until you have mounted and grounded those housings at the designated installation site.**

Base housings have a ground lug (see *Figure 2-2* through *Figure 2-7*) that accommodates up to a #4 AWG wire size. Once you have installed the base and any expansion housings, you must run a ground wire between the base housing ground lug and a known good earth ground.

Note: After you install the PSSM in the base housing, as an added precaution we recommend that you run a #14 AWG wire from the TB1-3 power connection (Ground) to the same known good earth ground.

Additional grounding guidelines include:

- Use stranded copper wire (#4 AWG) for the base housing to earth ground, and keep the length as short as possible.
- Clamp or braze the ground wire to the ground bed conductor (typically a stranded copper AWG 0000 cable installed vertically or horizontally).
- Tin the wire ends with solder (using a high-wattage soldering iron) prior to inserting the wire into the base housing ground lug.
- Run the ground wire so that any routing bend in the cable has a minimum radius of 12-inches below ground and 8-inches above ground.

2.3 Power Supply/Sequencer Module (PSSM)

Before we actually configure the PSSM and install it in the housing, we're going to discuss some general information about how it works.

2.3.1 General Information about the PSSM

The Power Supply/Sequencer module (PSSM) plugs into slot #1 (first slot from the left) on the ControlWave Micro Distributed I/O System's backplane using connector P1, a 44-pin female non-keyed header (see *Figure 2-2, Figure 2-3* and *Figure 2-4*).

Currently, we offer the PSSM in two configurations:

- PSSM with Display Interface and Watchdog output (model 396657-01-0, Revision A and above) (see *Figure 2-9*)
- PSSM with Mode Switch SW1 & Display Interface (model 396657-02-8 without Watchdog output, Revision A and above) (see *Figure 2-10*)

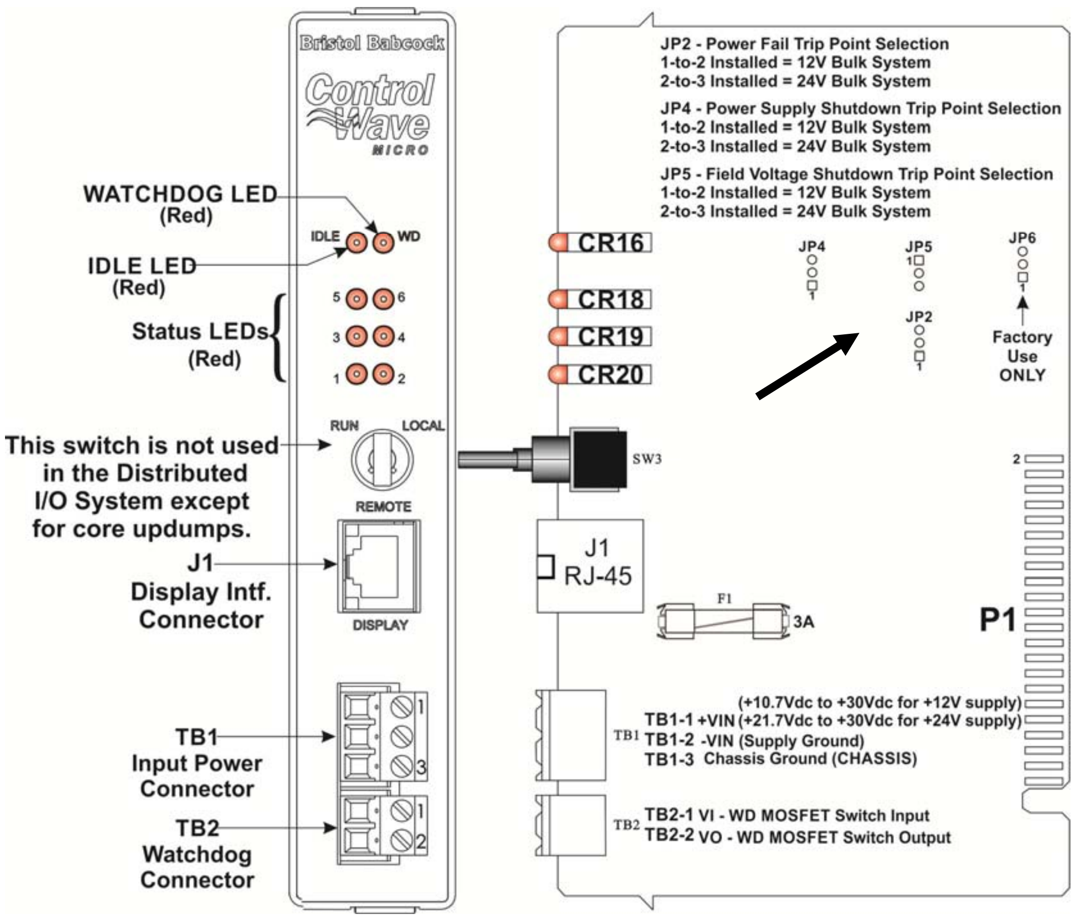


Figure 2-9. PSSM with Run/Remote/Local Switch, Display Interface, and Watchdog Connector

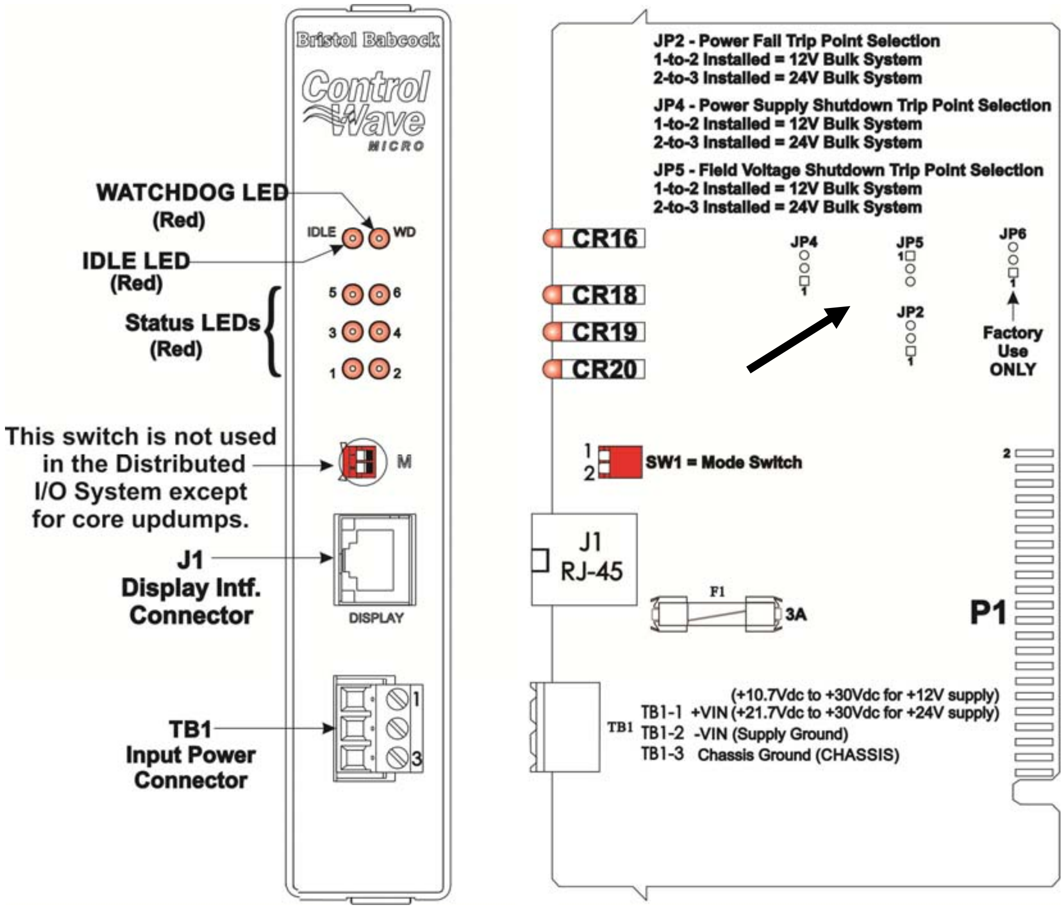


Figure 2-10. PSSM Module with Mode Switch, Display Interface, and without Watchdog Connector

Two terminal blocks (see *Figure 2-9*) provide external input power and watchdog connector switch connections. Two red LEDs on the PSSM’s front panel enable you to monitor the status of the watchdog (WD) and Idle (IDLE) circuits.

Note: The Idle LED is usually on, indicating when the CPU has free time at the end of its execution cycle. If the LED is off, it indicates the CPU has no free time and may be overloading.

Six additional LEDs provide system status codes (see *Chapter 5)*.

PSSMs contain a DC-to-DC converter that generates a +3.3 Vdc supply for the entire unit (that is, the CPU and various I/O modules that plug into the backplane).

Power Supply

An auxiliary +5 Vdc regulator powers low power detection circuitry and sequencer timing circuitry.

The power supply operates from +10.7 to +30 Vdc or from +21.7 to +30 Vdc. You can configure the nominal input supply configuration (12V or 24V) using configuration jumper switches on the PSSM PCB. See *Figure 2-9* and *Figure 2-10*.

Watchdog Switch

PSSMs optionally include a watchdog metal oxide semiconductor field-effect transistor (MOSFET) switch connector. The purpose of the watchdog connector is to trigger an external alarm or annunciator if the ControlWave Distributed I/O System enters a "watchdog" condition in which the CPU cannot control the I/O. This occurs on power-up before the ControlWave project starts, if the unit is reset, or if the system loses power. See *Section 2.3.6.*

2.3.2 PSSM Installation Overview

There are several steps you need to follow when you install the PSSM.

1. Identify the carton holding the PSSM and remove it from that carton. See *Section 2.2.1.*
2. Set jumpers on the PSSM based on whether your external DC bulk power supply provides +12V or +24V. See *Section 2.3.3.*
3. Slide the PSSM into slot #1 of the housing.
4. Unplug terminal block connector TB1 from the PSSM and wire it to an external bulk DC power supply. See *Section 2.3.5.*
5. If you want to use the watchdog connector TB2, unplug it from the PSSM and wire it to an external annunciator or similar device according to instructions in *Section 2.3.6.*
6. After you configure and install the CPU module in slot #2 re-connect terminal blocks to their connectors to apply power to the unit.

2.3.3 Setting Jumpers on the PSSM

The PSSM has three jumpers which you set based on whether your bulk DC power supply will provide +12V or +24V. See *Figure 2-9* or *Figure 2-10* to locate the jumpers on your version of the PSSM.

- **JP2**: Three-position Power Fail Trip Point Selection Jumper:
  - 1-to-2 Installed = Choose this to select +12V Bulk Supply Power Fail Trip Point
  - 2-to-3 Installed = Choose this to select +24V Bulk Supply Power Fail Trip Point (default)
- **JP4**: Three-position Power Supply Shutdown Trip Point Selection Jumper:

  - 1-to-2 Installed = Choose this to select +12V Bulk Supply Shutdown Trip Point.
  - 2-to-3 Installed = Choose this to select +24V Bulk Supply Shutdown Trip Point. (default)
- **JP5**: Three-position Field Voltage Shutdown Trip Point Selection Jumper
  - 1-to-2 Installed = +12V Bulk Supply Field Voltage Shutdown Trip Point Selected
  - 2-to-3 Installed = +24V Bulk Supply Field Voltage Shutdown Trip Point Selected. (default)

2.3.4 General Wiring Guidelines

- ControlWave Micro Distributed I/O System PSSMs use compression-type terminals that accommodate up to #14 AWG wire.
- When making a connection, insert the bare end of the wire (approx ¼” max) into the clamp adjacent to the screw and secure the wire.
- To prevent shorts, ensure that no bare wire is exposed. If using standard wire, tin the bare end with solder to prevent flattening and improve conductivity.
- Allow some slack in the wire while making terminal connections. Slack makes the wires more manageable and helps minimize mechanical strain on the terminal blocks.

2.3.5 Wiring a Bulk DC Power Supply to the PSSM

Caution **At this time you can also connect power and watchdog wiring. However; for safety reasons and to prevent accidental damage to the your bulk DC power supply, do not connect the pluggable terminal block connectors TB1 and TB2 to the PSSM until after you install, wire, and configure the CPU module.**

Follow the instructions in *Section 2.3.4 General Wiring Guidelines* when wiring connections.

You can connect one bulk DC power supply (nominally either +12 Vdc or +24 Vdc) to the PSSM. The PSSM then converts, regulates, and filters the power to +3.3 Vdc. For safety, the PSSM circuit has a 3A fuse.

The ControlWave Micro Distributed I/O System PSSM's operating range is +10.7 to +30.0 Vdc (with nominal +12Vdc input source) or +21.7 to +30.0 Vdc (with a nominal +24Vdc input source).

Use the following formula to determine the maximum current required for the +12 Vdc or +24 Vdc bulk power used with a particular ControlWave Micro Distributed I/O System:

Bulk + 12/24 Vdc Supply Current = CPU* + Sum of all ECOM modules and I/O modules.

Refer to *Table 2-1* for ControlWave Micro Distributed I/O System bulk power requirements.

Table 2-1. Bulk Power Requirements

Component	Bulk 24 Vdc Power Supply	Bulk 12 Vdc Power Supply
CPU, backplane, and PSSM (with Ethernet)	50 mA	100 mA
Any backplane	2 mA	4 mA
PSSM	3.2 mA	6.4 mA
Non-isolated AI/AO Module	2.8 mA + (47.2 mA – VEXT)	5.6 mA + (47.2 mA – VEXT)
Isolated DI Module	104 mA	208 mA
Isolated DO Module	13 mA	26 mA
Non-isolated DI/DO Module	12 mA	24 mA
Non-isolated HSC Module	5 mA	10 mA
Isolate5.3 mA d AI Module	113 mA + (24.5 mA/loop)	192 mA + (49 mA/loop)
Isolated AO Module	10 mA + (22.5 mA/I loop) or 10 mA + (5.3 mA/E loop @ 5 mA)	19 mA + (45 mA/I loop) or 19 mA + (10.5 mA/E loop @ 5 mA)
Non-isolated Mixed I/O module (with optional AO)	8.3 mA + (24.3 mA – VEXT)	16.67 mA + (24.3 mA – VEXT)
Isolated VAC DI module	5 A	10 mA
Isolated VAC/DC DO module	10 mA	20 mA
Isolated DI/DO module	83.1 mA	166.2 mA
Isolated RTD module	13.5 mA	27 mA

Component	Bulk 24 Vdc Power Supply	Bulk 12 Vdc Power Supply
Isolated LLAI module	26.3 mA	52.5 mA
ECOM without modem/radio	22 mA	45 mA
ECOM with modem	56 mA	112 mA
ECOM with FreeWave radio*	272 mA	545 mA
ECOM with modem and FreeWave radio*	306 mA	612 mA

* FreeWave radio no longer available

Terminal Block Connector TB1

Unplug removable connector TB1 from the PSSM and wire DC power to the connector. We recommend you do **not** plug the connector back into the PSSM until the CPU module is already installed in the housing.

TB1 provides three input connections for bulk power:

- TB1-1: (+VIN) (+10.7V to +30V dc for +12V supply) (+21.7V to +30V dc for +24V supply)
- TB1-2 = (-VIN) (Supply Ground - PSGND)
- TB1-3 = Chassis Ground - CHASSIS (⏚)

Figure 2-11 shows the typical wiring at the PSSM's TB1 block.

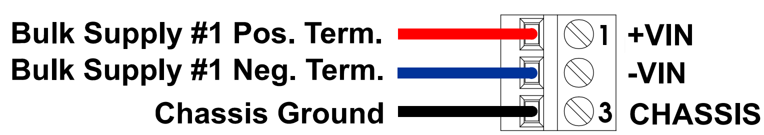


Figure 2-11. PSSM TB1 Wiring

Note: As an added precaution, we recommend that you run a #14 AWG wire from the TB1-3 power connection (Ground) to the same known good earth ground used for the base housing.

2.3.6 Wiring an External Alarm or Annunciator to the Watchdog Connector (OPTIONAL)

⚠ Caution

At this time you can also connect power and watchdog wiring. However; for safety reasons and to prevent accidental damage to the your bulk DC power supply, do not connect the pluggable terminal block connectors TB1 and TB2 to the PSSM until after you install, wire, and configure the CPU module.

Follow the instructions in *Section 2.3.4 General Wiring Guidelines* when wiring connections.

The version of the PSSM shown in *Figure 2-9* includes an optional watchdog connector. The purpose of the watchdog connector is to trigger an external alarm or annunciator if the ControlWave Micro Distributed I/O System enters a "watchdog" condition in which the CPU cannot control your I/O.

A watchdog condition occurs when:

- A watchdog timer expires. This occurs due to a reset of power failure.
- The CPU module detects that the regulated 3.3 Vdc or 1.8 Vdc supplies are out of specification.

A MOSFET switch activates the watchdog connector whenever a watchdog condition occurs.

Terminal Block Connector TB2

You must power the watchdog connector (TB2) from an external power supply. Unplug removable connector TB2 from the PSSM and wire power to the connector. We recommend you do **not** plug the connector back into the PSSM until the CPU module is already installed in the housing.

TB2 provides two watchdog MOSFET switch connections:

- TB2-1 = VI - Watchdog MOSFET Switch Input
- TB2-2 = VO - Watchdog MOSFET Switch Output

The VI input on TB2 powers the watchdog switch; its switched output connects to the VO output on the same terminal block. You must reference the external power source connected to the VI terminal to the return point of the input source powering the PSSM (which is either –VIN or PSGND on TB2). See *Figure 2-12*.

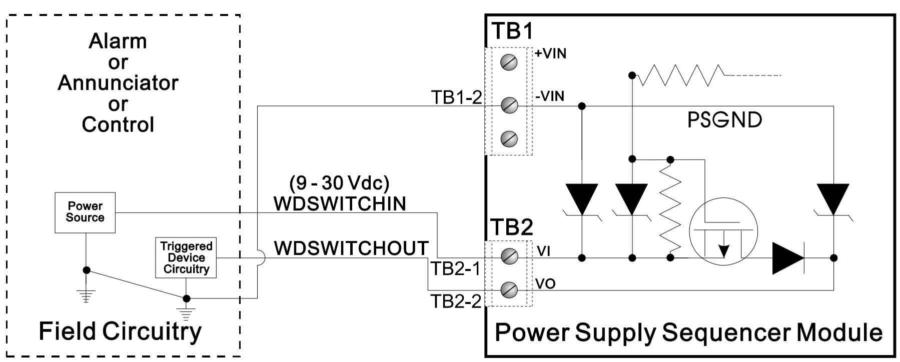


Figure 2-12. Watchdog MOSFET Switch Wiring

2.4 CPU Module

The CPU module, which controls the ControlWave Micro Distributed I/O System and handles memory and communication functions, can only be installed in Slot #2 of the backplane.

Note: Do not confuse the CPU module (which has communication components) with the Expansion Communication module (ECOM), which **does not** have a CPU component or a battery backup but **does** have additional communication components.

Identify the carton holding the CPU module and remove it from that carton. The CPU module has two RS-232 serial ports, one RS-485 serial port, and one Ethernet port (see *Figure 2-13*).

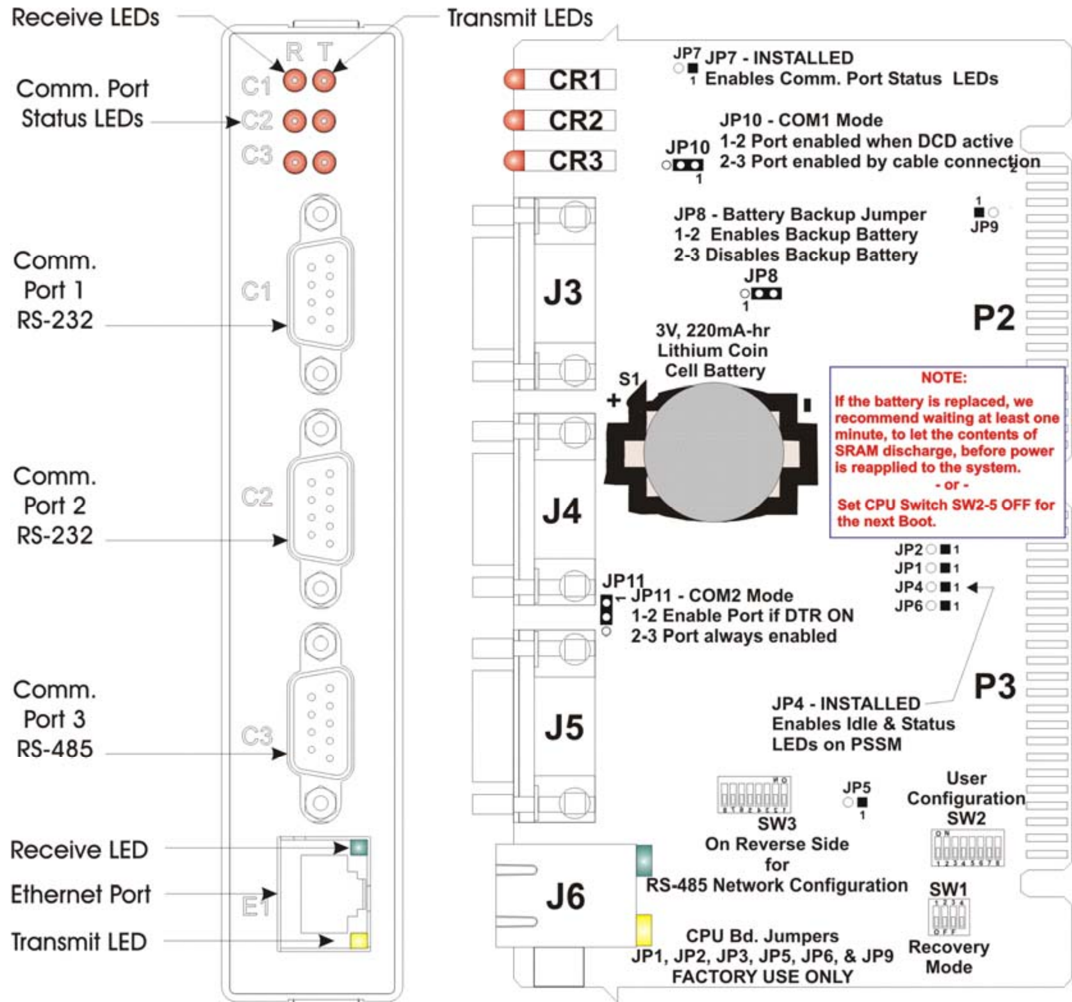


Figure 2-13. CPU Module with Three Serial Ports and One Ethernet Port

2.4.1 Setting Jumpers on the CPU Module

Each CPU module contains a number of jumpers (labeled with JP*n*) when *n* in the jumper number. See *Figure 2-13* to locate the jumpers.

Note: When present, jumpers 1, 2, 3, 5, 6, and 9 (**JP1, JP2**, **JP3**, **JP5**, **JP6,** and **JP9**) are reserved for factory use only. **Do not alter these jumpers from their factory settings**.

- Jumper 4 (**JP4**) enables the Idle and Status LEDs on the PSSM. It comes enabled from the factory. (We recommend you leave these LEDs enabled during initial installation and setup. If power conservation is an issue, you can disable these LEDs by removing the jumper.)
- Jumper 7 (**JP7**) enables the Communication Port Status LEDs on the CPU module. It comes enabled from the factory. We recommend you leave these LEDs enabled during initial installation and setup. If power conservation is an issue, you can disable these LEDs by removing the jumper.

Note: For maximum shelf life, the CPU module ships from the factory with the installed lithium backup battery disabled. You must enable it when you install the CPU module by placing JP8 on pins 1-2.

- Jumper 8 (**JP8**) enables/disables the lithium backup battery on the CPU module.

  Pins 1-2: Enables the CPU module’s backup battery.

  Pins 2-3: Disables the CPU module’s backup battery (**Factory default**)
- Jumper 10 (**JP10**) specifies how COM1 is enabled.

  Pins 1-2: Enables COM1 whenever DCD is active. (**Factory default**)

  Pins 2-3: Enables COM1 whenever you connect a cable to the port.
- Jumper 11 (**JP11**) when present, specifies how COM2 is enabled.

  Pins 1-2: Enables COM2 whenever DTR is ON. (**Factory default**)

  Pins 2-3: Port is always enabled. This setting can be used to control external radios that feature DTR sleep modes.

2.4.2 Setting DIP Switches on the CPU Module

Before you install the CPU module, you must determine the settings for three banks of DIP switches. Refer to *Figure 2-13* for the location of the DIP switch banks on each CPU module. Refer to *Tables 2-2* through *2-4* for DIP switch setting values.

Note: Examine each bank of DIP switches carefully to note the switch direction for ON or OFF.

Table 2-2. CPU Module Switch SW1

SW1 Setting	Function	Mode
1	N/A	Not currently used.
2	N/A	Not currently used.
3	Force Recovery Mode	Enables recovery mode. Values are: **ON** (enables recovery mode) **OFF** (disables recovery mode). – This is the **factory default**.
4	N/A	Not currently used.

Table 2-3. CPU Module Switch SW2

SW2 Setting	Function	Mode
1	Watchdog Enable	Controls whether the system enters a watchdog state when a crash or system hangup occurs and automatically restarts. Values are: **ON** (Enables watchdog circuit; **factory default**) **OFF** (Disables watchdog circuit and prevents automatic restart)
2	Lock/Unlock Soft Switches	Controls the ability to modify soft switches, other configurations, and flash files. Values are: **ON** (Unlocks soft switches and flash files; **factory default**). **OFF** (Locks soft switches, configurations, and flash files)
3	Use/Ignore Soft Switches	Controls the use of soft switches. Values are: **ON** (Enable user-defined soft switches configured in flash memory; **factory default**) **OFF** (Disable soft switch configuration and use factory defaults) **Note**: Setting both switch 3 and switch 8 to **OFF** (closed) sets all serial communication ports to 9600 bps operation. All serial communication ports must be set at 9600 bps before WINDIAG can perform communication tests.
4	Core Updump	Causes the ControlWave Micro Distributed I/O System to perform a core updump, provided you have set the PSSM mode switch to Recovery mode or properly sequenced the Run/Remote/Local switch on the PSSM. Values are:

SW2 Setting	Function	Mode
		ON (Disables core updump; **factory default**) **OFF** (Core updump via PSSM Run/Remote/Local switch or PSSM mode switch SW1)
5	SRAM Control	Manages SRAM contents following a low power situation or a power outage. Values are: **ON** (Retain values in SRAM during restarts; **factory default**) **OFF** (Reinitialize SRAM) – Data in SRAM lost during power outage or re-start.
6	System Firmware	Allows a remote download of system firmware (on units equipped with boot PROM version 4.7 or higher and system PROM version 4.7 and higher). Values are: **ON** (Enable remote download of system firmware; **factory default**) **OFF** (Disable remote download of system firmware)
7	N/A	Not currently used.
8	Enable WINDIAG	Suspends normal operation and allows diagnostic routines. Values are: **ON** (Permits normal system operation, including the boot project, and disables the WINDIAG diagnostics from running; **factory default**) **OFF** (Allow WINDIAG to run test; disable boot project and normal system operation.) **Note**: Setting both switch 8 **and** switch 3 to **OFF** (closed) sets all communication ports to 9600 bps operation. All serial communication ports must be set at 9600 bps before WINDIAG can perform communication tests.

Notes:

- *Table 2-4* describes switch settings for the RS-485 port. You may want to review *Section 2.4.4 Connections to RS-485 Serial Port(s)* before you set these switches.
- *Table 2-4* applies to the following switches:
  - SW3 on CPU Module – controls COM3
  - SW1 on Type 1 ECOM Module – controls COM5/COM9
  - SW1 on Type 2 ECOM Module – controls COM6/COM10
  - SW2 on Type 2 ECOM Module – controls COM7/COM11

Table 2-4. RS-485 Configuration Switch

Switch Setting	Function	Mode
1	TX+ to RX+ Loopback	**ON** (only for diagnostics or 2-wire)
2	TX- to RX- Loopback	**ON** (only for diagnostics or 2-wire)
3	100 Ohm RX+ Termination	**ON** (End nodes only)
4	100 Ohm RX- Termination	**ON** (End nodes only)

Switch Setting	Function	Mode
5	N/A	Not currently used
6	Slew Rate (ISO485 Only)	**ON** (Slow rate enabled) **OFF** (Fast rate enabled) **Note**: On CPU module, not currently used.
7	RX+ Bias (End Node)	**ON** (End nodes only)
8	RX- Bias (End Node)	**ON** (End nodes only)

After you configure the jumpers and DIP switches, slide the CPU module into slot #2 (the second slot from the left) of the base housing (see *Figure 2-2, Figure 2-3* or *Figure 2-4*).

2.4.3 Connections to RS-232 Serial Port(s) on CPU or ECOM Modules

An RS-232 port provides point-to-point, half-duplex and full-duplex communications (for a maximum of 20 feet using data quality cable).

Your CPU module includes either one or two RS-232 ports.

If you require additional RS-232 ports, you can purchase an optional expansion communication module that can include either one (ECOM Type 1) or two (ECOM Type 2) RS-232 ports. The ControlWave Micro Distributed I/O System can support up to two expansion communication modules, for a total of up to four additional RS-232 ports beyond those on the CPU module. Expansion communication modules reside in slot #3 and slot #4.

RS-232 COM Port Names and Connectors

RS-232 COM ports are assigned names based on their location in the ControlWave Micro Distributed I/O System.

Table 2-5. RS-232 Connectors on CPU

Connector	Name	# Pins	Function	Notes
J3	COM1	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-13*, *Figure 2-14* & *Table 2-7*
J4	COM2	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-13 Figure 2-14* & *Table 2-7*

- If you have an ECOM module with one RS-232 port, this is COM4 if the module is in slot #3 or COM8 if the module is in slot #4.
- If you have an ECOM module with two RS-232 ports, those ports are COM4 and COM5, respectively, if the ECOM module is in slot #3, or COM8 and COM9, respectively, if the ECOM module is in slot #4.

Table 2-6. RS-232 Connectors on Expansion Communications Modules

Connector	Name	# Pins	Function	Notes
J4	COM4 (when in slot 3) COM8 (when in slot 4)	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-14, Figure 2-21, Figure 2-22* & *Table 2-7*
J5	COM5 (when in slot 3) COM9 (when in slot 4)	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-14, Figure 2-22* & *Table 2-7* Only available on ECOM Type 2 models.

RS-232 COM Port Cables

For the ControlWave Micro Distributed I/O System, half-duplex communications use Modbus or BSAP protocol, while full-duplex communications use point-to-point protocol (PPP). RS-232 ports use a "null modem" cable (see *Figure 2-15*) to connect with other devices (such as a PC, a printer, another ControlWave [except the CW_10/30/35]) when the ControlWave Micro DIOS uses the full-duplex PPP protocol.

Note: You can configure the ControlWave Micro Distributed I/O System as either a master or slave node on a Modbus or BSAP network.

Figure 2-14 illustrates the CPU module's male 9-pin D-type connector. Use the content provided in *Table 2-7* to determine pin assignments for the COM1 and COM2 ports and the expansion communication ports COM4/5 and COM8/9.

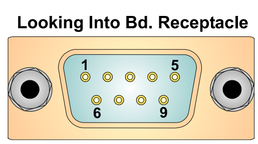


Figure 2-14. Male DB9 9-Pin Connector

Table 2-7. RS-232 Port Connector Pin Assignment

Pin	RS-232 Signal	RS-232 Description
1	DCD	Data Carrier Detect Input
2	RXD	Receive Data Input
3	TXD	Transmit Data Output
4	DTR	Data Terminal Ready Output
5	GND	Signal/Power Ground
6	DSR	Data Set Ready Input
7	RTS	Request to Send Output
8	CTS	Clear to Send Input
9		N/A

Use the “null modem” cable for full-duplex (PPP protocol) communications when connecting a ControlWave Micro to a PC. (See top part of *Figure 2-15*.)

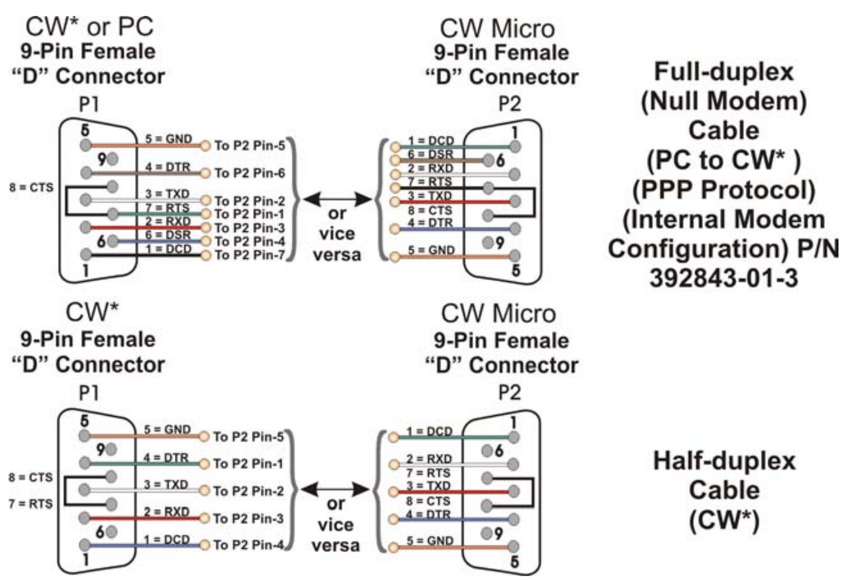


Figure 2-15. Full-duplex and Half-duplex Cable

Use the half-duplex cable (shown in the bottom part of *Figure 2-15*) when connecting the ControlWave Micro Distributed I/O System to another ControlWave series unit (again, with the exception of the CW_10/30/35).

When communicating with a Network 3000 series RTU 3305, RTU 3310, DPC 3330, or DPC 3335 or CW_10/30/35, you must use one of the cables shown in *Figure 2-16*.

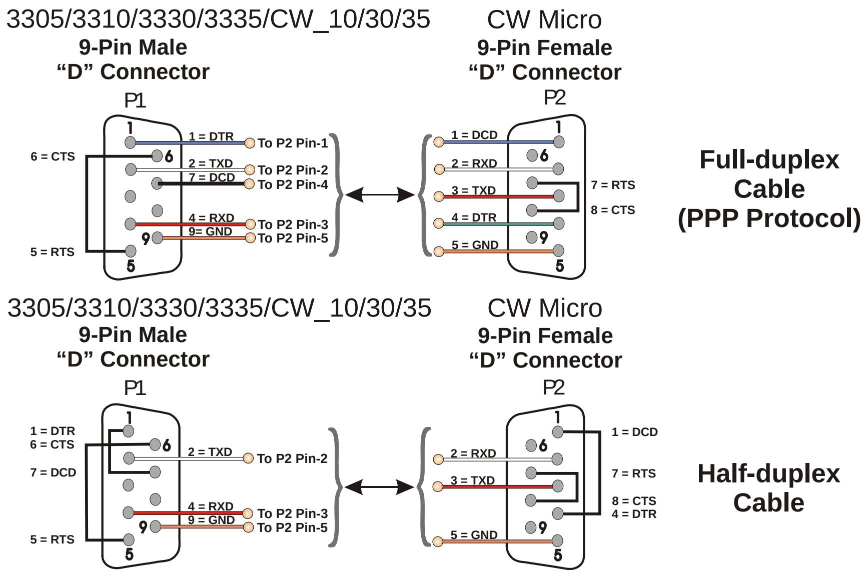


Figure 2-16. Full-duplex and Half-duplex Cable

When interfacing to the COM3 port of a ControlWave, or the COM5 or COM6 port a ControlWaveEXP unit, use the cable presented in *Figure 2-17* along with the cable shown in *Figure 2-15* or *Figure 2-16*.

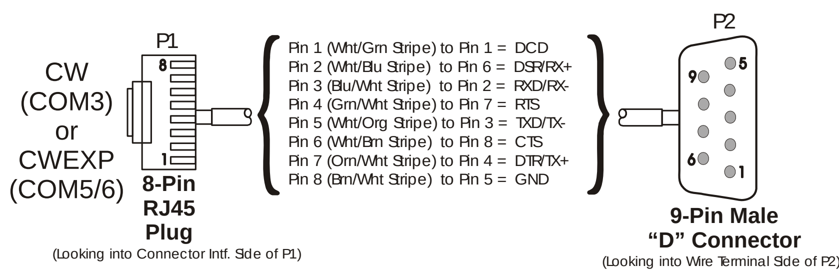


Figure 2-17. Full-duplex and Half-duplex Cable

RS-232 Cable Guidelines

Observe the following guidelines when constructing RS-232 communication cables:

- Ensure that DCD is high to transmit (except when dialing a modem)
- Verify that each RS-232 transceiver has one active receiver while disabled (in power down mode); connect the DCD signal to the active receiver.
- Set CTS to high to transmit.
- If the port is set for full-duplex operation, RTS is always ON.
- Ensure that DTR is always high when port is active; DTR enables RS-232 transceivers.

Note: Control DTR using the PORTCONTROL function block and the _P*n*_AUTO_DTR system variable in your ControlWave project. If you turn DTR off through these mechanisms, the port remains off, even though hardware is fully configured.

- When port is set for half-duplex operation, CTS must go low after RTS goes low.

- All RS-232 comm ports support RTS, DTR, CTS, DCD, and DSR control signals.
- All RS-232 comm port I/O signals are protected by surge protectors.

2.4.4 Connections to RS-485 Serial Port(s) on CPU or ECOM Modules

The RS-485 port supports local network communications to multiple nodes up to 4000 feet away.

Your CPU module includes one RS-485 port.

If you require additional RS-485 ports, you can purchase an optional expansion communication module that includes one or two RS-485 ports. The ControlWave Micro Distributed I/O System can support up to two expansion communication modules, for a total of up to four additional RS-485 ports beyond the one on the CPU module. Expansion communication modules reside in slot #3 and slot #4.

RS-485 COM Port Names and Connectors

RS-485 COM ports are assigned names based on their location in the ControlWave Micro Distributed I/O System.

- The CPU module's RS-485 port is COM3.
- If you have a Type 1 ECOM module in slot #3, its RS-485 port is COM5. If you have a Type 1 ECOM module in slot #4, its RS-485 port is COM9.
- If you have a Type 2 ECOM module in slot #3, its RS-485 ports are COM6 and COM7. If you have a Type 2 ECOM module in slot #4, its RS-485 ports are COM10 and COM11.

Table 2-8 provides the connector assignments for CPU port COM3; *Table 2-9* shows the assignments for ECOM1 port COM5/9; and *Table 2-10* shows assignments for ECOM2 ports COM6/10 and 7/11.

Table 2-8. RS-485 Connectors on CPU

Connector	Name	# Pins	Function	Notes
J5	COM3	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-13* and *Table 2-11.*

Table 2-9. RS-485 Connectors on Type 1 Expansion Communications Modules

Connector	Name	# Pins	Function	Notes
J5	COM5 (when in slot 3) COM9 (when in slot 4)	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-21* & *Table 2-11*

Table 2-10. RS-485 Connectors on Type 2 Expansion Communications Modules

Connector	Name	# Pins	Function	Notes
J6	COM6 (when in slot 3) COM10 (when in slot 4)	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-22* & *Table 2-11*
J7	COM7 (when in slot 3) COM11 (when in slot 4)	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-22* & *Table 2-11*

RS-485 COM Port Cables

Figure 2-14 illustrates the CPU module's male 9-pin D-type connector. Use the content provided in *Table 2-11* to determine pin assignments for the COM3 port on the CPU, and COM5/9, COM6/10, and COM7/11 expansion communication ports.

Table 2-11. RS-485 Port Connector Pin Assignment

Pin	RS-485 Signal	RS-485 Description
1		N/A
2	RXD–	Receive Data – Input
3	TXD–	Transmit Data – Output
4	TXD+	Transmit Data + Output
5	GND/ ISOGND	Ground/Isolated Ground
6	RXD+	Receive Data + Input
7		N/A
8		N/A
9		N/A

Since the RS-485 port is intended for network communications, refer to *Table 2-12* for the appropriate connections for wiring the master, first slave, and *nth* slave.

Essentially, the master and the first slave transmit and receive data on opposite lines; all slaves (from the first to the *nth*) are paralleled (daisy-chained) across the same lines. Wire the master node to one end of the RS-485 cable run using a 24-gauge paired conductor cable (such as a Belden 9843).

Note: ControlWave Micro DIOS supports **only** half-duplex RS-485 networks.

Table 2-12. RS-485 Network Connections

From Master	To First Slave	To nth Slave
TXD+	RXD+	RXD+
TXD–	RXD–	RXD–
RXD+	TXD+	TXD+
RXD–	TXD–	TXD–
GND/ISOGND	GND/ISOGND	GND/ISOGND

To ensure that the "Receive Data" lines are in a proper state during inactive transmission periods, you must maintain certain bias voltage levels at the master and most distant slave units (end nodes). These end nodes also require the insertion of 100Ω terminating resistors to properly balance the network.

You must also configure switches at each node to establish proper network performance. Accomplish this by configuring switches listed so that the 100Ω termination resistors and biasing networks are installed at the end nodes and are removed at all other nodes on the network. You enable receiver biasing and termination (as well as 2-wire or 4-wire selection) using an 8-position DIP switch located on the CPU and ECOM modules. See *Table 2-4* in *Section 2.4.2 Setting DIP Switches on the CPU Module*s for information on RS-485 termination and loopback control switch settings.

2.4.5 Connections to Ethernet Port(s) on the CPU Module

Caution — **The RJ45 Ethernet ports are located on the CPU module. The PSSM also has one RJ45 port for the optional Display/Keypad. Never connect Ethernet to the Display/Keypad port or damage to the PSSM will result.**

ControlWave Micro Distibuted I/O Systems support one Ethernet port. It uses a 10/100Base-T RJ-45 modular connector that provides a shielded twisted pair interface to an Ethernet hub. Two LEDs provide transmit and receive status indications:

Port assignments are:

- Ethernet Port 1: CPU Bd. J6, 8-Pin RJ-45 - Shielded Twisted Pair A typical Ethernet hub provides eight 10/100Base-T RJ-45 ports (with port 8 having the capability to link either to another hub or to an Ethernet communications port). Both ends of the Ethernet twisted pair cable are equipped with modular RJ-45 connectors.

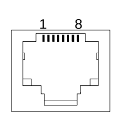


Figure 2-18. RJ-45 Ethernet Connector

These cables have a one-to-one wiring configuration as shown in *Figure 2-19*. *Table 2-13* provides the assignment and definitions of the 8-pin 10/100Base-T connectors.

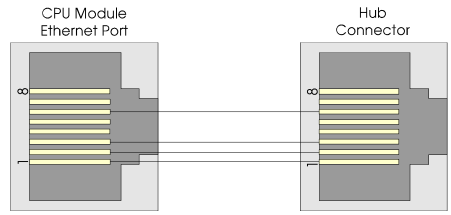


Figure 2-19. Standard 10/100Base-T Ethernet Cable (CPU Module to Hub)

Table 2-13. Ethernet 10/100Base-T CPU Module Pin Assignments

Pin	Description
1	Transmit Data+ (Output)
2	Transmit Data– (Output)
3	Receive Data+ (Input)
4	Not connected
5	Not connected
6	Receive Data– (Input)
7	Not connected
8	Not connected

Note: You can swap TX and RX at the hub.

You can connect two nodes in a point-to-point configuration without using a hub. However, you must configure the cable so that the TX+/- Data pins connect to the RX+/- Data pins (swapped) at the opposite ends of the cable (see *Figure 2-20*).

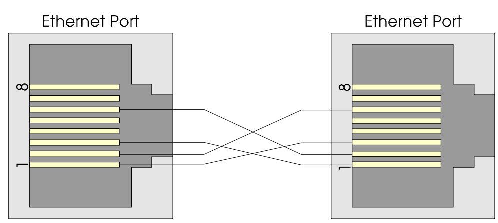


Figure 2-20. Point-to-Point 10/100Base T Ethernet Cable

The maximum length of one segment (CPU to hub) is 100 meters (328 feet). The use of Category 5 shielded cable is recommended.

2.5 Expanded Communications Module (ECOM)

ControlWave Micro Distributed I/O Systems can support up to two optional expanded communications modules (ECOMs) which you can install **only** in slots #3 or #4 (in place of I/O modules). ECOMSs **do not** have a CPU component.

Two Types of ECOM Modules

There are two types of ECOM module:

- Type 1 Expansion Communications Module (ECOM1) with one RS-232 port, one RS-485 serial port, and an optional modem port (see *Figure 2-21*)
- Type 2 Expansion Communications Module (ECOM2) with two RS-232 serial ports and two RS-485 serial ports (see *Figure 2-22*)

Identify the carton holding the ECOM module(s) and remove the module from that carton.

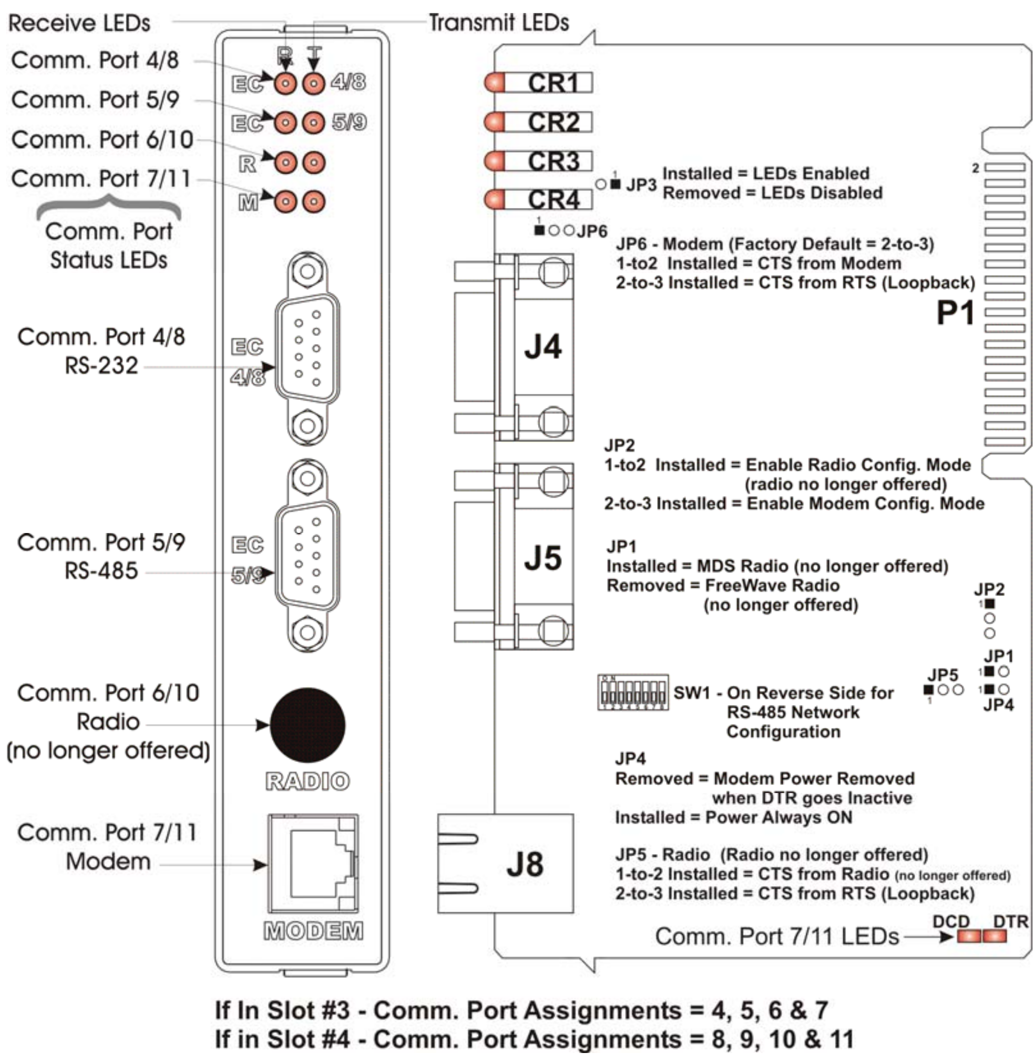
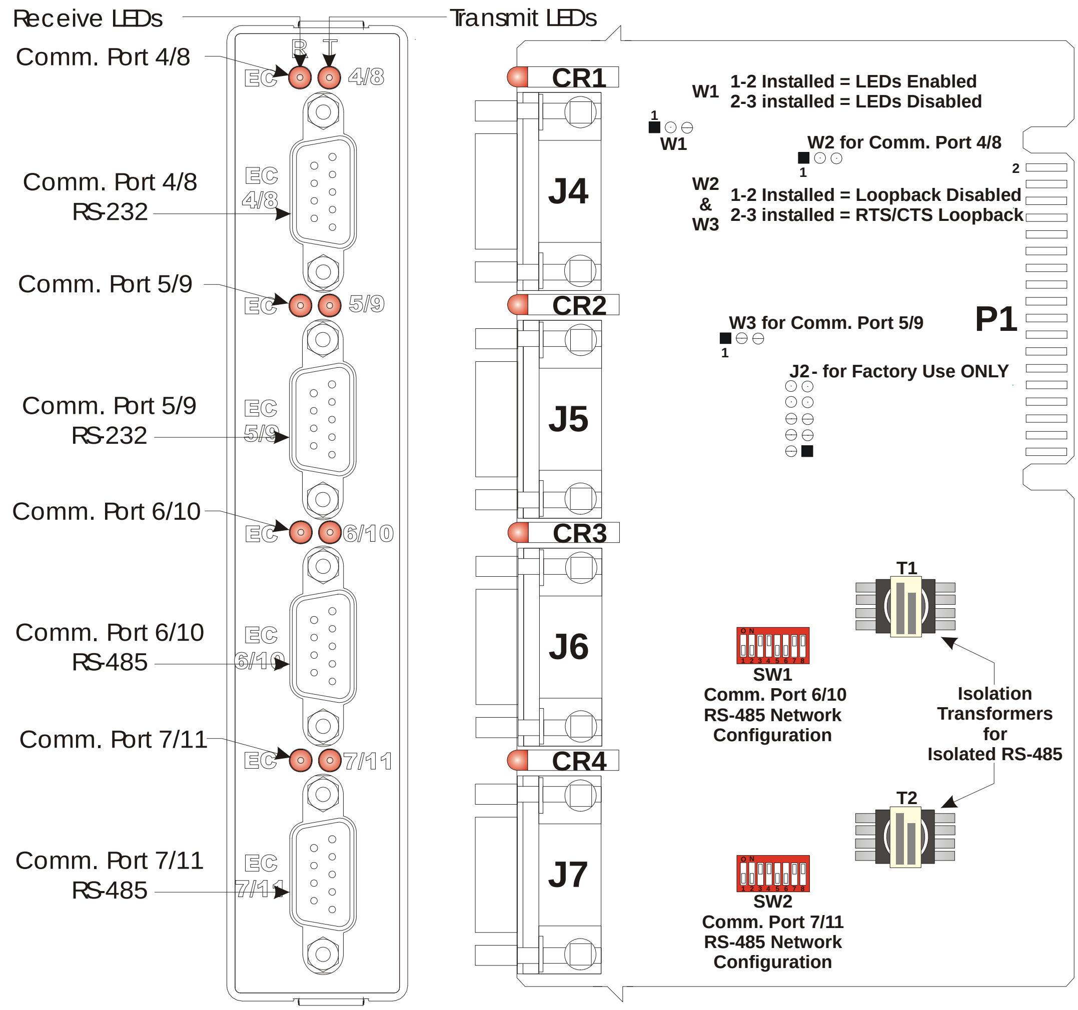


Figure 2-21. Type 1 ECOM with Two Serial Ports and a Modem



If In Slot #3 - Comm. Port Assignments = 4, 5, 6 & 7
If in Slot #4 - Comm. Port Assignments = 8, 9, 10 & 11

Figure 2-22. Type 2 ECOM with Two RS-232 and Two RS-485 Ports

Detailed Technical Specifications For detailed technical specifications, please see document CWMICRO:COM available on our website http://www.emersonprocess.com/remote.

2.5.1 RS-232 Ports

Type 1 ECOMs include one RS-232 port. Type 2 ECOMs include two RS-232 ports. For information on connecting to these ports, including cabling information, see *Section 2.4.3.*

2.5.2 RS-485 Ports

Type 1 ECOMs include one RS-485 port. Type 2 ECOMs include two RS-485 ports. For information on connecting to these ports, including cabling information, see *Section 2.4.4.*

When connecting a ControlWave Micro Distributed I/O System to an external modem, use the cable configuration in *Figure 2-23*.

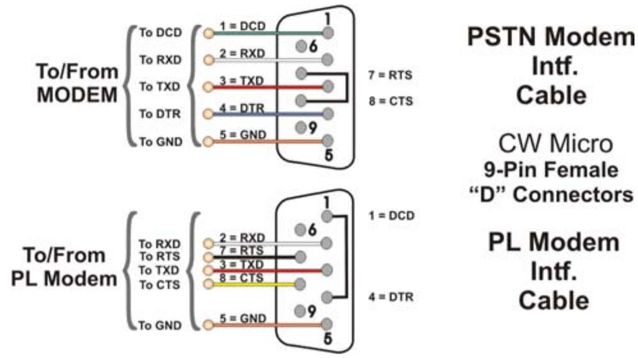


Figure 2-23. Full-duplex and Half-duplex Cable

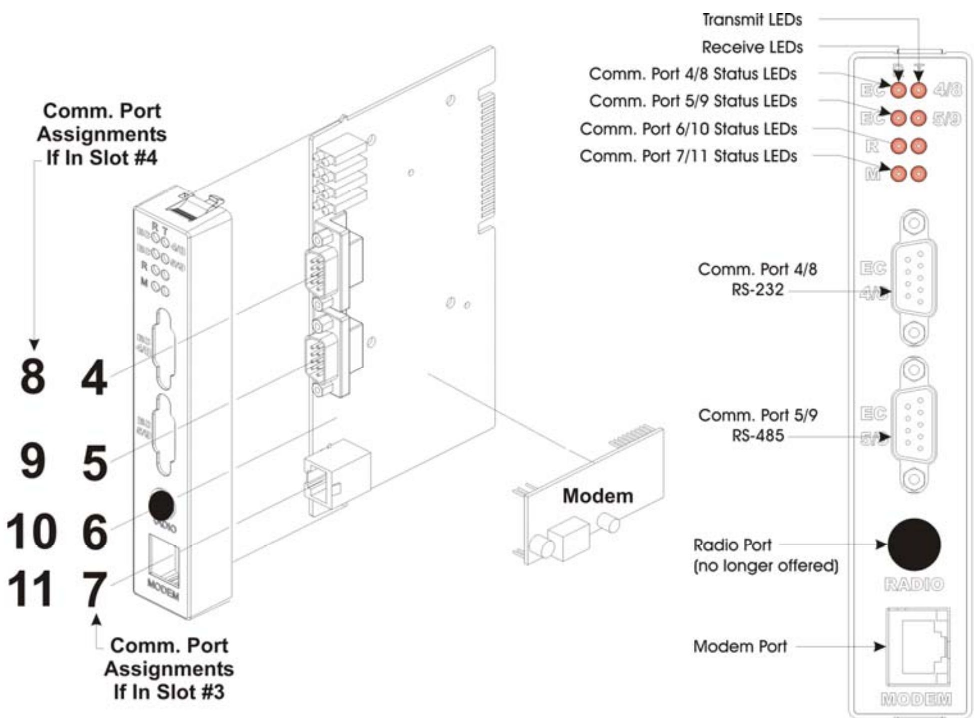


Figure 2-24. ECOM Modem Installation

2.5.3 Modem Port (Type 1 ECOM only)

You can mount an optional 56Kb PSTN Hayes-type modem on a Type 1 ECOM (see *Figure 2-24*).

The ControlWave Micro Distributed I/O System then assigns the modem COM7 (if in slot #3) or COM11 (if in slot #4).

You can configure the MultiTech model MT9234SMI modem module for publicly switched telephone network (PSTN) operation. You can also clock DTE/DCE serial data into (transmit) or out of (receive) the modem at rates up to 115.2 kHz.

The factory supplies the modem pre-installed or in kit form with all required hardware. You install it on the ECOM1 module and then use the Ports page in the Flash Configuration utility (in NetView, LocalView, or TechView) to assign ports. Configure a profile for the modem using AT commands submitted using a terminal emulation program (such as HyperTerminal). Users typically use AT commands only when checking the modem's active or stored profile or when reconfiguring a modem (to turn auto answer on or off, etc.).

Prior to shipment from the factory, the MultiTech modems are pre-configured using the following steps:

1. Connect pin Enable modem setup by setting jumper JP2 on the ECOM to 2-3.
2. Connect via HyperTerminal (Parameters = 9600, 8, N, 1, None) to ECOM port C1 using the null modem cable (see *Figure 2-15*).
3. Send Factory Default = **AT&F0**
4. Disable Flow Control = **AT&K0**
5. Set baud rate using AT Command: **AT$SB9600,** or whatever baud rate you require.
6. Write to Memory. = **AT&W**
7. Disable setup mode. Park JP2 (no connection)

Note: You can reconfigure the modem using AT commands and a terminal program (like HyperTerminal). Connect pins 2 and 3 of JP2 with a suitcase jumper, and use a null modem cable (see *Figure 2-15*) to connect the PC to the modem (COM4 or COM8).

PSTN Connections

Figure 2-25 shows a publicly switched telephone network (PSTN) using a single master and three remote ControlWave Micro Distributed I/O Systems (each equipped with a PSTN modem). This application requires only one remote connection.

Use a cable with standard telephone connectors (RJ11s) on each end. Plug one end of the cable into the RJ11 connector jack on the ECOM and the end into a RJ11 wall jack. The telephone company provides the necessary subscriber loops at its central system along with the phone numbers for each destination.

Caution: **Connect only one modem on each drop. If you attempt to parallel two or more modems across a single drop, an impedance mismatch occurs, adversely affecting the signal. Modems cannot provide reliable communications under these conditions.**

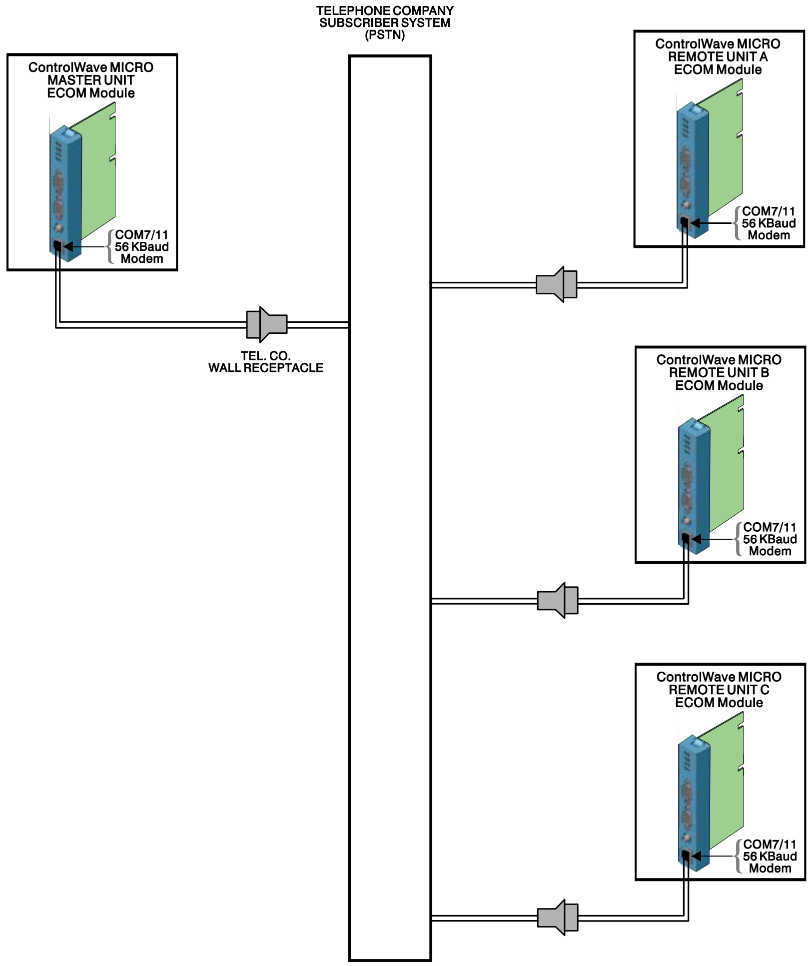


Figure 2-25. PTSN Field Connections for ControlWave Micro Distributed I/O Systems

Figure 2-26. Phone Cord Wiring

The 56K PSTN modem is FCC-approved for use with public telephone lines. However, before you place a modem in operation, check the following items to make sure you meet all FCC requirements:

- Connections to party line service are subject to state tariffs.
- Connections to telephone company-provided coin service (central office implemented systems) are prohibited.
- The equipment compliance information is summarized as follows:
  - Complies with Part 68 FCC Rules.

  - Contains device with FCC Registration Number: AU7-USA-25814-M5-E
  - Ringer Equivalence Number (REN): 0.3B

Note: The sum of all the RENs on your telephone lines should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

- Make any direct connections to PSTN lines through standard plugs and jacks as specified in the FCC rules. The PSTN line connector plugs into J1 on the modem. Notify your telephone company that the jack (connector) required for your device is one of the following:
  - USOC: RJ11C **or**
  - USOC: RJ11W

Note: The jack provided on the Modem (J1) is a 6-pin TLECO RJ-11. The connections to the modem are pin 3 PSTN-Tip, and pin 4 PSTN-Ring.

- After the telephone company has installed the above jack, connect the modem to your equipment by inserting the appropriate equipment interface RJ11 plug into the modem and wall connector.

2.6 Bezels

Bezels are blue plastic covers (see *Figure 2-27*) that protect an adjacent pair of I/O modules and provide an easy way for you to route wiring. The factory provides bezels with each order. Install bezels over I/O modules whenever the ControlWave Micro Distributed I/O System is operational; remove the bezels for maintenance procedures.

Bezels attach to the module covers of two adjacent I/O modules. Hooks on the bezels (see *Figure 2-27*) attach to notches in the upper and lower portions of the module covers. Align the hooks on the bezel with the notches on the I/O module covers and slide the bezel down. To remove the bezel, grasp its sides and gently squeeze them, and pull up and then away from the I/O modules.

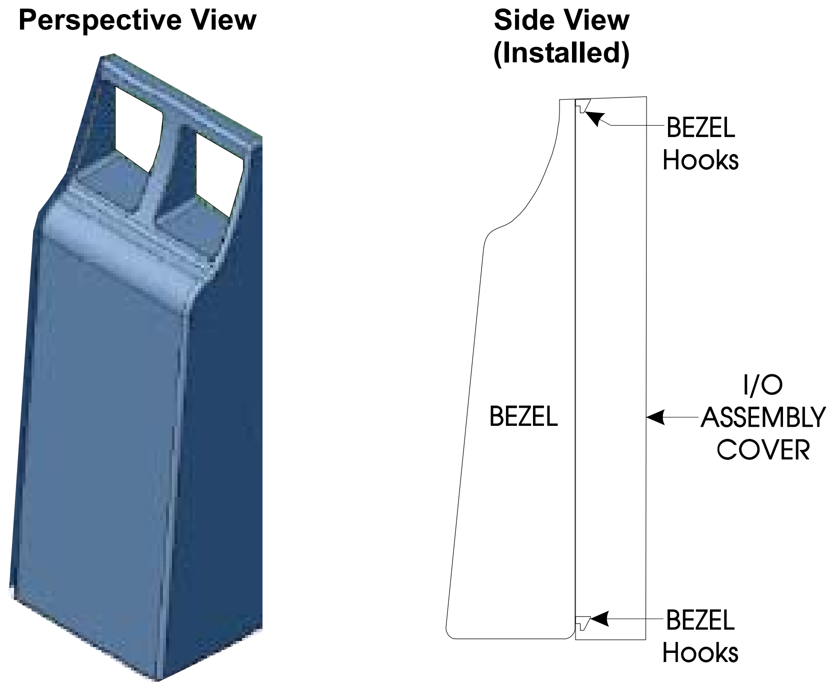


Figure 2-27. Bezel Assembly

2.7 Optional Display/Keypads

The ControlWave Micro Distributed I/O System supports two optional display/keypads:

- A 2-button keypad (shown in the left of *Figure 2-28*)
- A 25-button keypad (shown in the right *Figure 2-28*)

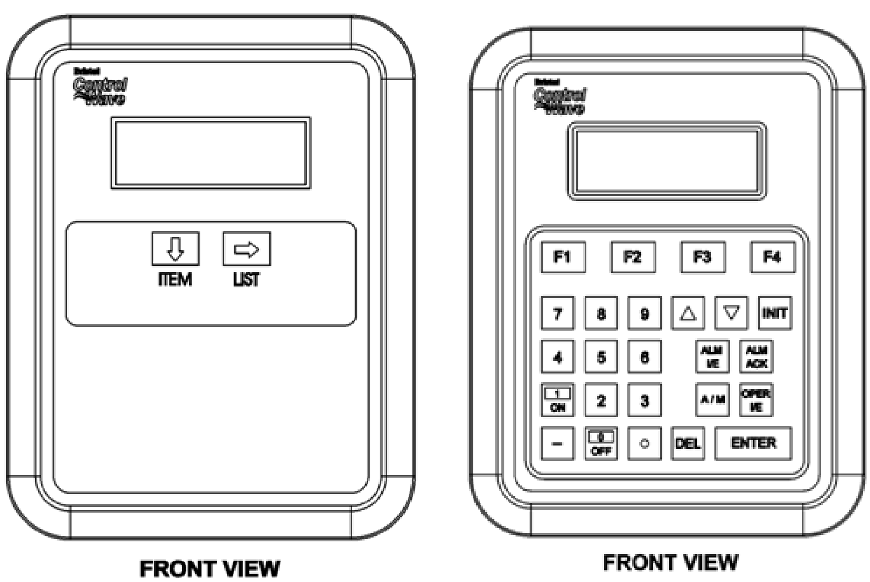


Figure 2-28. Optional 2-Button and 25-Button Keypads

Both keypads use the same 4-line by 20-character LCD displays. You connect the keypad to the ControlWave Micro Distributed I/O System using a cable, one end of which has an RJ-45 jack (connected into the RJ-45 equipped with two plugs. This cable connects between the RJ-45 display jack (J1) on the PSSM Board and RJ-45 jack (J1) on the remote Display/Keypad assembly. A potentiometer, provided on the keypad, allows you to set the contrast of the LCD display.

Note: For further information on the installation and use of the optional keypads, refer to the *ControlWave Display/Keypad Manual (D5135)*.

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Chapter 3 – I/O Modules

This chapter discusses the placement and wiring for I/O modules for the ControlWave Micro Distributed I/O System. The chapter begins with some general instructions on module installation that are common to most I/O modules. The balance of the chapter includes specific details for configuring and wiring each type of I/O module.

In This Chapter

Installation

Installing any I/O module in the ControlWave Micro distributed I/O system involves the same basic steps:

1. Remove the I/O module and associated I/O module cover from the shipping carton.

   Note: Modules normally ship from the factory completely assembled.

2. Align the I/O module with its intended slot on the base or expansion housing and slide the module into the housing. Make sure the module snaps into the appropriate securing notches on the housing.
3. Wire and plug the local or remote cable assemblies into the appropriate module connectors.
4. After installing and wiring two I/O modules into adjacent slots in the housing, cover the modules with a protective bezel. The bezels snap on and off for maintenance.
5. Using a PC running the ControlWave Designer and OpenBSI software, configure the ControlWave project that runs in the ControlWave Micro **host** controller to accept the new I/O modules in the distributed I/O system rack and download the revised ControlWave project into the host controller.

Note: This step is beyond the scope of this manual. Refer to the *ControlWave Designer Programmer's Handbook* (D5125) for further instructions.

Caution

Power down the ControlWave Micro distributed I/O system before you install or remove any I/O module. Shut down any processes the distributed I/O system may be managing (or switch them over manually or handle with another controller). Perform any hardware configuration (wiring, jumper configuration, and installation) only when the ControlWave Micro distributed I/O system is powered down.

Before any I/O modules can become operational, you must use ControlWave Designer to configure and then download the application (project) into the ControlWave Micro host controller.

Do not install any modules in the housing until you have mounted and grounded the housing at the designated installation site.

To ensure safe use of this product, please review and follow the instructions in the following supplemental documentation:

- **Supplement Guide - ControlWave Site Considerations for Equipment Installation, Grounding, and Wiring (S1400CW)**
- **ESDS Manual – Care and Handling of PC Boards and ESD Sensitive Components (S14006)**

3.1 Module Placement

You place I/O modules in the I/O slots of the housing:

- 3-slot base housing: supports one I/O module in slot 3.
- 4-slot base housing: supports up to two I/O modules in slots 3 and 4.
- 8-slot base housing: supports up to six I/O modules in slots 3 through 8.

Note: Some modules have placement restrictions. Note these in the individual descriptions.

3.2 Wiring

With a few exceptions (noted in the module descriptions), I/O modules support either "local termination" (field wiring connected directly to the module's removable terminal blocks) or "remote termination" (field wiring connected to the remote headers under the module's cover and routed to a DIN-rail mounted terminal assembly and then to field devices).

ControlWave Micro I/O modules use compression-type terminals that accommodate up to #14 AWG wire. Insert the wire's bared end (approx. ¼" max) into the clamp beneath the screw and secure the wire. To prevent shorts, ensure that no bare wire is exposed. If using standard wire, tin the bare end with solder to prevent flattening and improve conductivity. Allow some slack in the wires when making terminal connections. Slack makes the wires more manageable and helps minimize mechanical strain on the terminal blocks.

3.2.1 Local Termination

For I/O modules equipped with local terminal blocks, install the field wiring between the I/O module's removable terminal block connectors and field devices (see *Figure 3-1*). Use AWG 14 or smaller wire (consult with the field device manufacturer for recommendations). Leave some slack and plan for wire routing, identification, and maintenance. Route the bundled wires out through the bottom of the I/O module assembly between the terminal block and the terminal housing.

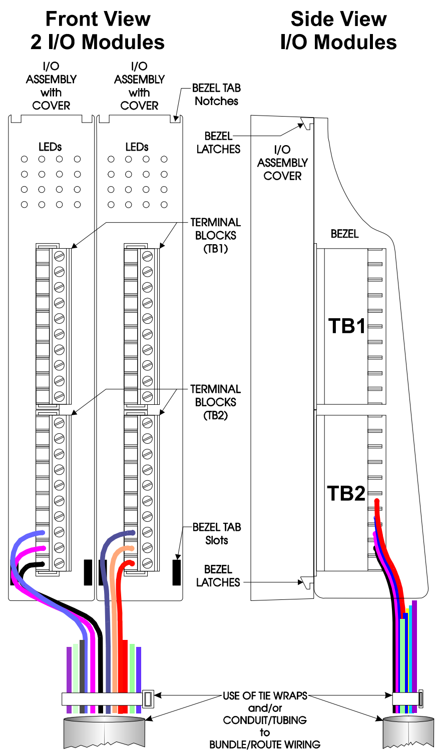


Figure 3-1. Module Wiring: Local Termination

3.2.2 Remote Termination

For I/O modules that support remote terminations, install cables between the module's remote headers and the remote DIN-rail mounted terminal block assemblies (see *Figure 3-2*). Install field wiring between the DIN-rail mounted terminal bock assembly and field devices (see the wiring diagrams associated with each I/O module description).

Use AWG 14 or smaller wire (consult with the field device manufacturer for recommendations) for remote terminations. Leave some slack and plan for wire routing, identification, and maintenance. Route the cables running between the I/O module and the DIN-rail mounted terminal blocks out through the bottom of the I/O module assembly via the bezel assembly.

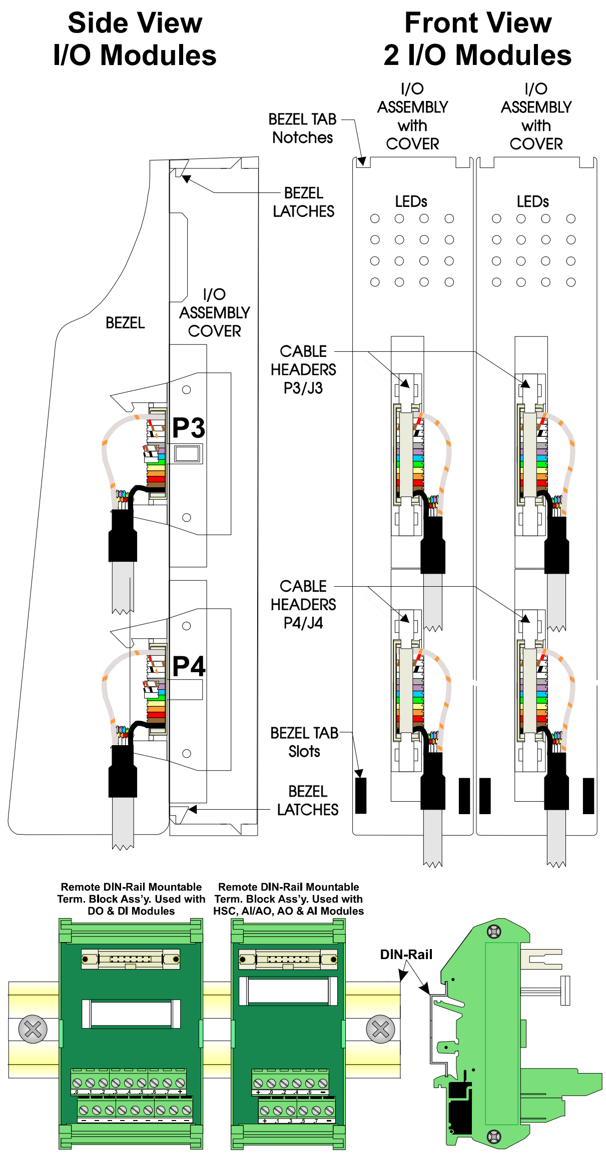


Figure 3-2. Module Wiring: Remote Termination

3.2.3 Shielding and Grounding

Use twisted-pair, shielded and insulated cable for I/O signal wiring to minimize signal errors caused by electromagnetic interference (EMI), radio frequency interference (RFI), and transients. When using shielded cable, ground all shields at only one point in the appropriate system. This prevents circulating ground current loops that can cause signal errors.

3.3 Isolated Digital Input (DI) Module

Isolated DI modules provide 16 isolated digital inputs. For 24V DI modules you can individually configure inputs for either externally sourced inputs or internally powered (dry contact) applications.

Table 3-1. Isolated DI Module General Characteristics

Type	Number Supported	Characteristics
Digital Inputs (DI)	16	Each DI supports/ includes: ▪ Nominal input voltage of 12V or 24Vdc ▪ Nominal input current of 5 mA ▪ 30 ms input filtering ▪ Dedicated LED on module turns ON when DI is ON. (not available on all module versions)

A DI module consists of an isolated digital input printed circuit board (PCB) with either two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination). Each DI module also includes 19 configuration jumpers and a module cover. The DI PCB connects to the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

Isolated Digital Input (DI) modules (general part number **396571-XX-X**) come in different configurations. See *Table 3-2* to see the variations.

Table 3-2. Isolated DI Module Configurations

Part Number	Termination Connector	Notes
396571-02-6	24V local	Includes LED daughterboard.
396571-04-2:	24V remote	Includes LED daughterboard.
396571-07-7	12V local	**Does NOT support internal power source.** Includes LED daughterboard.

Figure 3-3, Figure 3-4, and *Figure 3-5* show wiring for the DI module.

Isolation

Surge suppressors and optocouplers electrically isolate the DI field circuitry from the module's bus interface circuitry. 24V input modules configured for use in dry contact applications contain a +21 Vdc isolated power supply powered by the output of the +VIN power source originating on the Power Supply/Sequencer module (PSSM).

Setting Jumpers

Set configuration jumpers W1 through W19 according to *Table 3-3*. Use jumper W19 (see *Figure 3-3*) to enable or disable the +21 Vdc field power supply.

Note: Jumpers W1 through W12 and W15 through W19 only apply to 24V DI Modules.

Table 3-3. Jumper Assignments: Isolated DI Module

Jumper	Purpose	Description
WI	Configures DI1	Pins 2-3 & 4-5 installed = External Power DI Pins 1-2 & 3-4 installed = Internal Source DI
W2-W12	Configures DI2 through DI12 (respectively)	Same as W1
W13	Enables LEDs	Pins 1-2 installed = allows hardware to enable LEDs Pins 2-3 installed = allows software to enable LEDs
W14	Programs Serial EEPROM	**Reserved for factory use only**
W15	Configures DI13	Same as W1
W16	Configures DI14	Same as W1
W17	Configures DI15	Same as W1
W18	Configures DI16	Same as W1
W19[1]	Enables VIN	Pins 1-2 enable VIN Pins 2-3 disable VIN

1 You must install a jumper on pins 1-2 of W19 to configure **any** DI for internally sourced operation.

Wiring the Module

Figure 3-3 shows field wiring assignments associated with locally terminated DI modules; *Figure 3-4* shows field wiring assignments associated with remotely terminated DI modules. *Figure 3-5* shows an optional remote termination module with built-in discrete relay module that supports input from 120 Vac DIs. The special remote termination module (with built-in discrete relay module) interfaces with an externally sourced DI module.

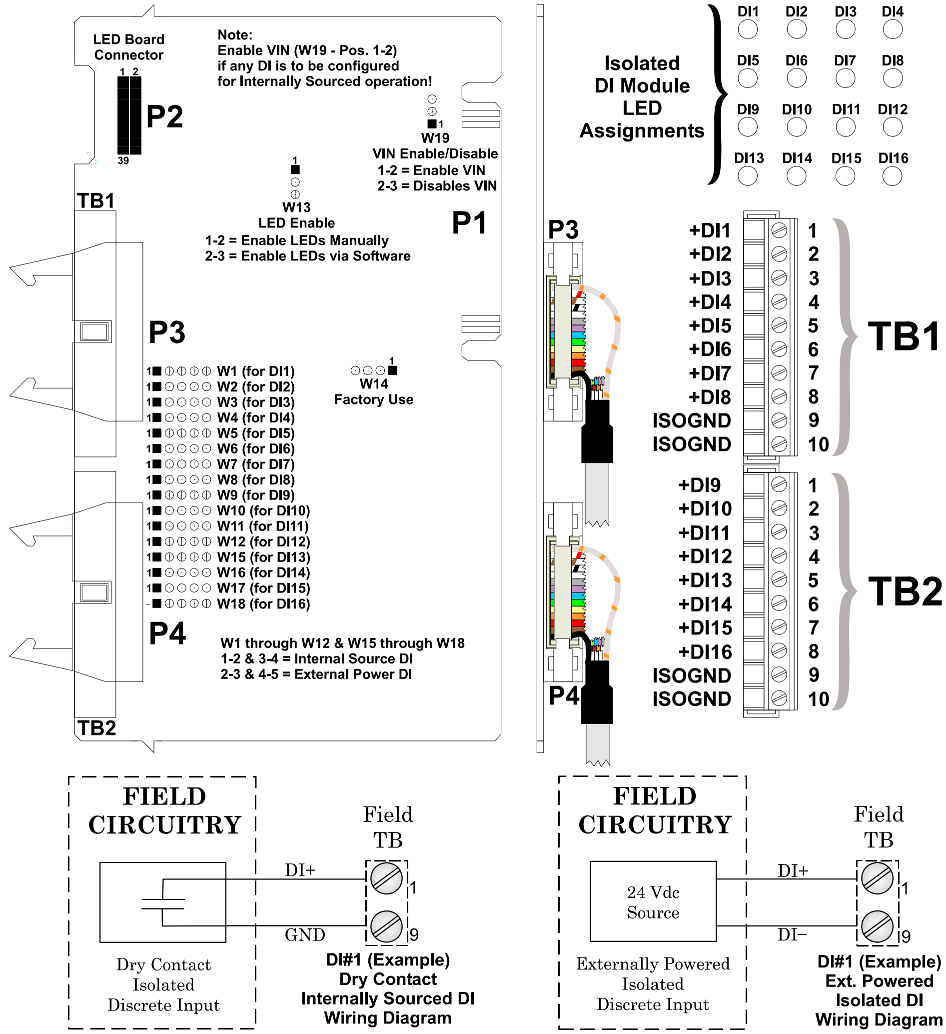


Figure 3-3. Isolated DI Module (Local Termination)

Figure 3-4 shows the wiring assignments associated with a DIN-rail mounted terminal block assembly for a DI module associated with either internally sourced or externally powered operation. *Figure 3-5* shows the wiring assignments associated with a DIN-rail mounted terminal block assembly for a DI module associated with relay isolated 120 Vac operation.

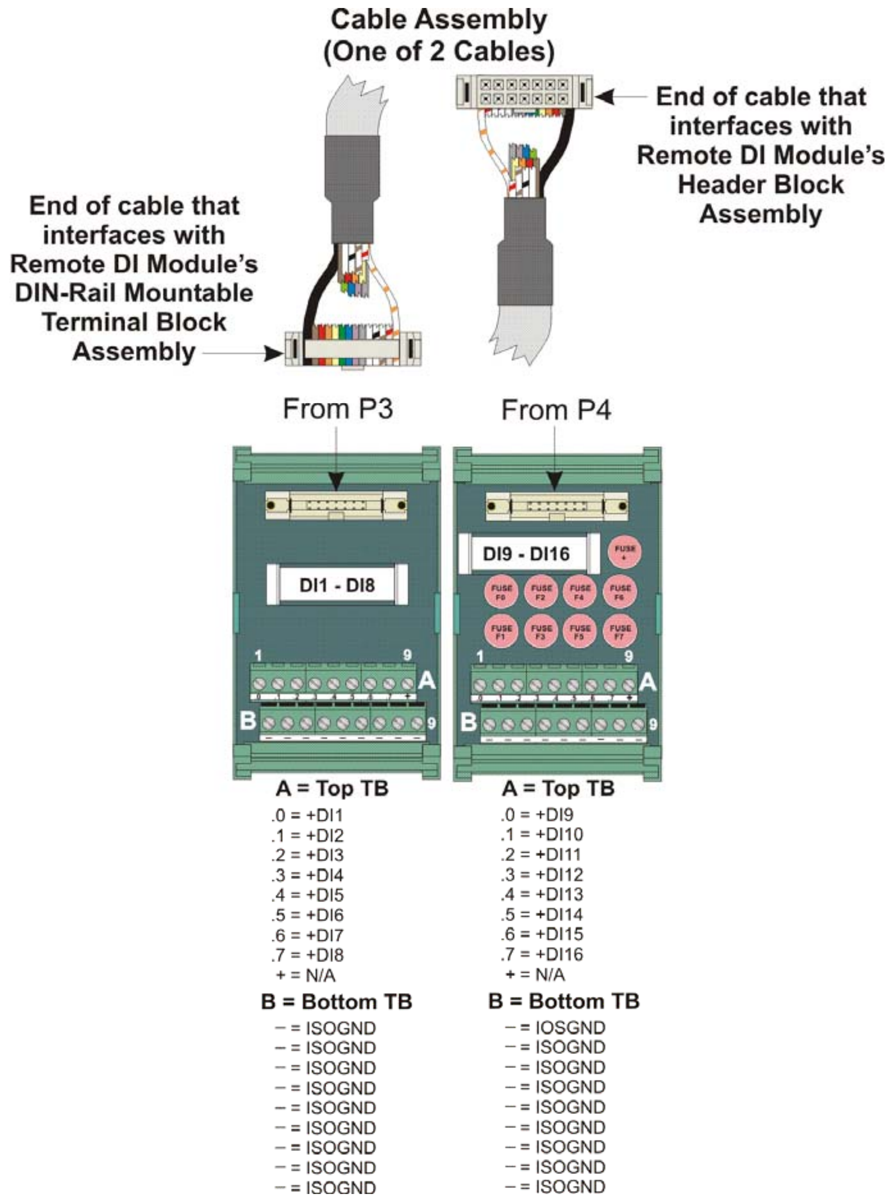


Figure 3-4. Isolated DI Module (Remote Termination, Internally Sourced or Externally Powered)

Note: Fuses F0 to F7 are 1/8 A; F+ is a 2A fuse.

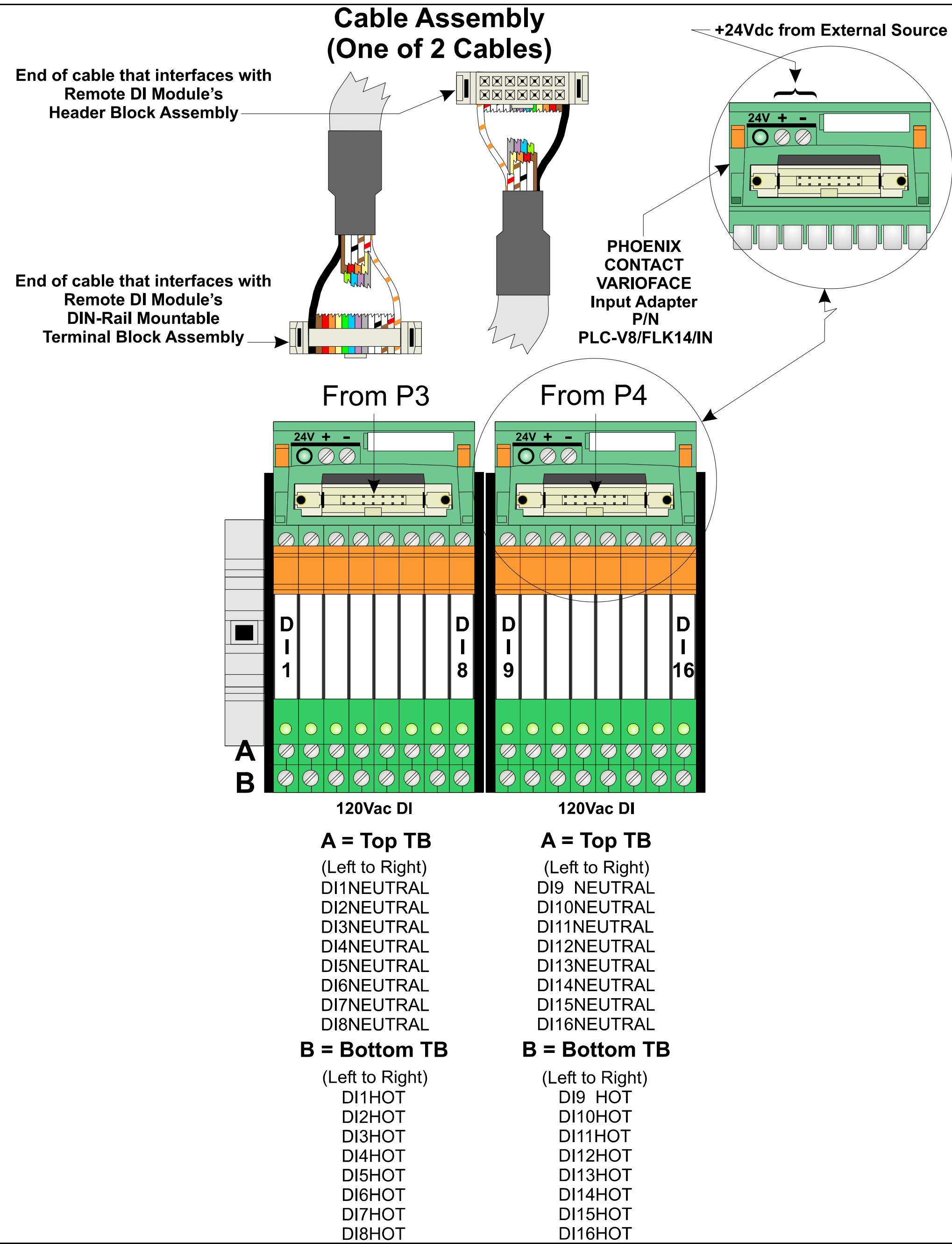


Figure 3-5. Isolated DI Module (Remote Termination, Internally Sourced or Externally Powered with and without Fuses)

Software Configuration

To use data from an isolated DI module you must add an **ERM_DI16** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.4 Isolated Digital Output (DO) Module

Isolated DO modules provide 16 DOs to control signaling functions.

DO modules consist of a DO PCB with either two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination). DO modules also include two configuration jumpers, an LED board with 16 status LEDs (one for each point), and a cover assembly. The DO PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-4. Isolated DO Module General Characteristics

Type	Number Supported	Characteristics
Digital Outputs (DO)	16	Each DO supports/ includes: ▪ Optically isolated open source MOSFET with surge suppression that is capable of handling 500mA at 30V. ▪ Dedicated LED on module turns ON when DO is ON.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The isolated Digital Output (DO) module (general part number **396572-XX-X**) comes in two possible configurations, see *Table 3-5*:

Table 3-5. Isolated DO Module Configurations

Part Number	Termination Connector	Notes
396572-02-2	local	Includes LED daughterboard.
396572-04-9	remote	Includes LED daughterboard.

Isolation

Surge suppressors and optocouplers electrically isolate the DO field circuitry MOSFETs from the module's bus interface circuitry.

DO modules provide a total of 16 DOs with surge protection. Each DO uses an open source MOSFET that is capable of driving up to 31Vdc at up to 500mA. A 500Vdc MOV to chassis and a 31Vdc MOV (across output) are provided to protect each DO. The maximum operating frequency is 20 Hz.

Outputs set OFF on Power-up

An on-board DO load register stores output data. At power-up the load register clears and sets all outputs to "off."

Setting Jumpers

DO modules contain two configuration jumpers (W1 and W2), which function as follows:

Table 3-6. Jumper Assignments: Isolated DO Module

Jumper	Purpose	Description
WI	Configures DI1	Pins 1-2 installed = Manually enables status LEDs Pins 2-3 installed = Software enables status LEDs See *Figure 3-6* for the location of this jumper.
W2	Programs serial EEPROM	**Reserved for factory use only**

Wiring the Module

Figure 3-6 shows field wiring assignments associated with a locally terminated DO module; *Figure 3-7* shows field wiring assignments associated with remotely terminated DO modules. *Figure 3-8* shows a remote termination module with built-in discrete relay modules.

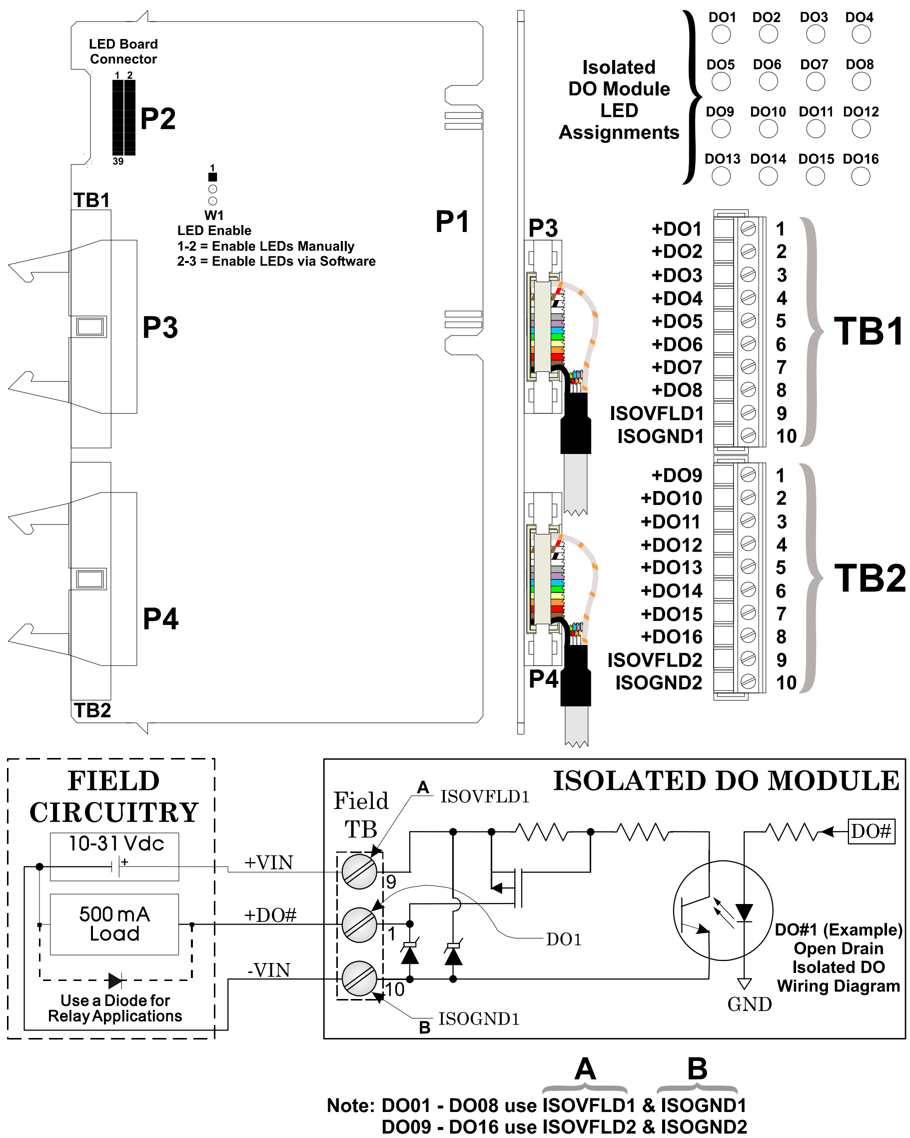


Figure 3-6. Isolated DO Module (Local Termination)

Figure 3-7 shows the terminal block assignments for a remotely terminated DIN-rail mounted open source isolated DO module. *Figure 3-8* shows the terminal block assignments for a remotely terminated DIN-rail mounted relay isolated 24 Vdc DO module.

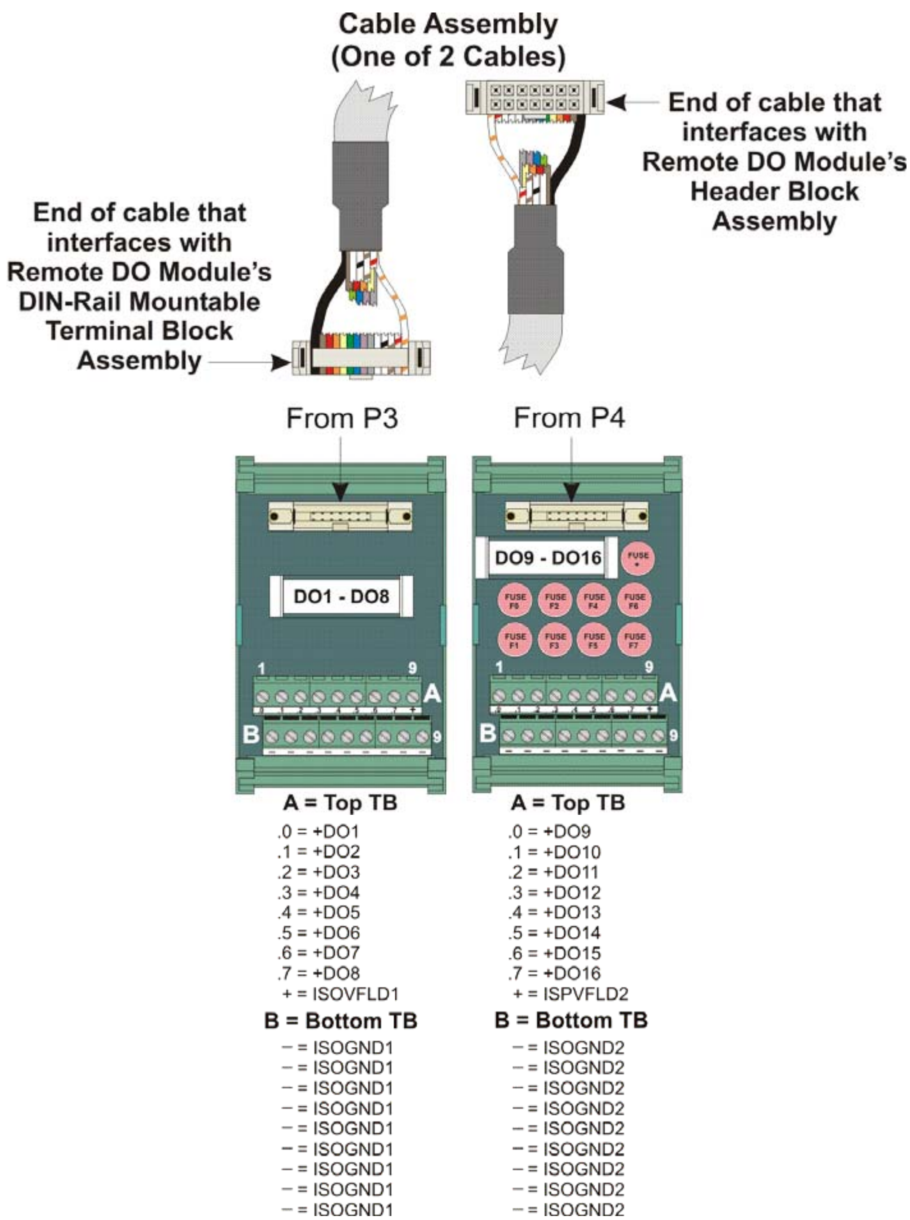


Figure 3-7. Isolated DO Module (Remote Termination)

Note: Fuses F0 to F7 are 1/8 A; F+ is a 2A fuse.

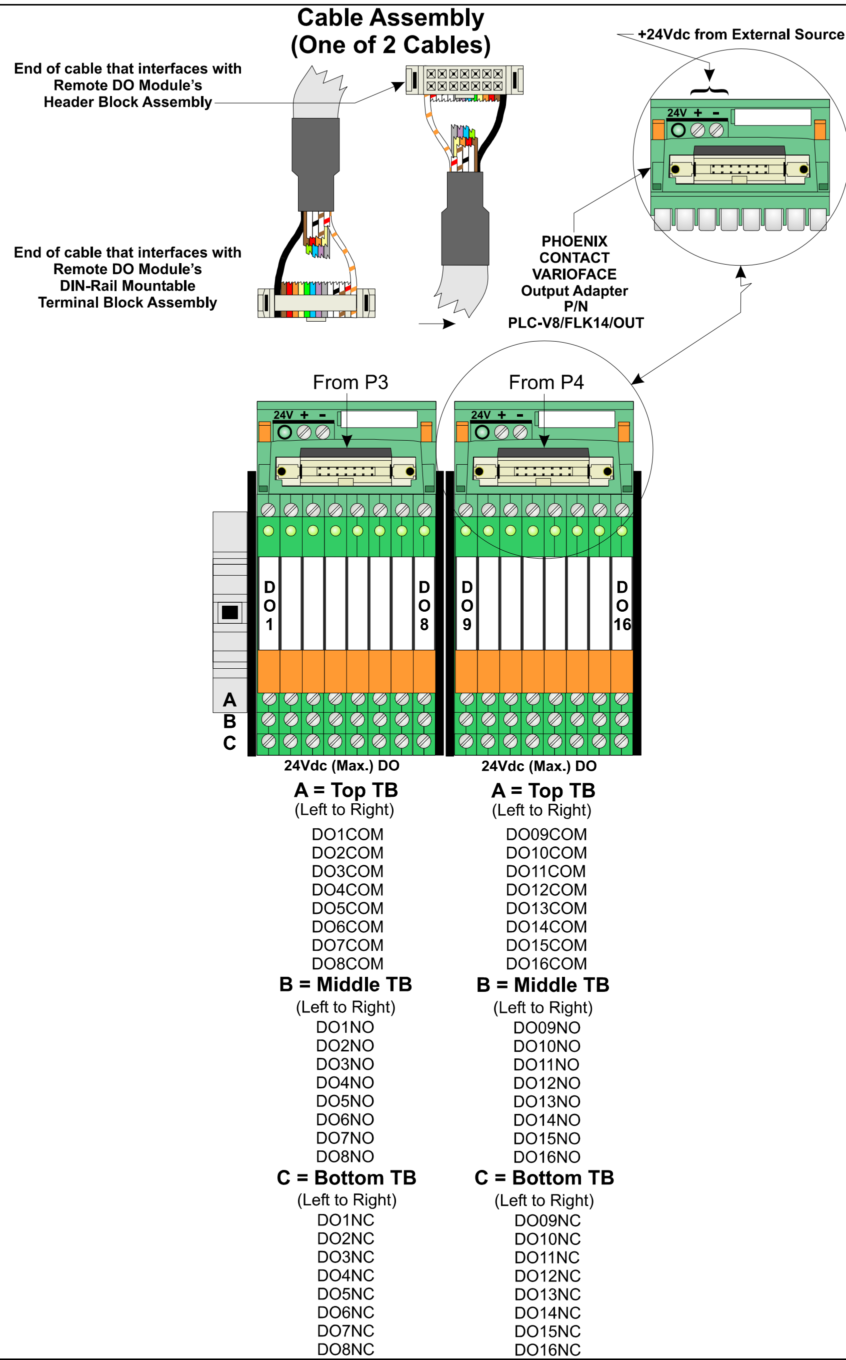


Figure 3-8. Isolated DO Module (Remote Termination with Relay Isolated with 24 Vdc)

Software Configuration

To use data from an isolated DO module you must add an **ERM_DO16** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.5 Non-isolated Digital Input/Output (DI/O) Module

Non-isolated DI/O modules consist of a digital input/output PCB with either two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination). The DI/O module also includes 14 configuration jumpers, an LED board with 16 status LEDs (one for each point), and a cover assembly. The DI/O module connects with the backplane using a 36-pin gold-plated card-edge connector.

Non-isolated DI/O modules contain field interface circuitry for up to 12 digital inputs and four digital outputs.

Table 3-7. Non-Isolated DI/DO Module General Characteristics

Type	Number Supported	Characteristics
Digital Inputs (DI)	12	Each DI supports/ includes: ▪ Internally sourced DI operation for dry contacts pulled internally to 3.3Vdc when field input is open. ▪ Surge suppressor ▪ Signal conditioning ▪ Filter time of 15 ms ▪ Jumper to configure source current for either 2 mA or 60 uA ▪ Dedicated LED on module turns ON when DI is ON.
Digital Outputs (DO)	4	Each DO supports/ includes: ▪ Open drain MOSFET provides 100mA at 30Vdc to an externally powered device. ▪ Surge suppressor ▪ Current sink to ground of DI/DO module ▪ Dedicated LED on module turns ON when DO is ON.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The non-isolated DI/O module (general part number **396567-XX-X**) comes in several different configurations. See *Table 3-8.*

Table 3-8. Non-Isolated DI/O Module Configurations

Part Number	Termination Connector	Notes
396567-02-9	local	Includes LED daughterboard.

Part Number	Termination Connector	Notes
396567-04-5:	remote	Includes LED daughterboard.

Setting Jumpers

DI/O modules provide 12 individually field configurable DIs and 4 non-configurable externally powered DOs.

Using configuration jumpers W1 through W12, you can set each DI individually to provide either a 2 mA or 60 uA source current. *Table 3-9* details jumper settings.

Table 3-9. Jumper Assignments: Non-isolated DI/O Module

Jumper	Purpose	Description
W1-W12	Configures DI1 through DI12 (respectively)	Pins 1-2 installed = 2mA Source Current Pins 2-3 installed = 60uA Source Current
W13	Enables LEDs	Pins 1-2 installed = allows manual enabling of LEDs Pins 2-3 installed = allows software enabling of LEDs
W14	Programs Serial EEPROM	**Reserved for factory use only**

Wiring the Module

Figure 3-9 shows the terminal block assignments for a locally terminated DI/O module. *Figure 3-10* shows the terminal block assignments for a DIN-rail mounted remotely terminated DI/O module.

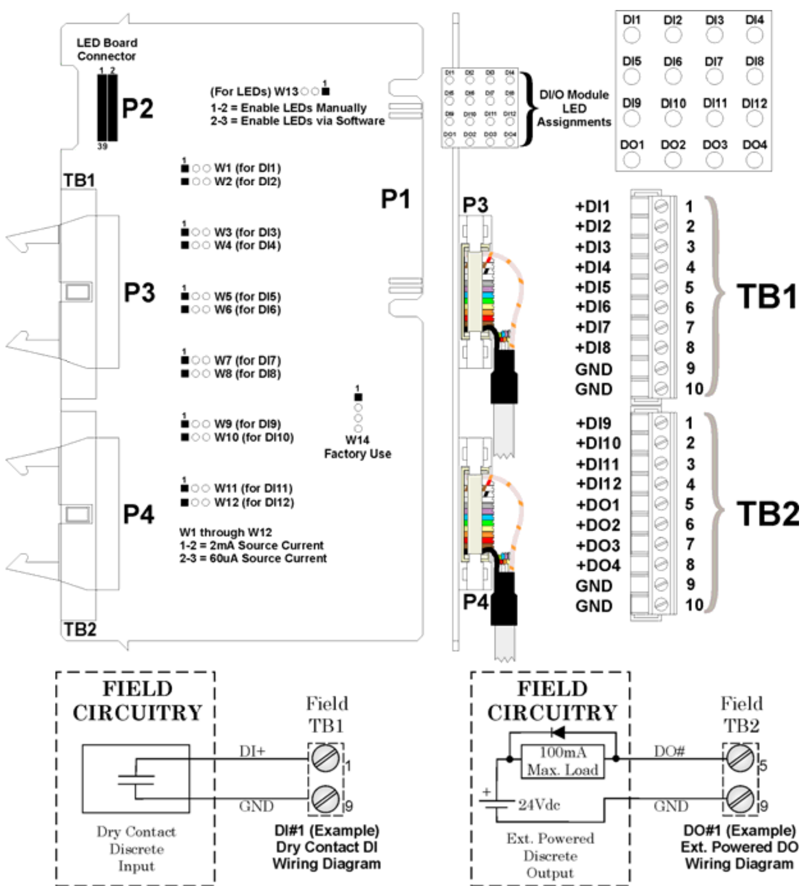


Figure 3-9. Non-isolated DI/O Module (Local Termination)

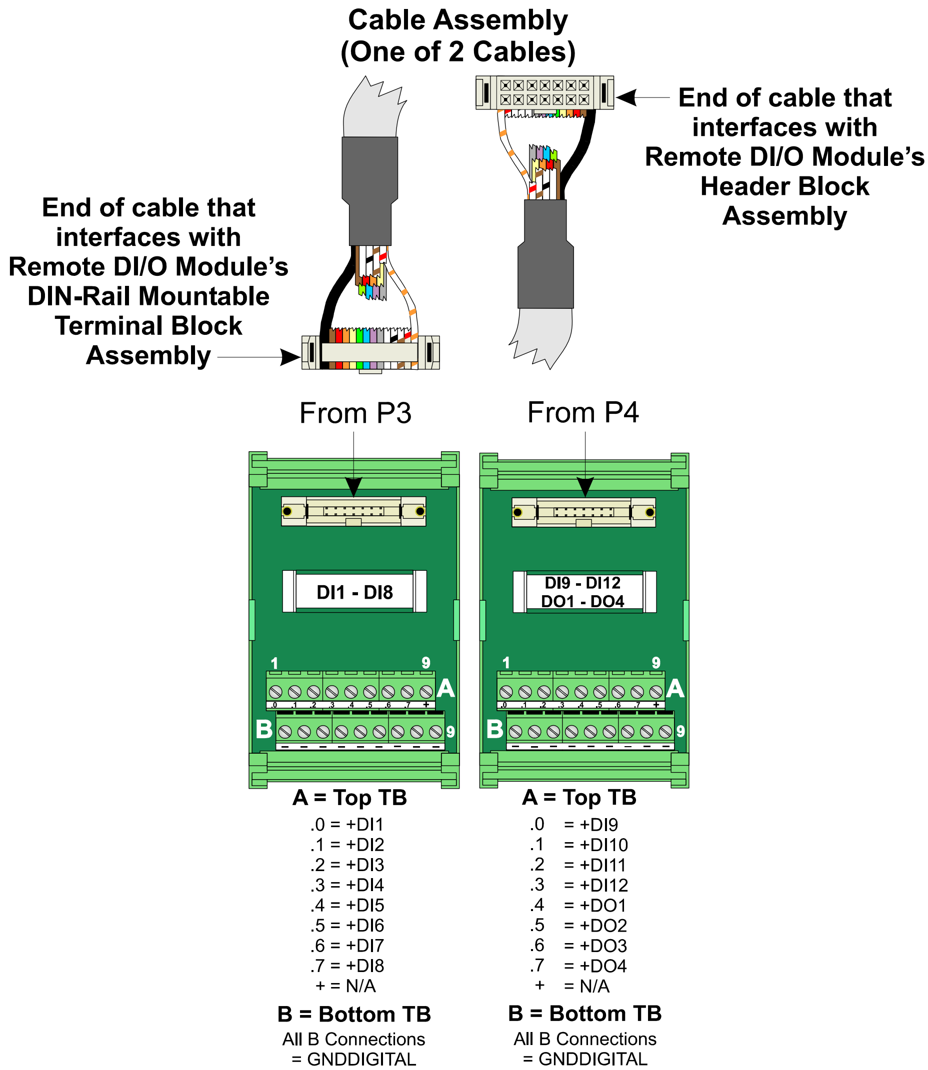


Figure 3-10. Non-isolated DI/O Module (Remote Termination)

Software Configuration

To use data from a non-isolated DI/O module you must add an **ERM_MD** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.6 Non-isolated Analog Input/Output & Analog Input Module

Non-isolated Analog Input/Output (AI/O) modules support six externally sourced 4–20mA or 1–5 Vdc single-ended analog inputs and optionally, two independently configurable 4–20 mA or 1–5 Vdc analog outputs. **Non-isolated Analog Input (AI) modules are identical to AI/O modules but have a depopulated AO section.**

AI/O modules consist of an AI/O PCB with two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination), 12 configuration jumpers, and a cover assembly. The AI/O module connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-10. Non-Isolated AI/O and AI Module General Characteristics

Type	Number Supported	Characteristics
Analog Inputs (AI)	6 on AI/O Module 6 on AI Module	Each AI supports/includes: ▪ Jumper to configure input for either 4–20mA or 1–5 Vdc ▪ Signal conditioning that provides 2 Hz low pass filter ▪ Transorb for surge suppression ▪ Analog to Digital converter
Analog Outputs (AO)	2 on AI/O Module None on AI Module	Each AO supports/includes: ▪ Jumper to configure output for either 4–20mA or 1–5 Vdc ▪ maximum external load to the 4–20mA output of either 250 ohms with an external 11V power source or 650 ohms with an external 24V power source. ▪ maximum external load current to the 1–5 Vdc output is 5 mA with an external 11-30 V power source. ▪ AO operation requires an 11–30Vdc power source connected to the VEXT terminal of the AI/O module.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

Each non-isolated **AI/O** module (general part number **396568-XX-X**) consists of a PCB with six AIs, 2 AOs, and comes with a module cover. There are two configurations:

Table 3-11. Non-Isolated AI/O Module Configurations

Part Number	Termination Connector	Notes
396568-01-7:	local	
396568-02-5:	remote	

Each non-isolated **AI** module (general part number **396569-XX-X**) consists of a PCB with six AIs and comes with a module cover. There are two configurations:

Table 3-12. Non-Isolated AI Module Configurations

Part Number	Termination Connector	Notes
396569-01-3:	local	
396569-02-1:	remote	

Cable Shields

Connect cable shields associated with AI wiring to the ControlWave Micro's housing ground. Multiple shield terminations require that you supply a copper ground bus (up to a #4 AWG wire size) and connect it to the housing's ground lug.

This ground bus must accommodate a connection to a known good earth ground (in lieu of a direct connection from the ground lug) and to all AI cable shields. Shield wires should use an appropriate terminal lug. Secure them to the copper bus using industry rugged hardware (screw/bolt, lock washer, and nuts).

Setting Jumpers

AI/O and AI modules have jumpers you can use to configure each of the six AIs. You can individually configure AIs for 1–5 Vdc or 4–20 mA operation. See *Table 3-13*.

Table 3-13. Jumper Assignments: Non-isolated AI/O and AI Module

Jumper	Purpose	Description
JP1-JP6	Configures AI1 through AI6 (respectively)	Pins 1-2 installed = 4-20 mA AI Pins 2-3 installed = 1-5 V AI
JP7[1]	AO1 Field Output	Pins 1-2 installed = 4-20 mA AO Pins 2-3 installed = 1-5 V AO
JP8[1]	AO2 Field Output	Pins 1-2 installed = 4-20 mA AO Pins 2-3 installed = 1-5 V AO
JP9[1]	AO1 Calibration Test	Pins 1-2 installed = 1-5 V AO Pins 2-3 installed = 4-20 mA AO
JP10[1]	AO2 Calibration Test	Pins 1-2 installed = 1-5 V AO Pins 2-3 installed = 4-20 mA AO
JP1	Configures ISP Connector	**Reserved for factory use only**
W1	Programs Serial EEPROM	**Reserved for factory use only**

1 Configuration for JP7 and JP9 must match (that is, both 1-5 V or 4-20mA)
Configuration for JP8 and JP10 must match (that is, both -5 V or 4-20mA)

Wiring the Module *Figure 3-11* shows field wiring assignments associated with the locally terminated AI/O and AI modules. *Figure 3-12* shows field wiring assignments associated with remotely terminated AI/O and AI modules.

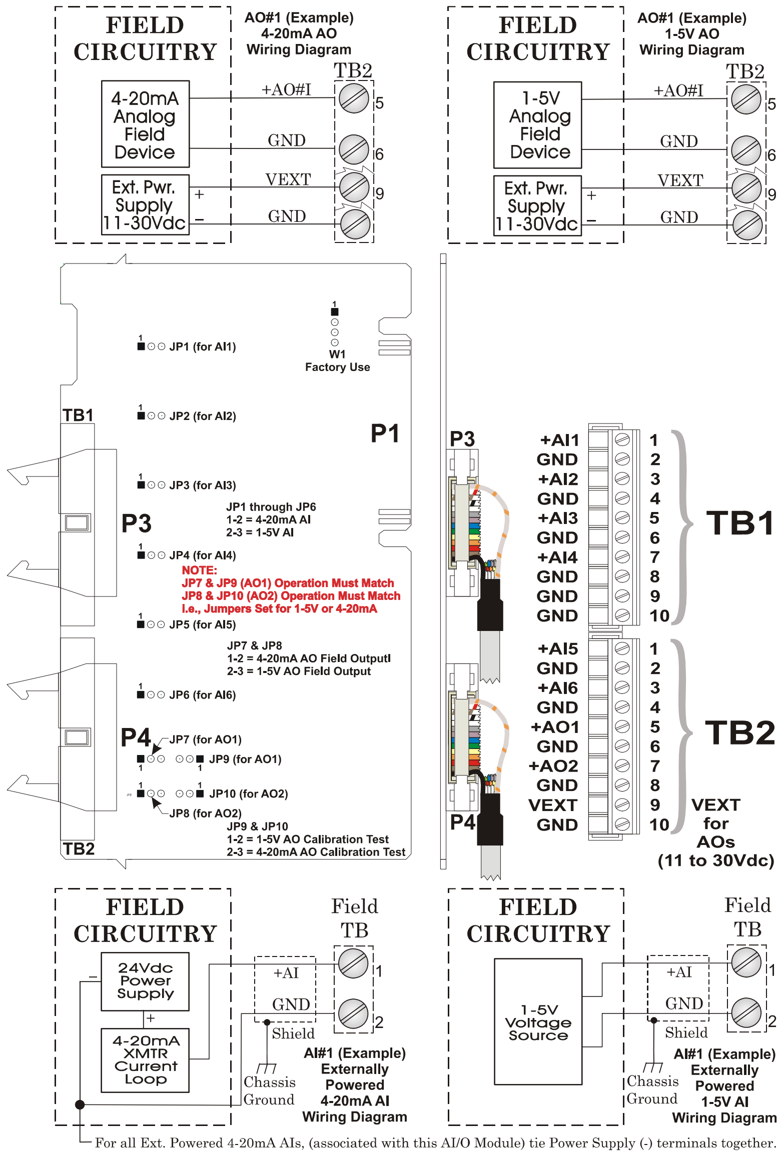


Figure 3-11. Non-isolated AI/O and AI Module Configuration (Local Termination)

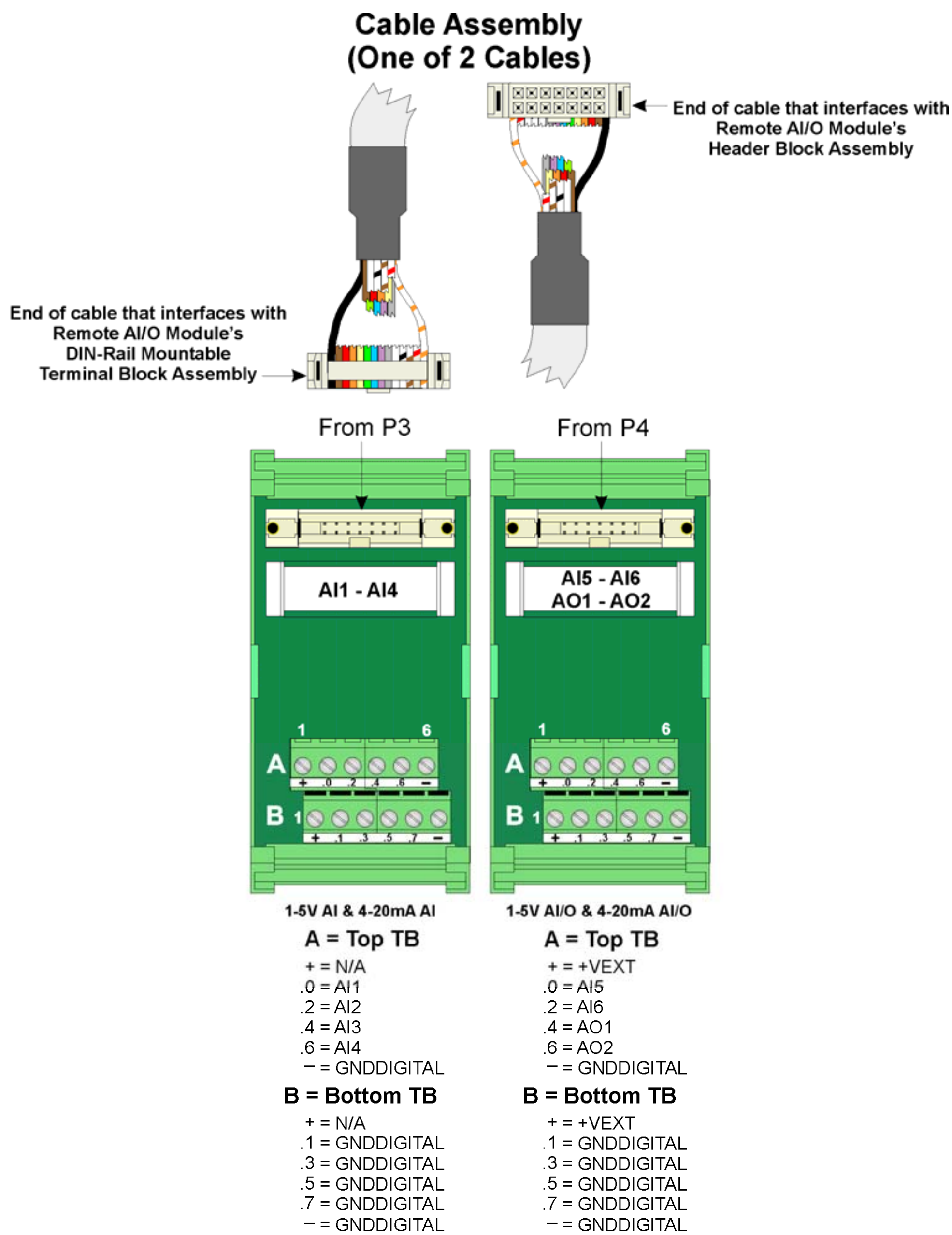


Figure 3-12. Non-isolated AI/O and AI Modules (Remote Termination)

Software Configuration

To use data from a non-isolated AI/O module you must add an **ERM_MA** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. To use data from a non-isolated AI module you must add an **ERM_AI6** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for these modules.

3.7 Non-isolated High Speed Counter (HSC) Input Module

Non-isolated High Speed Counter (HSC) Input modules provide up to four inputs. You can individually configure HSC module inputs for either a 10 KHz (high speed) or 300 Hz (low speed) input, and as a 16-bit high speed counter

HSC modules consist of a HSC PCB with two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination), 14 configuration jumpers, an LED daughter board with four status LEDs (one for each point), and a cover assembly. The HSC PCM connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-14. High Speed Counter Module General Characteristics

Type	Number Supported	Characteristics
High Speed Counter Inputs (HSC)	4	Each HSC supports/includes: ▪ Jumper to configure point as either a low speed input (300 Hz) or a high speed input (10 KHz). ▪ Jumper to configure HSC current. ▪ Bandwidth limiting ▪ Surge suppression ▪ Field inputs can be driven by signals or relay contacts. ▪ LED status indicator

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The non-isolated HSC module (general part number **396570-XX-X**) has the following configurations:

Table 3-15. High Speed Counter Module Configurations

Part Number	Termination Connector	Notes
396570-05-4:	local	
396570-06-2:	remote	

Setting Jumpers

HSC modules support up to four HSC inputs. Configure the HSC jumpers (W1 through W14) according to *Table 3-16*.

Table 3-16. Jumper Assignments: Non-isolated HSC Module

Jumper	Purpose	Description
W1 – W4	Configures HSC1 through HSC4 (respectively)	Pins 1-2 installed = Enables 300 Hz (low speed input) Pins 2-3 installed = Enables 10 KHz (high speed input)

Jumper	Purpose	Description
W5	Programs Serial EEPROM	**Reserved for factory use only**
W6	Enables LEDs	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W7 & W8	Controls HSC1 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load
W9 & W10	Controls HSC2 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load
W11 & W12	Control HSC3 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load
W13 & W14	Controls HSC4 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load

Wiring the Module

Figure 3-13 shows field wiring assignments for the locally terminated HSC module; *Figure 3-14* shows field wiring assignments for the remotely terminated HSC module.

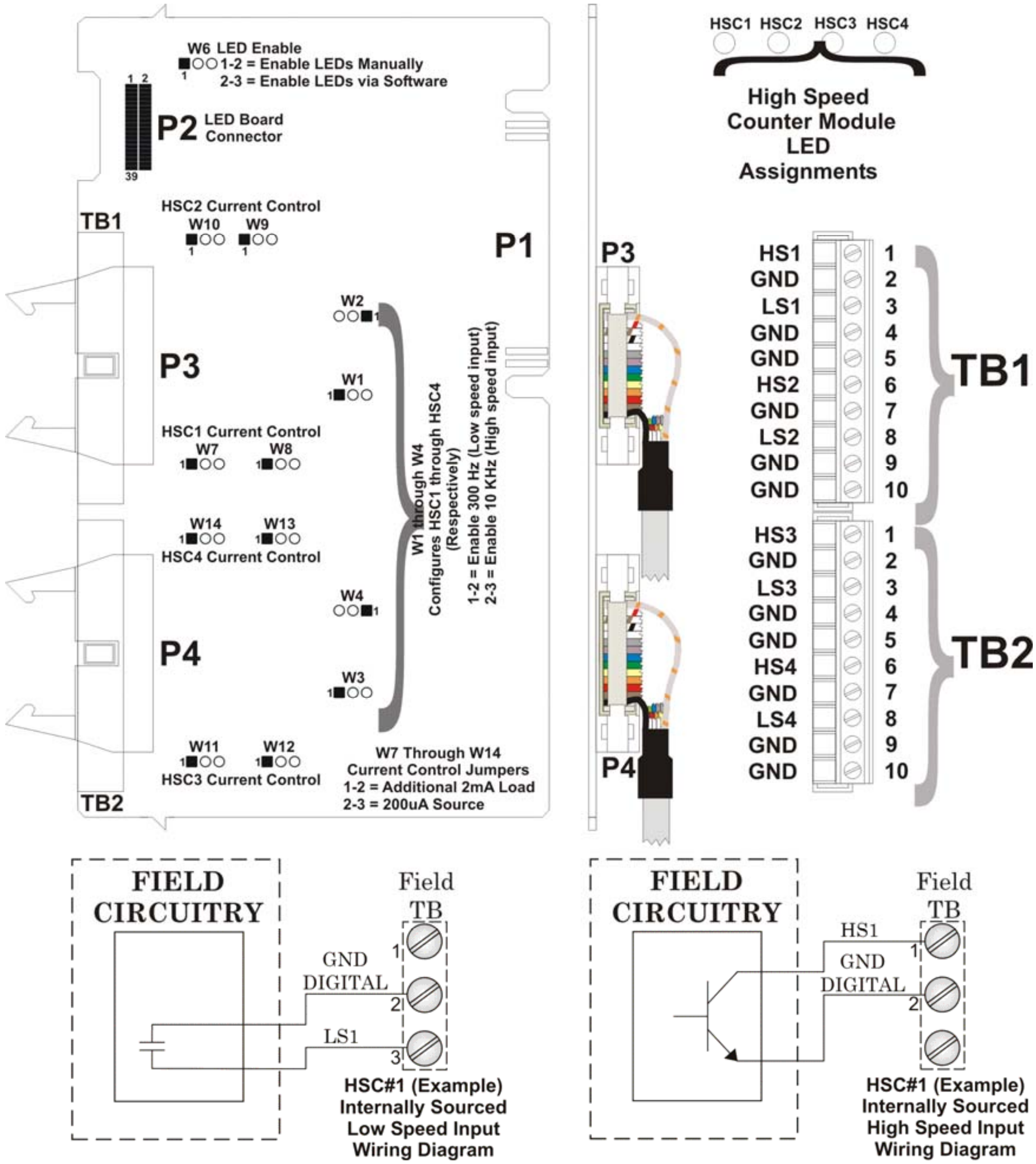
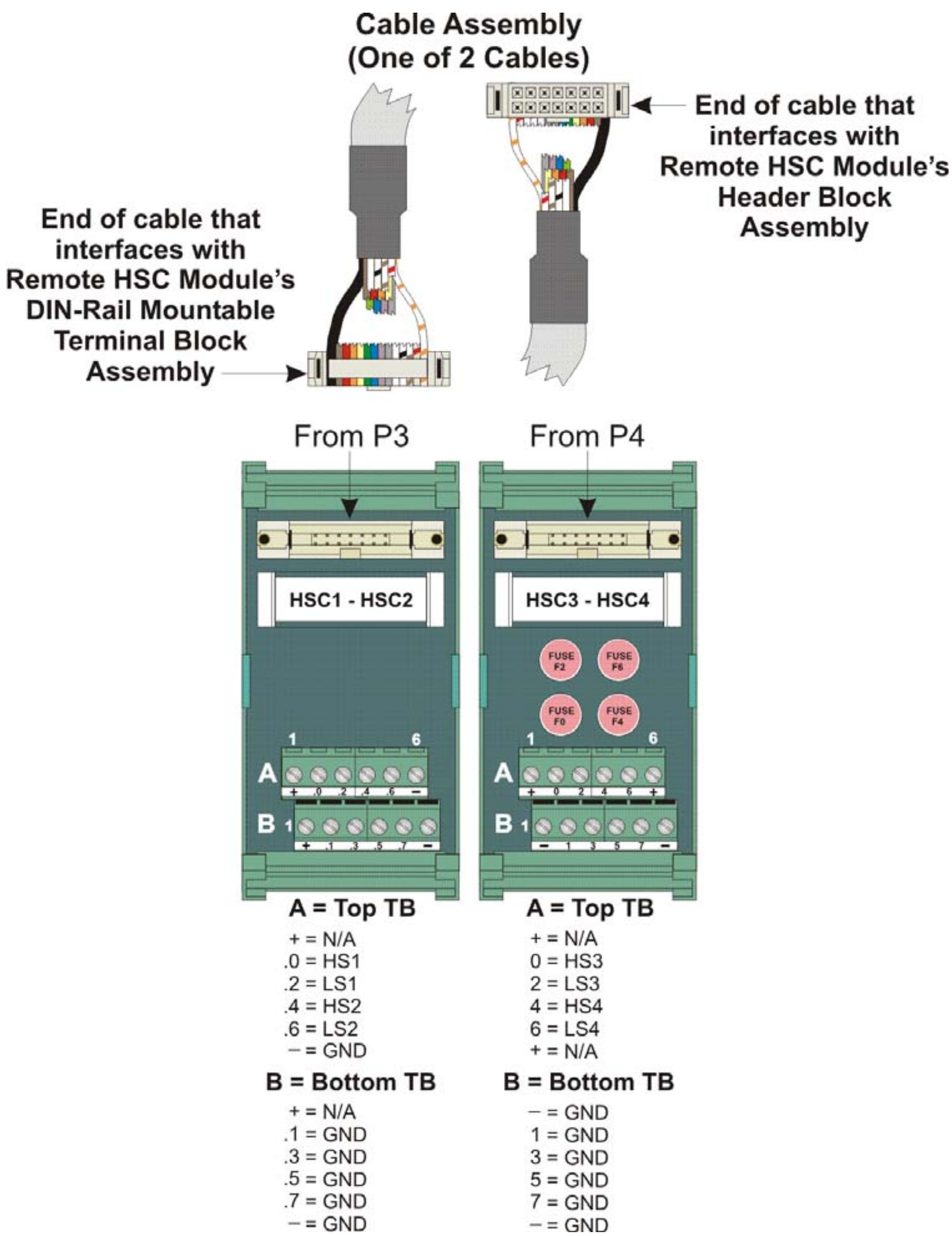


Figure 3-13. Non-isolated HSC Module (Local Termination)



Note: Fuses F0, F2, F4, and F6 are 1/8 A.

Figure 3-14. Non-isolated HSC Module (Remote Termination)

Software Configuration

To use data from a high speed counter module you must add an **ERM_HSC4** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.8 Isolated Analog Input (AI) Module

Isolated AI modules support eight 4–20 mA, 1–5 Vdc, or 0–10 Vdc differential analog inputs.

AI modules consist of an AI PCB with two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination), eight configuration jumpers, and a module cover assembly. The AI PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-17. Isolated Analog Input (AI) Module General Characteristics

Type	Number Supported	Characteristics
Analog Inputs (AI)	8	Each AI supports/includes: ▪ Jumpers to configure input for either isolated 4–20mA, isolated 1–5 Vdc, isolated 0–10 Vdc, or non-isolated internally powered 4-20mA current loop operation. ▪ AIs configured as isolated inputs have a common mode range of ±180V ▪ Analog input circuitry isolated from bus interface

Cable Shields

Connect cable shields associated with AI wiring to the ControlWave Micro's housing ground. Multiple shield terminations require that you supply a copper ground bus (up to a #4 AWG wire size) and connect it to the housing's ground lug.

This ground bus must accommodate a connection to a known good earth ground (in lieu of a direct connection from the ground lug) and to all AI cable shields. Shield wires should use an appropriate terminal lug. Secure them to the copper bus using industry rugged hardware (screw/bolt, lock washer, and nuts).

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The isolated Analog Input (AI) module (general part number **396604-XX-X**) has the following configurations:

Table 3-18. Isolated Analog Input Module Configurations

Part Number	Termination Connector	Notes
396604-03-0	local	
396604-04-8	remote	

Setting Jumpers

AI modules have jumpers you can use to configure each of the eight AIs. You can individually configure AI for 4–20 mA, 1–5 Vdc, or 0–10 Vdc isolated operation or internally sourced 4–20 mA non-isolated operation. See *Table 3-19* for settings.

Table 3-19. Jumper Assignments: Isolated AI Module

Jumper	Purpose	Description
W1 – W8	Configures AI1 through AI8 (respectively)	Voltage Input AIs use two dual-pin jumpers Isolated Current AIs use three dual-pin connectors Internally sourced AIs use four dual-pin jumpers See *Figure 3-15* and *Figure 3-16* for examples of how to use these jumpers.
W9	Programs Serial EEPROM	**Reserved for factory use only**

Wiring the Module

Figure 3-15 shows terminal assignments for a locally terminated AI module; *Figure 3-16* shows terminal assignments for a remotely terminated AI.

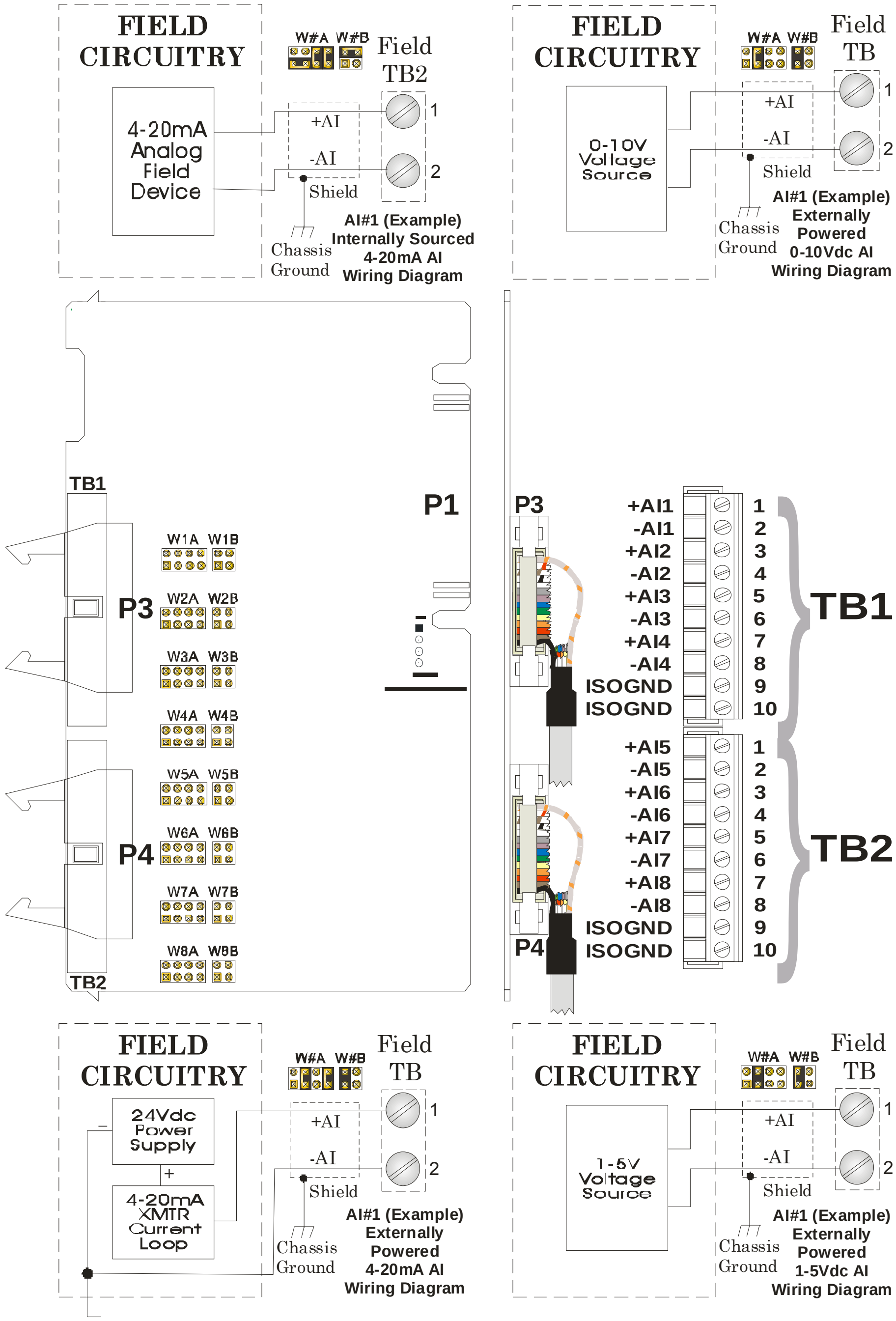
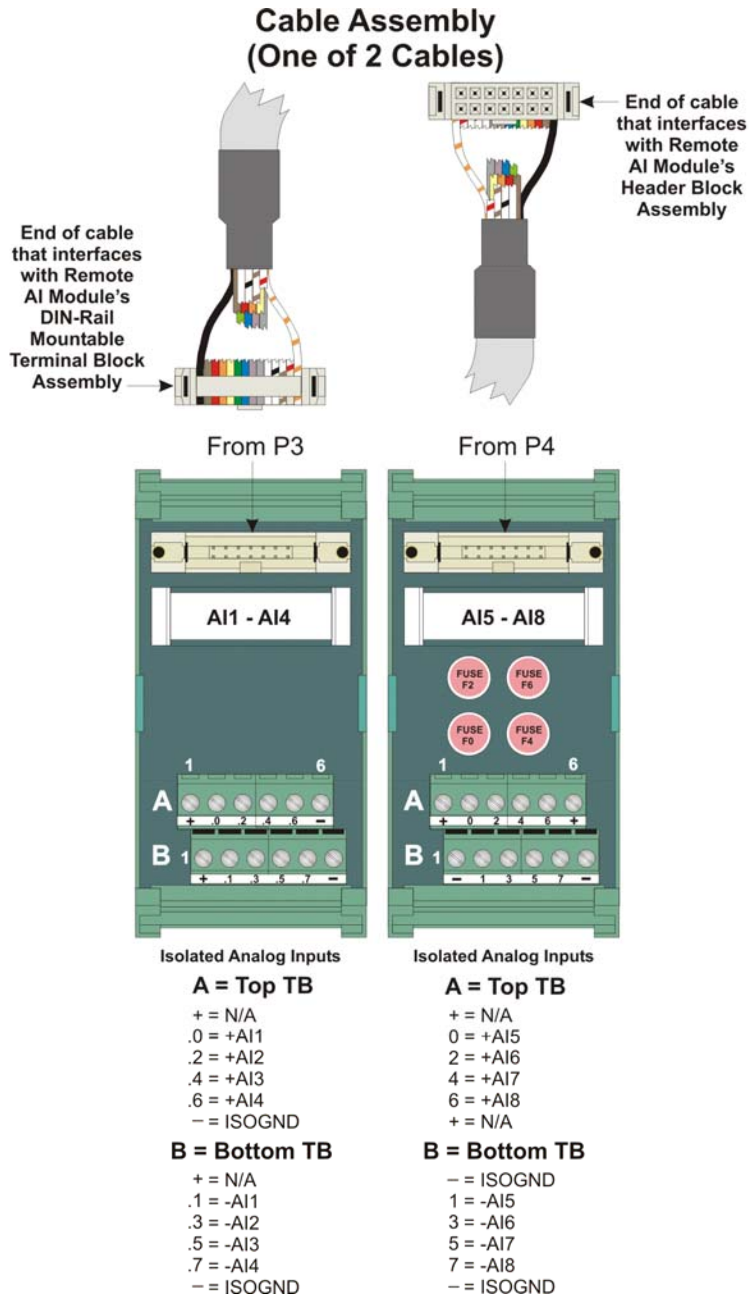


Figure 3-15. Isolated AI Module (Local Termination)



Note: Fuses F0, F2, F4, and F6 are 1/8 A.

Figure 3-16. Isolated AI Module (Remote Termination)

Software Configuration

To use data from an isolated analog input module you must add a **ERM_AI8** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.9 Isolated Analog Output (AO) Module

AO modules support four independently configurable 4–20 mA or 1–5 Vdc isolated analog outputs. Analog output circuitry is electrically isolated from the CPU power system.

AO modules consist of an AO PCB with two 10-point terminal block assemblies (TB1 and TB2 for local termination) or two 14-pin mass termination headers (P2 and P3 for remote termination), four configuration jumpers, and a module cover. The AO PCB connects to the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The isolated Analog Output module (general part number **396603-XX-X**) has the following configurations:

Table 3-20. Isolated Analog Output Module Configurations

Part Number	Termination Connector	Notes
396603-01-7	local	
396603-02-5	remote	

Setting Jumpers

AO modules have jumpers you can use to configure each of the four AOs. You can individually configure each AO for 4–20 mA or 1–5 Vdc isolated operation. See *Table 3-21*.

Table 3-21. Jumper Assignments: Isolated AO Module

Jumper	Purpose	Description
JP1	Configures AO1	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output
JP2	Configures AO2	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output
JP3	Configures AO3	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output
JP4	Configures AO4	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output

Wiring the Module

Figure 3-17 shows field wiring assignments for a locally terminated AO module. *Figure 3-18* shows field wiring assignments for a remotely terminated AO module.

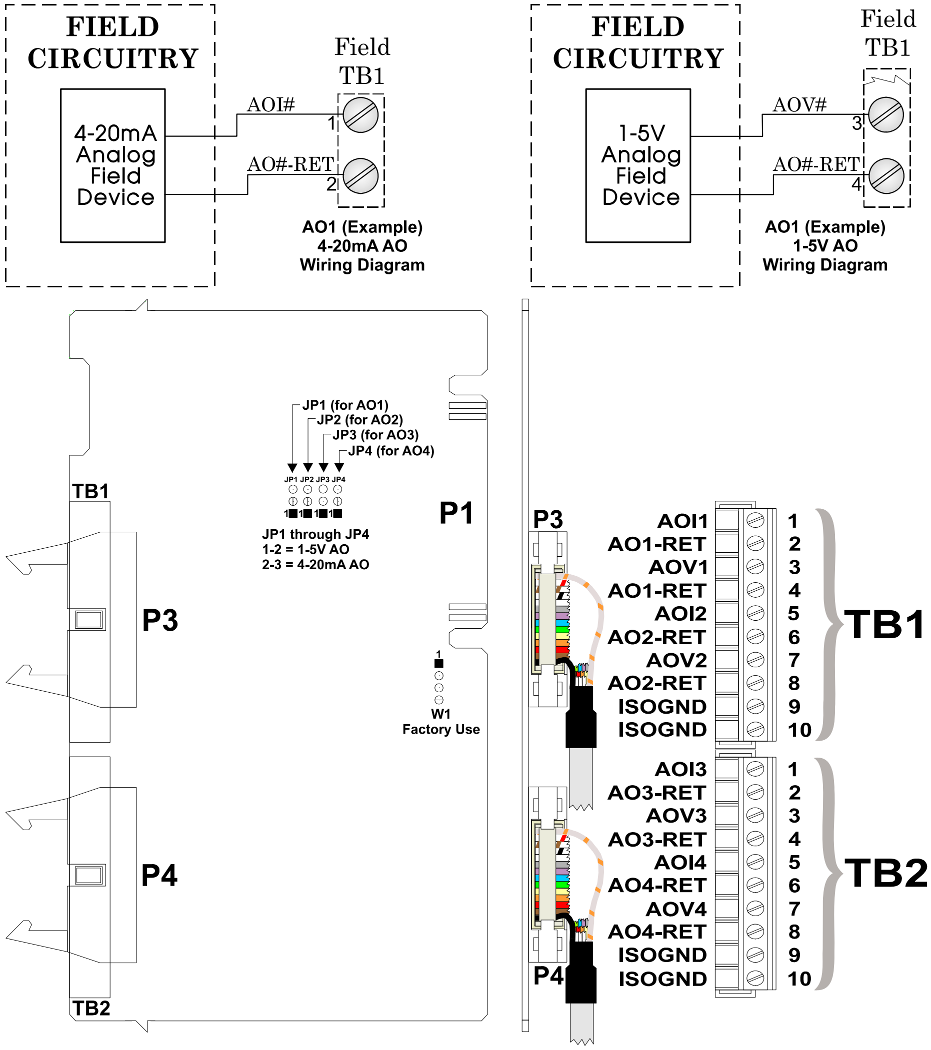
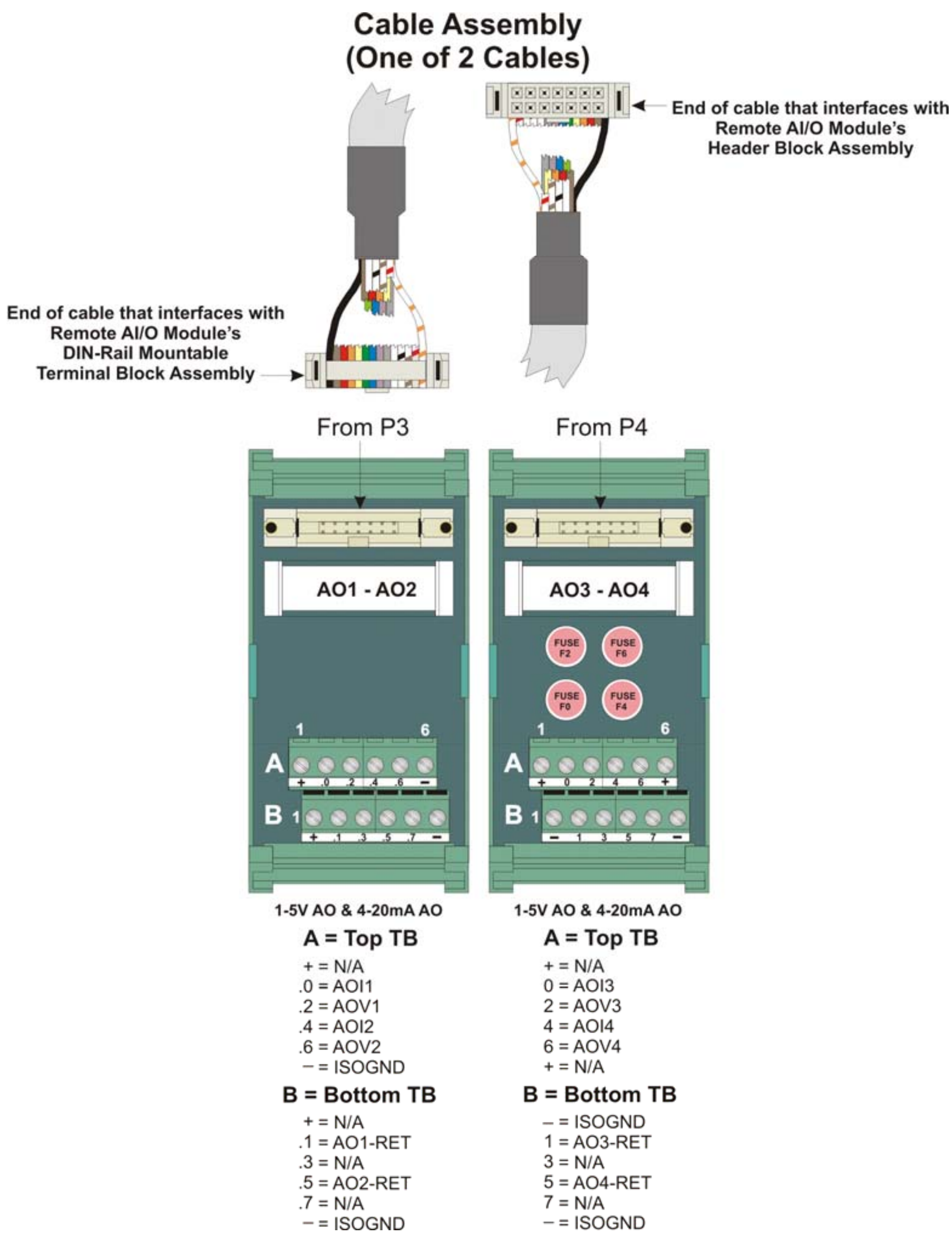


Figure 3-17. Isolated AO Module (Local Termination)



Note: Fuses F0, F2, F4, and F6 are 1/8 A.

Figure 3-18. Isolated AO Module (Remotely Terminated)

Software Configuration

To use data from an isolated analog output module you must add an **ERM_AO4** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.10 Non-isolated Mixed I/O (MI/O) Module

Non-isolated Mixed I/O (MI/O) modules provide up to six individually field configurable DI/Os, four AIs, two HSC Inputs and, optionally, one AO.

MI/O modules consist of an MI/O PCB with two 10-point terminal block assemblies (TB1 and TB2 for local termination) or two 14-pin mass termination headers (P2 and P3 for remote termination), 28 configuration jumpers, and a module cover. The MI/O PCB connects to the backplane using a 36-pin gold-plated card-edge connector.

Note: I/O circuitry is identical to circuitry used on other I/O modules.

HSC inputs have surge suppression, bandwidth limiting and 20 microsecond (50kHz) filtering. You can individually field-configure HSC inputs for 2mA or 200uA (low power) operation. Each input of the HSCI Module is configured as a 16-bit high-speed counter.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Optional AO

Optionally, certain configurations of MI/O modules can also support one externally powered (VEXT = 11–30 Vdc) analog output.

AO circuitry consists of a 12-bit resolution Digital-to-Analog Converter (DAC).

Configurations

The non-isolated Mixed I/O (MI/O) module (general part number **396630-XX-X**) has the following configurations:

Table 3-22. Mixed I/O Module Configurations

Part Number	I/O Included	Termination Connector	Notes
396897-01-0	4AI, 2HSC, 6DI/DO	local	includes LED daughterboard
396897-02-9	4AI, 2HSC, 6DI/DO & 1AO (on daughterboard)	local	includes LED daughterboard
396897-03-7	4AI, 2HSC, 6DI/DO	remote	includes LED daughterboard
396897-04-5	4AI, 2HSC, 6DI/DO & 1AO (on daughterboard)	remote	includes LED daughterboard

Setting Jumpers

MI/O modules have 28 jumpers you can use to configure each input or output. See *Table 3-23*.

Table 3-23. Jumper Assignments: Non-isolated MI/O Module

Jumper	Purpose	Description
W1[1]	Configures optional AO for voltage or current output	Pins 1-2 installed = Sets AO for current output Pins 2-3 installed = Sets AO for voltage output
W2	Configures optional AO for voltage or current output	Pins 1-2 installed = Sets AO for voltage output Pins 2-3 installed = Sets AO for current output
W3	Enables DI/DO status LEDs	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W4	Enables HSC status LEDs	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W5 & W6	Controls HSC1 Current	Pins 1-2 installed = Permits additional 2 mA load Pins 2-3 installed = Permits 200 uA source; no 2 ma load
W7 & W8	Controls HSC2 Current	Pins 1-2 installed = Permits additional 2 mA load Pins 2-3 installed = Permits 200 uA source; no 2 ma load
W9 & W10	Configures HSC1 and HSC2 debounce (respectively)	Pins 1-2 installed = Enables HSC debounce Pins 2-3 installed = Disabled HSC debounce
W11-W16	Configures DI1 through DI6 current (respectively)	Pins 1-2 installed = Sets 2 mA source current Pins 2-3 installed = Sets 60 uA source current
W17-W22	Select DI/O1 through DI/O6 points (respectively)	Pins 1-2 installed = Sets digital input operation Pins 2-3 installed = Sets digital output operation
W23-W26	Configures AI1 through AI4 (respectively)	Pins 1-2 installed = 4–20 mA AI (250Ω resistor in) Pins 2-3 installed = 1–5 Vdc AI
W27[2]	Selects AO Voltage	Pins 1-2 installed = N/A Pins 2-3 installed = External Field Voltage (TB2-9)
W28	Enables HSC Circuitry	Pins 1-2 installed = Enable (power) HSC circuit Pins 2-3 installed = Disable HSC circuit

1 W1 jumper located on optional AO daughterboard.
2 Set W27 **always** to pins 2-3.

Wiring the Module

Figure 3-19 shows field wiring assignments for a locally terminated MI/O module. *Figure 3-20* shows field wiring assignments for a remotely terminated MI/O module.

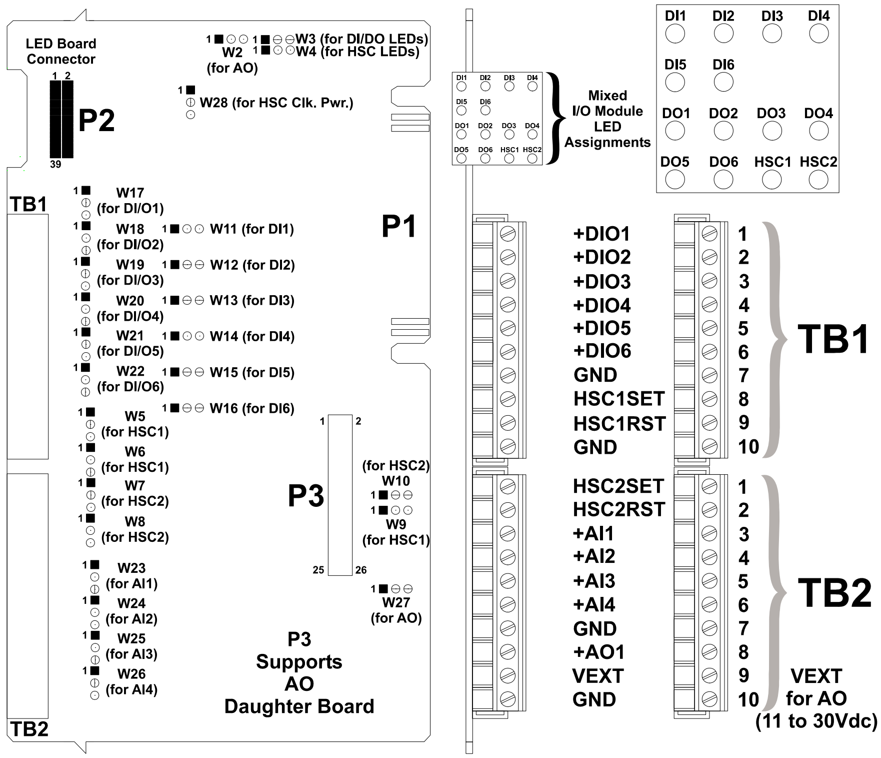


Figure 3-19. Non-isolated MI/O Module (Local Termination)

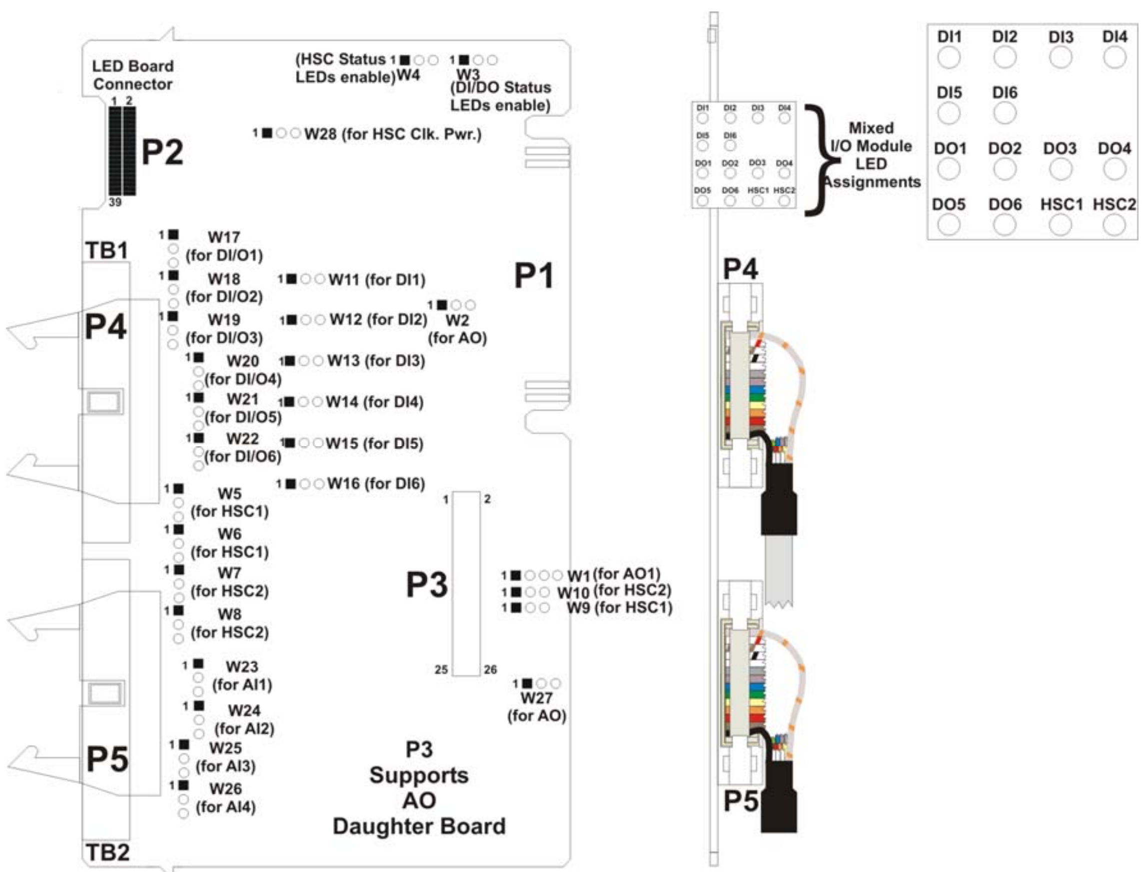
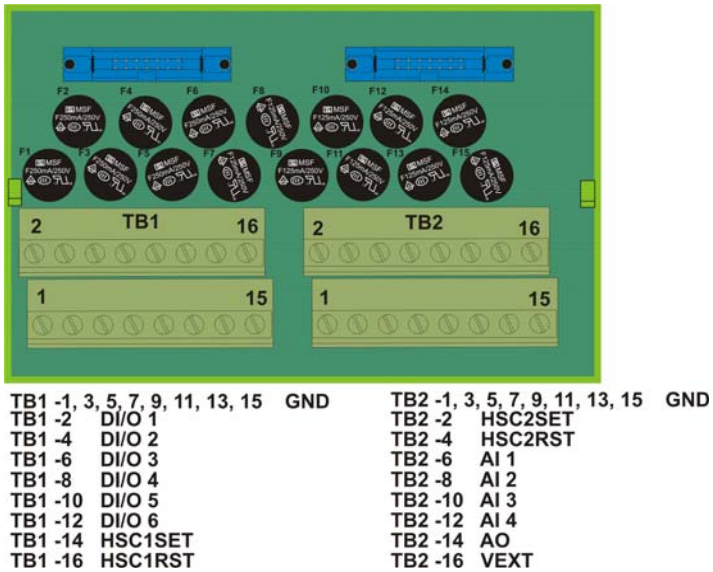


Figure 3-20. Non-isolated MI/O Module (Remote Termination)

Figure 3-21 shows terminal block assignments for remote termination. *Figure 3-22* shows a wiring diagram for mixed I/O for local termination. *Figure 3-23* shows a wiring diagram for mixed I/O for remote termination.



Note: Fuses F1 to F6 are ¼ A; fused F7 to F15 are 1/8 A.

Figure 3-21. MI/O Module (Remote Termination)

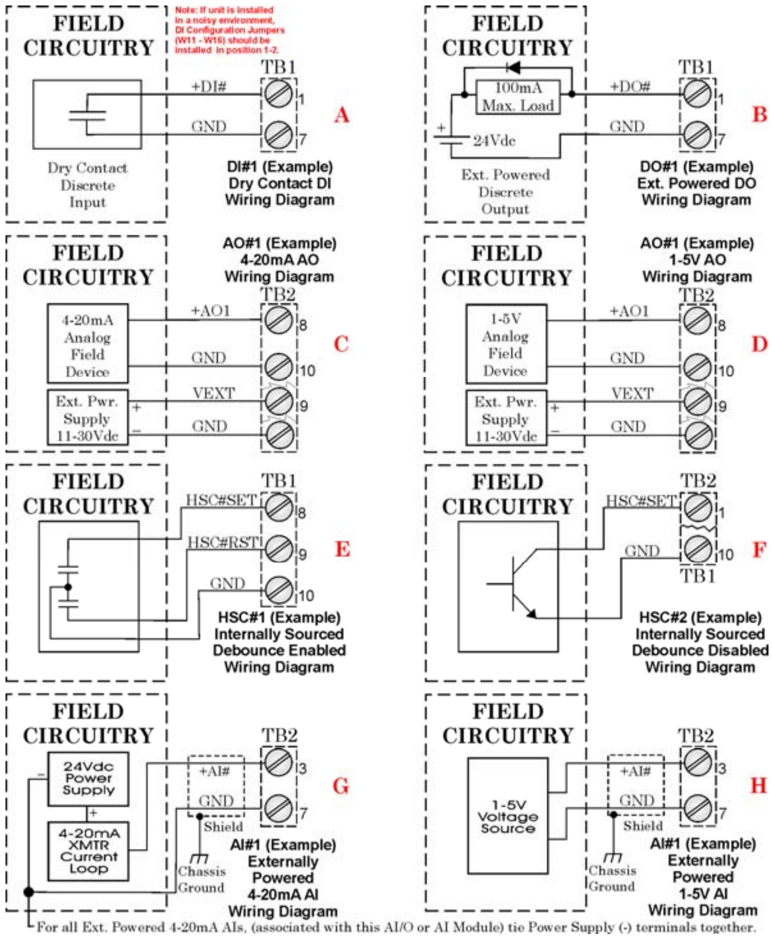


Figure 3-22. MI/O Module Wiring (Local Termination)

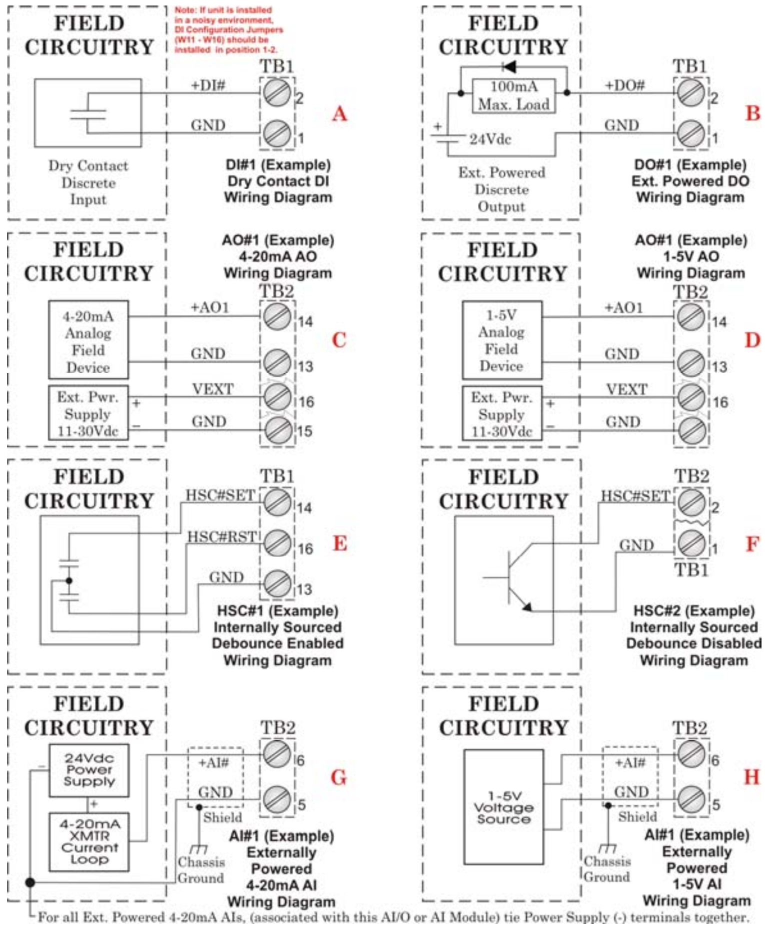


Figure 3-23. MI/O Module Wiring (Remote Termination)

Software Configuration

To use data from a mixed I/O module you must add an **ERM_MIX** board in ControlWave Designer’s I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.11 Isolated Vac Digital Input Module

Isolated Vac DI modules provide eight isolated DIs, which can interface to field-powered devices providing 110 Vac or 220 Vac.

Table 3-24. Isolated Vac DI Module General Characteristics

Type	Number Supported	Characteristics
Isolated Digital Inputs (DI)	8	Each DI supports/includes: ▪ Nominal field powered input voltage of 110Vac or 220Vac ▪ Nominal input current of 12mA @ 120Vac ▪ 30 ms input filtering ▪ LED that turns ON when DI is ON.

Vac DI modules consists of a DI PCB with two 10-point terminal block assemblies (for local termination), one configuration jumper, an LED daughterboard with eight status LEDs (one for each point), and a module cover. The Vac DI PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated Vac DI module is available in a single configuration (part number **396686-01-0**):

Isolation

Optocouplers electrically isolate the module's DI field circuitry from the module's bus interface circuitry.

Setting Jumpers

Vac DI module has one jumper which enables the DI status LEDs. See *Table 3-25.*

Table 3-25. Jumper Assignments: Isolated Vac DI Module

Jumper	Purpose	Description
W1	Enables DI status LED	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software

Wiring the Module *Figure 3-24* shows field wiring assignments for a locally terminated Vac DI module.

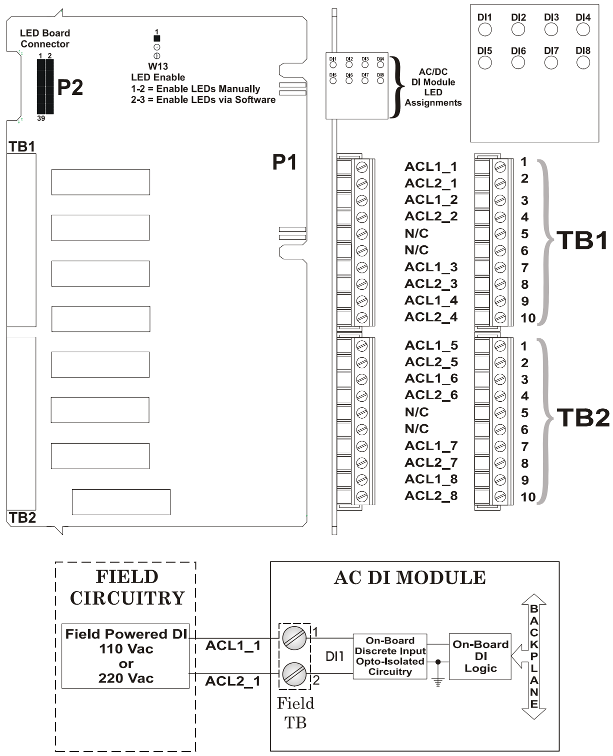


Figure 3-24. Isolated Vac DI Module Wiring (Local Termination)

Software Configuration To use data from an isolated Vac Digital Input module you must add an **ERM_DI16** board in ControlWave Designer’s I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.12 Relay Isolated Vac/Vdc Digital Output Module

⚠ Caution **You cannot install a relay isolated Vac/Vdc DO module in slot #1 of the housing.**

Relay isolated Vac/Vdc DO modules provide a total of eight isolated DOs to control signaling functions. The DOs do **not** have surge protection (this is a customer-provided feature, if necessary).

Table 3-26. Relay Isolated Vac/Vdc DO Module Characteristics

Type	Number Supported	Characteristics
Relay Isolated Digital Outputs (DO)	8	Each DO supports/includes: ▪ A pair of Normally Open (NO) relay contacts capable of handling a maximum operating load of 6A at 240 Vac or 5A at 30Vdc. ▪ Output relay provides 500 Vdc electrical isolation for the DO. ▪ Maximum operating frequency of 360 operations per hour (under rated load). ▪ LED that turns ON when DO is ON.

Isolated Vac/Vdc DO modules consist of a DO PCB with two 10-point terminal block assemblies (for local termination), one configuration jumper, an LED daughterboard with eight status LEDs (one for each point), and a module cover. The DO PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Isolation Relays electrically isolate the Vac/Vdc DO field circuitry from the module’s bus interface circuitry. An onboard DO load register stores output data. At power up the DO load register clears and sets all outputs to “off.”

Configuration The relay isolated Vac/Vdc DO module is available in a single configuration (part number **396687-01-6**).

Setting Jumpers The Vac/Vdc DO module has one jumper which enables the DI status LEDs. See *Table 3-27.*

Table 3-27. Jumper Assignments: Isolated Vac DI Module

Jumper	Purpose	Description
W1	Enables DO status LED	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software

Wiring the Module

Figure 3-25 shows field wiring assignments for a locally terminated relay isolated Vac/Vdc DO module.

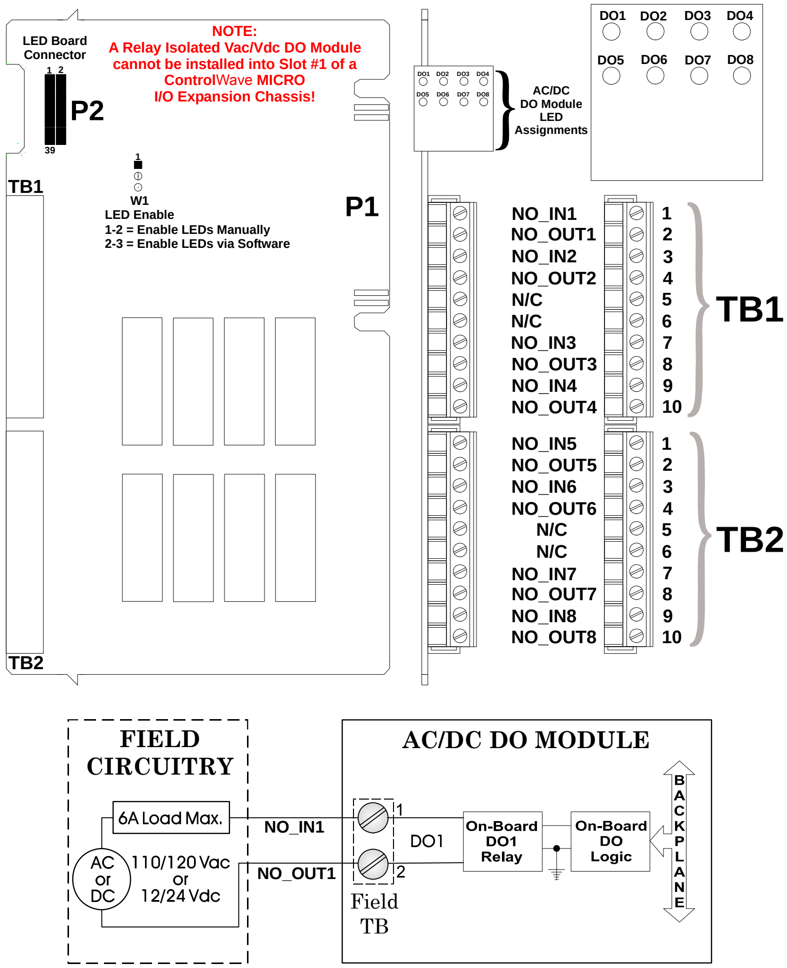


Figure 3-25. Relay Isolated Vac/Vdc DO Module Wiring (Local Termination)

Software Configuration

To use data from a Relay Isolated Vac/Vdc Digital Output module you must add an **ERM_DO16** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.13 Isolated Digital Input/Output (DI/O) Module

Isolated Digital I/O modules provide four isolated DOs that are externally powered and twelve isolated DIs.

Table 3-28. Isolated (DI/O) Module Characteristics

Type	Number Supported	Characteristics
Isolated Digital Outputs (DO)	4	Each isolated DO supports/includes: ▪ Externally powered. Supports 500mA maximum load (nominally powered from a 10Vdc supply [30Vdc max]_ ▪ Surge protection. ▪ Open source MOSFET drives up to 31Vdc at up to 500mA. ▪ 500Vdc MOV to chassis and 31Vdc MOV (across output) protect each DO. ▪ Maximum operating frequency of 20 Hz.
Isolated Digital Inputs (DI)	12	Each isolated DI supports/includes: ▪ Jumper allows externally powered single end inputs or internally sourced dry contact operation. ▪ Nominal input voltage of 24Vdc. ▪ Nominal input current of 5mA. ▪ 30 ms filtering.

Isolated DI/O modules consist of a DI/O PCB with two 10-point terminal block assemblies (for local termination), 14 configuration jumpers, an LED daughterboard with 16 status LEDs (one for each point), and a module cover. The isolated DI/O PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated DI/O module is available in a single configuration (part number **396804-01-2**).

Isolation

Surge suppressors and optocouplers electrically isolate the DI field circuitry from the module’s bus interface circuitry.

When configured for use in dry contact applications, all DIs use a built-in +21Vdc field power supply. This is an isolated supply powered by the output of the +VIN power source originating on the PSSM. Use jumper W15 to enable or disable the +21Vdc field power supply.

Each of the four DO circuits contain an optically isolated open source MOSFET with surge suppressor and are capable of handling 500mA @ 30V.

Use jumper W15 to enable power for DIs that are configured for internal power. The nominal input voltage is 24Vdc at 5mA.

Setting Jumpers

The isolated DI/O module has 15 jumpers you can use to configure inputs and outputs. See *Table 3-29.*

Table 3-29. Jumper Assignments: Isolated Vac DI Module

Jumper	Purpose	Description
W1	Configures DI1	Pins 2-3 & 4-5 installed = Permit external power DI Pins 1-2 & 3-4 installed = Permit internal source DI
W2-W12	Configures DI2 through DI12 (respectively)	Pins 2-3 & 4-5 installed = Permit external power DI Pins 1-2 & 3-4 installed = Permit internal source DI
W13	Enables DI/O status LED	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W14	Programs serial EEPROM	**Reserved for factory use only**
W15[1]	Enables VIN	Pins 1-2 installed = Enable VIN Pins 2-3 installed = Disable VIN

1 Place configuration jumper on pins 1-2 if you configure **any** DI for internally sourced operation.

Wiring the Module

Figure 3-26 shows field wiring assignments for a locally terminated isolated DI/O module.

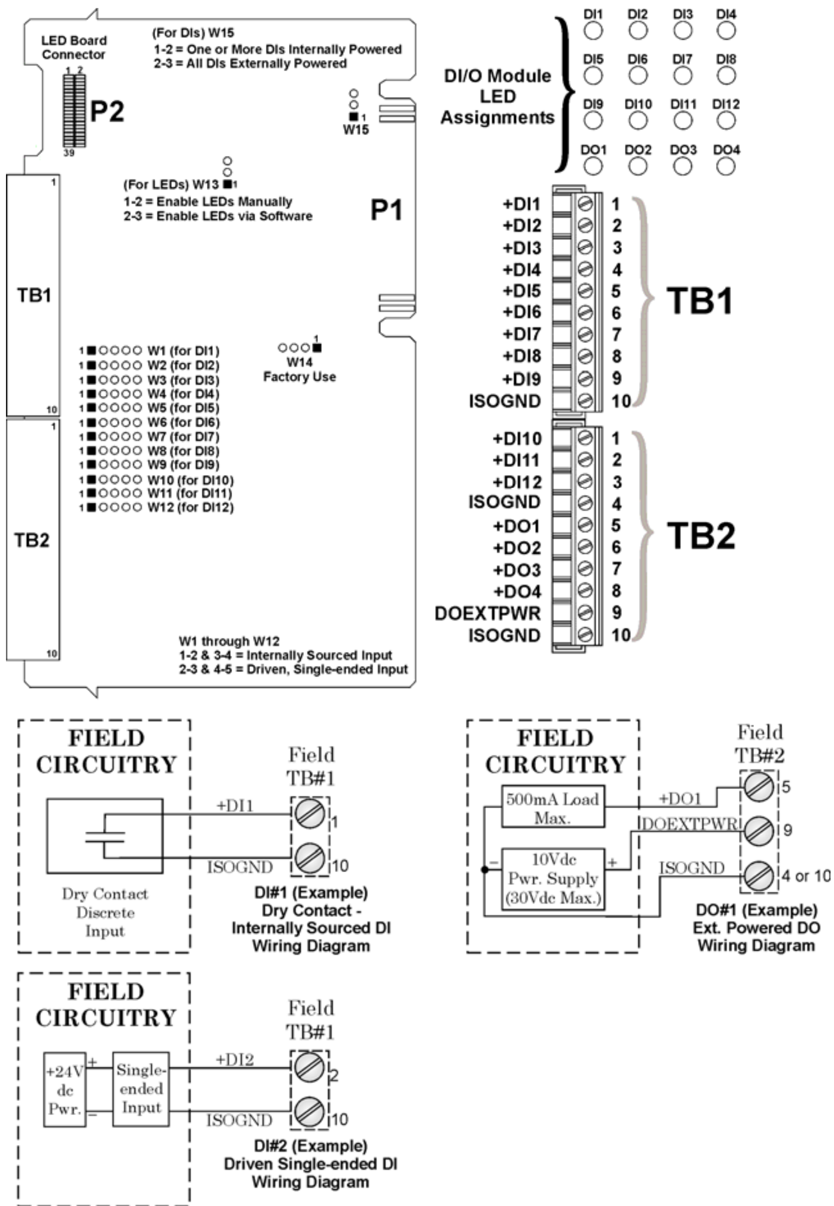


Figure 3-26. Isolated DI/O Module Wiring (Local Termination)

Software Configuration

To use data from an isolated digital input/output module you must add an **ERM_MD** board in ControlWave Designer’s I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.14 Isolated Resistance Temperature Device (RTD) Input Module

RTD Input modules provide a total of four inputs. Firmware detects the RTD type (2-, 3- or 4 platinum wire) via the installation of jumper wires on the terminal block for 2-wire and 3-wire RTDs (see *Figure 3-27*).

Table 3-30. Isolated RTD Input Module General Characteristics

Type	Number Supported	Characteristics
Isolated RTD Input	4	Each isolated RTD input supports/includes: ▪ Signal conditioning circuitry ▪ Surge protection with a 12V transorb that meets IEEE standard 472-1978 ▪ Over voltage protection ▪ 24-bit analog to digital converter (ADC) ▪ Common mode range of 500V with respect to chassis ▪ Electrical isolation of 500Vdc (channel to channel/system bus) ▪ Source current to RTD limited to 330 uA

RTD Input Modules consists of an Isolated RTD Input Board with two 10-point Terminal Block Assemblies (for local termination) or two 14-pin Mass Termination Header Block Assembly (for remote termination), and a Cover Assembly. Each Isolated RTD Board is connected to the unit's Backplane via a 36-pin card edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated RTD module (general part number **396876-XX-X**) has the following configurations:

Table 3-31. Isolated RTD Input Module Configurations

Part Number	Termination Connector	Notes
396876-01-3	local	
396876-02-1	remote	

Wiring the Module

Figure 3-27 shows field wiring assignments for locally terminated isolated RTD modules. *Figure 3-28* shows field wiring assignments for remotely terminated isolated RTD modules.

Figure 3-28 also provides wiring diagrams for 2-wire, 3-wire, and 4-wire RTDs to the Local RTD Module Terminal Blocks; wiring assignments, i.e., +RTD#_3/4W, -RTD#_4W, +RTD# and –RTD# are similar to those assigned to the Remote DIN-Rail Mountable Terminal Blocks.

Note: To maintain specified accuracy with a 3-wire RTD, you must match the two field wires that source and sink the RTD current within 0.01 ohms (matched in length and matched in wire type) and the ambient temperature on these wires must be the same.

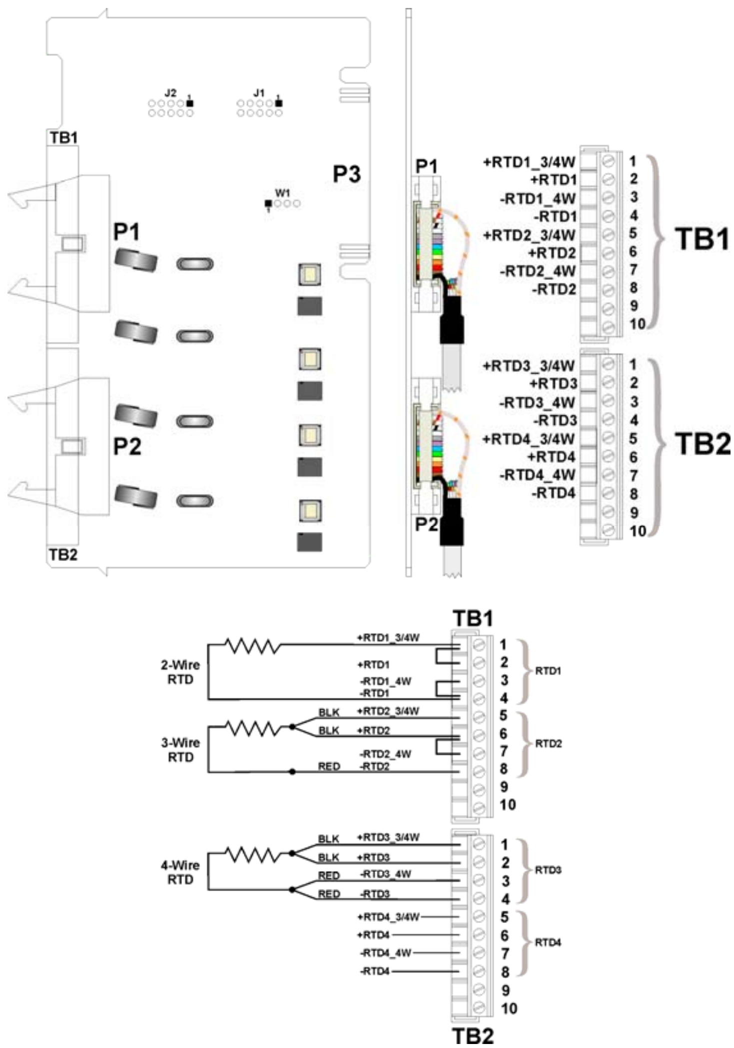


Figure 3-27. Isolated RTD Module Wiring (Local Termination)

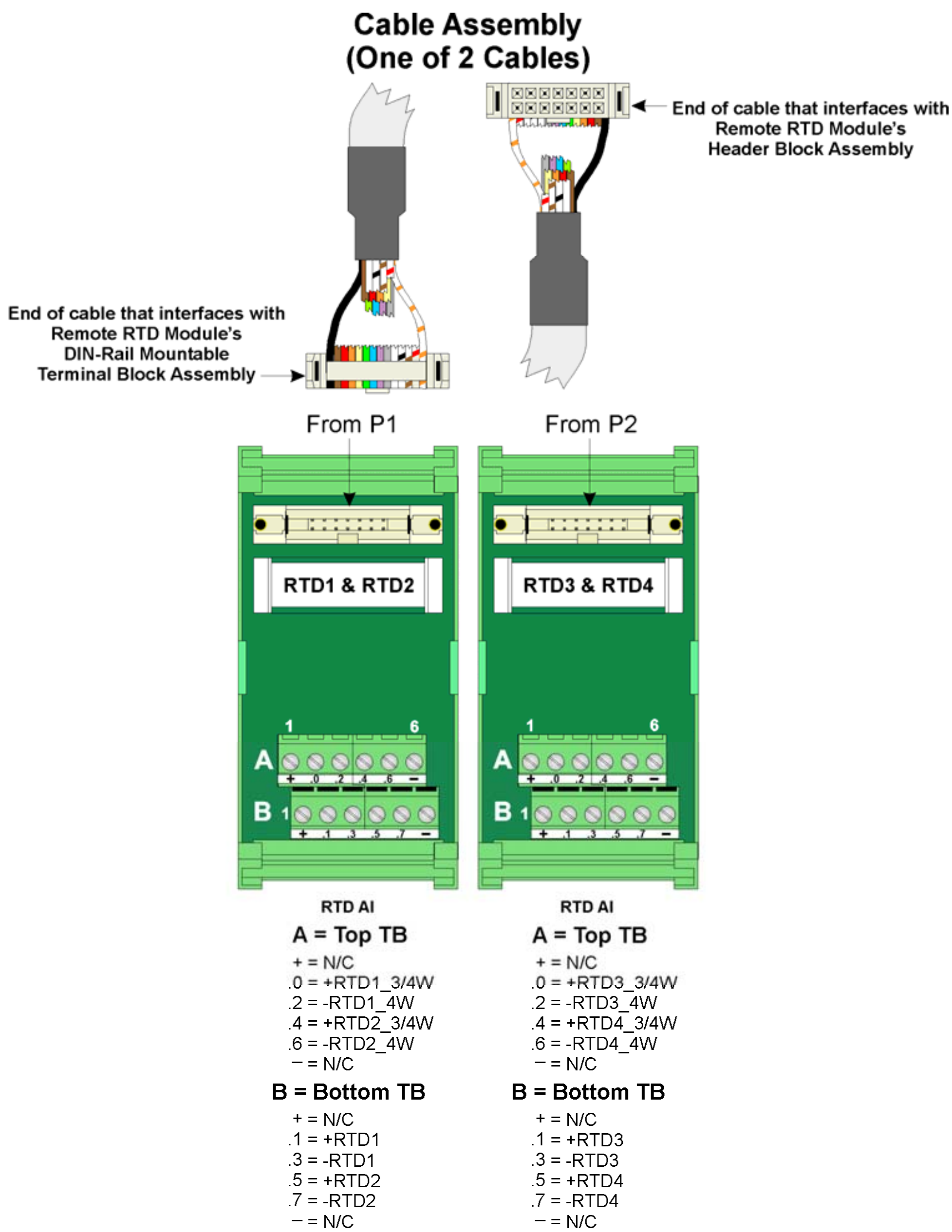


Figure 3-28. Isolated RTD Module Wiring (Remote Termination)

Software Configuration

To use data from an isolated RTD input module you must add an **ERM_RTD4** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.15 Isolated Thermocouple Module

Thermocouple (TC) modules (sometimes known as Low Level Analog Input modules) provide six individually isolated differential inputs for thermocouples or ±10mV inputs plus one cold junction compensation (CJC) input for temperature compensation at the terminal block.

Table 3-32. Isolated Thermocouple Module Characteristics

Type	Number Supported	Characteristics
Isolated Thermocouple	6	Each isolated TC supports/includes: ▪ Signal conditioning circuitry including a 2.5V reference ▪ Surge suppression with a 188V Transorb that meets IEEE standard 472-1978. ▪ Over voltage protection ▪ Opto-isolation circuitry. Each input is provided electrical isolation of 500Vdc (channel to channel/system bus). ▪ 24-bit analog to digital converter (ADC)

The CJC with a built-in RTD provides thermocouple temperature compensation at the terminal block and is electrically isolated. Pins 8, 9 and 10 of the local terminal block (TB1) source and sink the CJC's RTD.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated TC module (general part number **396875-XX-X**) has the following configurations:

Table 3-33. Isolated TC Module Configurations

Part Number	Termination Connector	Notes
396875-01-7	local	
396875-02-5	remote	

Wiring the Module

Figure 3-29 shows field wiring for locally terminated isolated TC modules. *Figure 3-30* shows field wiring for remotely terminated isolated TC modules.

Figure 3-29 also provides diagrams showing the wiring for thermocouples and the 3-wire cold junction compensation (CJC) PCB to a locally terminated TC module (that is, +AI#, -AI#, +CJC (Reference), -CJC (Return) & +CJC (Sense) are similar to those assigned to the remote DIN-rail mountable terminal blocks. A small CJC PCB is factory-installed to the terminal block.

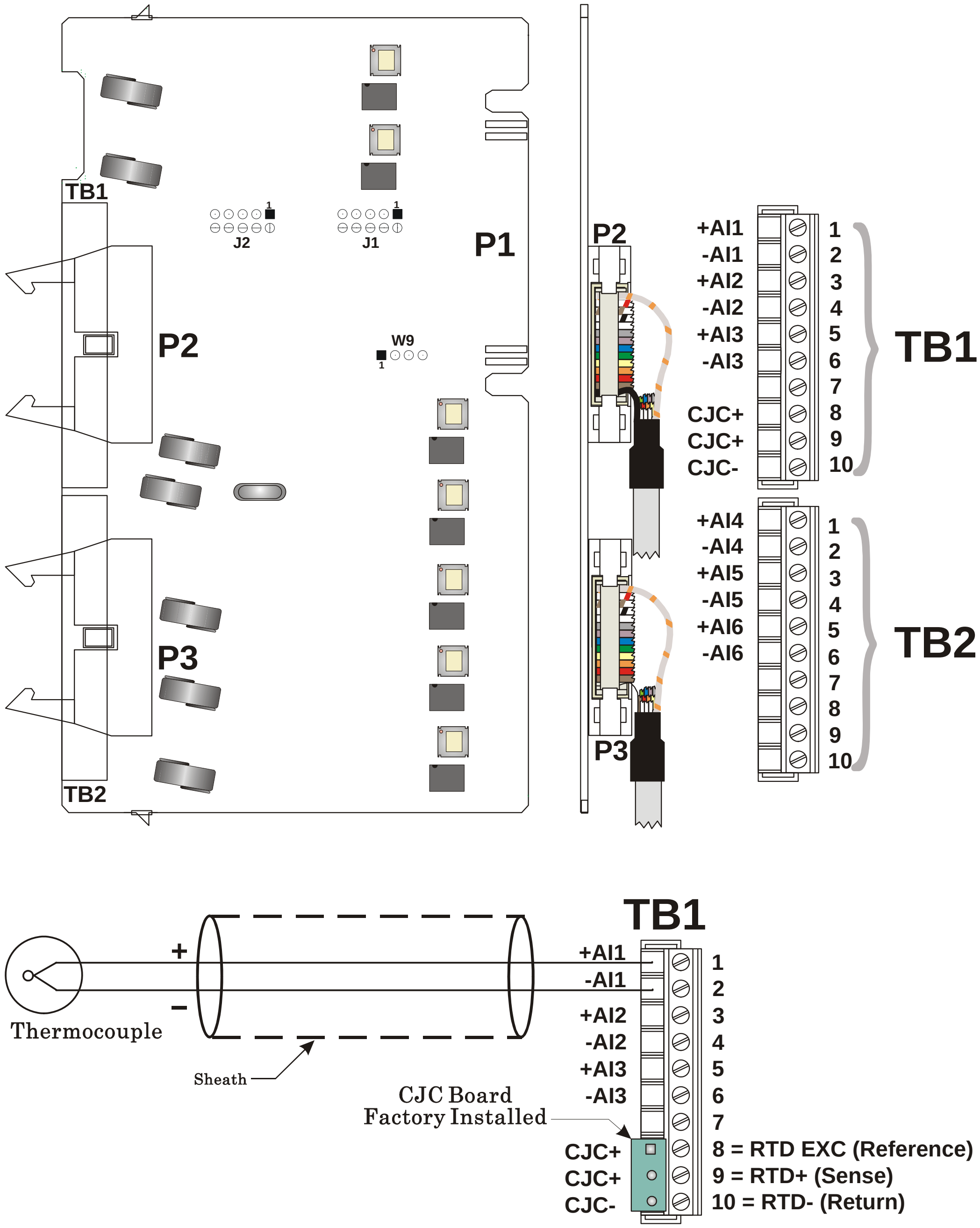


Figure 3-29. Isolated TC Module Wiring (Local Termination)

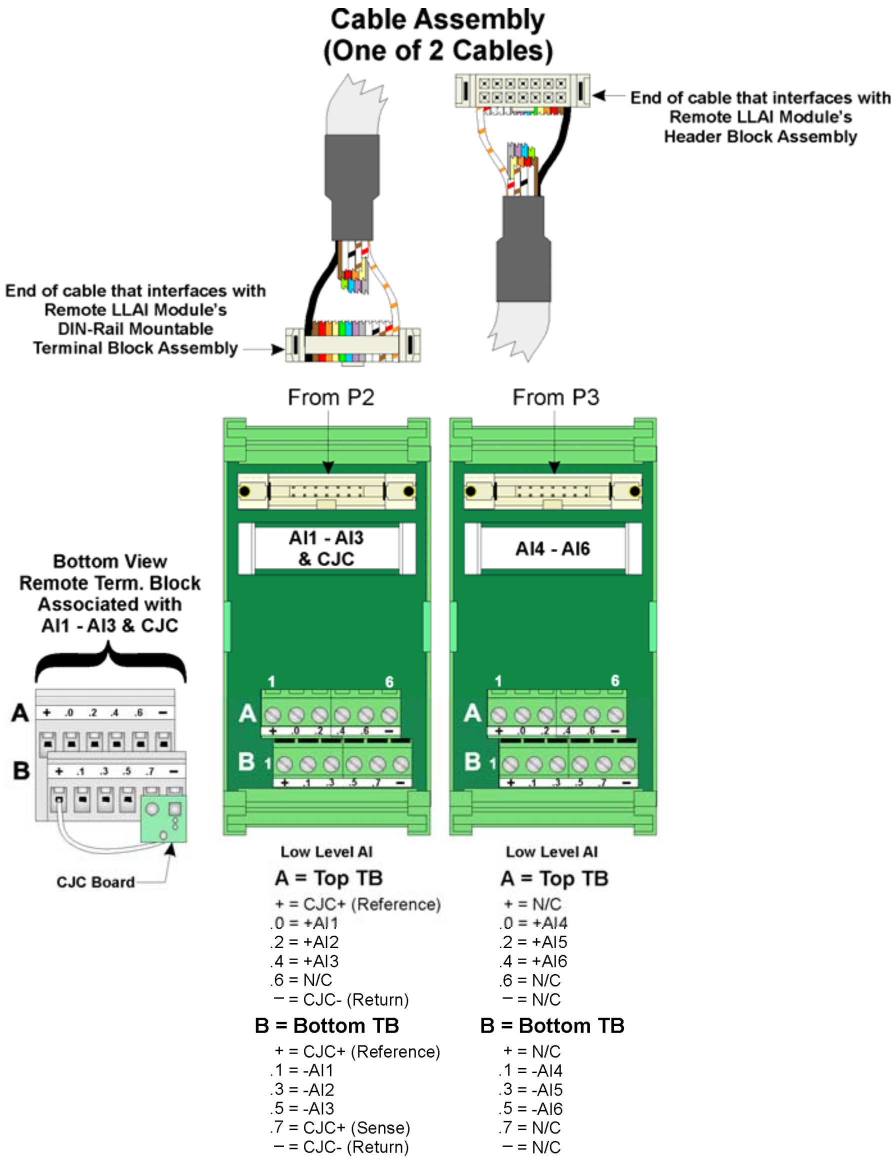


Figure 3-30. Isolated TC Module Wiring (Remote Termination)

Ranges & Errors

Table 3-34 provides the accuracy, resolution and temperature range for the various thermocouples and 10mV TC inputs. *Table 3-35* lists the RTD errors.

Table 3-34. TC Module Input Accuracy and Resolution

Input Type	Accuracy/Range	Resolution	25°C	–20°C to +70°C
B – Thermocouple	100°C to 200°C	2.00°C	± 8°C	± 16°C
	200°C to 390°C	1.00°C	± 4°C	± 8°C
	390°C to 840°C	0.50°C	± 2°C	± 4°C
	840°C to 1820°C	0.20°C	± 1°C	± 2°C
R – Thermocouple	50°C to +50°C	0.40°C	± 2°C	± 4°C
	+50°C to 1720°C	0.17°C	± 1°C	± 2°C
S – Thermocouple	– 50°C to +50°C	0.37°C	± 2°C	± 4°C
	+50°C to 1760°C	0.18°C	± 1°C	± 2°C

Input Type	Accuracy/Range	Resolution	25°C	–20°C to +70°C
C – Thermocouple	0°C to 2315°C	0.16°C	± 0.75°C	± 1.5°C
N – Thermocouple	– 270°C to – 260°C	1.50°C	± 8°C	± 16°C
	– 260°C to – 250°C	0.75°C	± 4°C	± 8°C
	– 250°C to – 230°C	0.50°C	± 2°C	± 4°C
	– 230°C to – 150°C	0.25°C	± 1°C	± 2°C
	– 150°C to 1300°C	0.09°C	± 0.500°C	± 1°C
J – Thermocouple	– 210°C to 191°C	0.08°C	± 0.750°C	± 1.5°C
	191°C to 1200°C	0.11°C	± 0.500°C	± 1°C
E – Thermocouple	– 270°C to – 260°C	1.00°C	± 3°C	± 6°C
	– 260°C to – 225°C	0.25°C	± 1°C	± 2°C
	– 225°C to – 200°C	0.08°C	± 0.750°C	± 1.5°C
	– 200°C to 1000°C	0.09°C	± 0.500°C	± 1°C
K – Thermocouple	– 270°C to – 261°C	2.00°C	± 5°C	± 10°C
	– 260°C to – 246°C	0.56°C	± 2°C	± 4°C
	– 245°C to – 180°C	0.25°C	± 1°C	± 2°C
	– 179°C to – 145°C	0.08°C	± 0.750°C	± 1.5°C
	– 145°C to 1372°C	0.14°C	± 0.500°C	± 1°C
T – Thermocouple	– 270°C to – 261°C	1.50°C	± 4°C	± 8°C
	– 260°C to – 251°C	0.38°C	± 2°C	± 4°C
	– 250°C to – 181°C	0.18°C	± 1°C	± 2°C
	– 180°C to – 136°C	0.08°C	± 0.750°C	± 1.5°C
	– 135°C to 400°C	0.06°C	± 0.500°C	± 1°C
± 10mV	–± 10mV	–± 1.2µV	± 0.25%	± 0.05%

Note: The CJC RTD adds an additional error (see *Table 3-35*)

Table 3-35. TC Module RTD Error with CJC at 25°C

Thermocouple Type	Process Temperature Range	RTD Error with CJC @ 25°C
B	100°C to 1820°C	± 0.30°C
R	– 50°C to +50°C	± 0.49°C
	+50°C to 1720°C	± 0.30°C
S	– 50°C to +50°C	± 0.45°C
	+50°C to 1760°C	± 0.30°C
C	0°C to 2315°C	± 0.30°C
N	– 270°C to – 261°C	± 20.50°C
	– 260°C to – 251°C	± 5.00°C
	– 250°C to – 231°C	± 2.70°C
	– 230°C to – 189°C	± 1.40°C
	– 188°C to – 70°C	± 0.70°C
	– 70°C to + 25°C	± 0.35°C
	+25°C to 1300°C	± 0.30°C
J	– 210°C to – 111°C	± 0.80°C
	– 110°C to +25°C	± 0.40°C
	+25°C to 1200°C	± 0.30°C

Thermocouple Type	Process Temperature Range	RTD Error with CJC @ 25°C
E	– 270°C to – 261°C	± 10°C
	– 260°C to – 245°C	± 3°C
	– 244°C to – 200°C	± 1.50°C
	– 200°C to – 87°C	± 0.75°C
	– 86°C to +25°C	± 0.39°C
	+25°C to 100°C	± 0.30°C
K	– 270°C to – 261°C	± 15.00°C
	– 260°C to – 247°C	± 4.50°C
	– 246°C to – 222°C	± 2.20°C
	– 220°C to – 160°C	± 1.10°C
	– 159°C to +25°C	± 0.55°C
	+25°C to 1372°C	± 0.30°C
T	– 270°C to – 261°C	± 10.30°C
	– 260°C to – 243°C	± 3.00°C
	– 242°C to – 196°C	± 1.50°C
	– 195°C to – 61°C	± 0.75°C
	– 60°C to +25°C	± 0.375°C
	+25°C to 400°C	± 0.30°C

Note: Use straight-line approximation to calculate approximate error between end points.

Software Configuration

To use data from an isolated thermocouple module you must add an **ERM_TC6** board in ControlWave Designer's I/O Configurator into the ControlWave project that runs in the host ControlWave Micro, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

Chapter 4 – Operation

This chapter provides general operational details for using the ControlWave Micro Distributed I/O System.

In This Chapter

⚠ **WARNING**

EXPLOSION HAZARD

Substitution of components may impair suitability for use in Class I, Division 2 environments.

When the ControlWave Micro Distributed I/O System s situated in a hazardous location, turn off power before servicing or replacing the unit and before installing or removing I/O wiring.

Do not disconnect equipment unless the power is switched off or the area is known to be non-hazardous.

4.1 Powering Up/Powering Down the ControlWave Micro Distributed I/O System

The ControlWave Micro distributed I/O system receives power from an external bulk power supply into connector TB1. *Chapter 2* includes instructions for wiring a power supply to the distributed I/O system.

To apply power to the ControlWave Micro distributed I/O system, plug the power supply into connector TB1 on the PSSM.

To remove power from the device, unplug the power supply from connector TB1 on the PSSM.

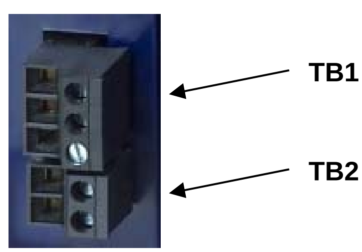


Figure 4-1. Connectors TB1 and TB2

4.2 Communicating with the ControlWave Micro Distributed I/O System

You communicate to the ControlWave Micro distributed I/O system by connecting a cable between a port on your PC workstation and one of the ControlWave Micro distributed I/O system ports.

The port at the PC workstation must match the configuration of the distributed I/O system's port.

4.2.1 Default Comm Port Settings

As delivered from the factory, ControlWave Micro distributed I/O system communication ports have default settings. *Table 4-1* details these defaults.

Table 4-1. Default Comm Port Settings (by PCB)

Port	PCB	Default Configuration
COM1	CPU	Ships from factory at RS-232; 115.2 Kbps using BSAP. Once the default switch is OFF, a factory default of IP Point-to-Point protocol (PPP) at 115,200 applies with an IP address of 1.1.1.1 and a mask of 255.255.255.255.
COM2	CPU	RS-232; 9600 baud, 8 bits, no parity, 1 stop bit, RTU message type Modbus Slave protocol
COM3	CPU	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol

Notes:

- You can re-enable the factory default comm. settings at any time by setting switch SW2-3 on the CPU module to "OFF."
- If you set both SW2-3 and SW2-8 to "OFF" all serial ports (including COM1) become 9600 baud/BSAP. This is used for diagnostics mode.
- For information on communication cables see *Chapter2*.

Ethernet

Using the Ethernet port (located on the CPU module), you can connect either directly or through a network to a PC equipped with an Ethernet port.

The factory pre-configures the initial IP addresses and mask as follows:

ETH1 IP Address: 10.0.1.1 IP Mask: 255.255.255.0

Because each unit ships from the factory with this address initially pre-programmed, you should only use this address for "bench" testing and configuration. You must change this address before putting the I/O system on an actual network, since an address conflict would exist as soon as you place the second ControlWave unit online.

4.2.2 Changing Port Settings

You change port settings (baud rate, port type, IP address, and so on) using the Flash Configuration utility.

You must establish communications with the distributed I/O system using NetView, LocalView, or TechView before you can run the Flash Configuration utility.

Note: For detailed information on using the Flash Configuration utility, see *Chapter 5* of the *OpenBSI Utilities Manual* (D5081).

Caution

When you change the baud rate for a port, the baud rate changes as soon as you write the flash file changes to the RTU, and do not require a reset. For this reason, you should not change baud rate for the active port on which you are communicating, or communications will immediately stop due to the baud rate mismatch between the PC port and the controller port. If this happens accidentally, you can use CPU switch settings as discussed in the notes in *Section 4.2.1* to restore defaults and re-establish communications.

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Chapter 5 – Service and Troubleshooting

This chapter provides general diagnostic and test information for the ControlWave Micro Distributed I/O System.

In This Chapter

Equipment

You need the following equipment to perform the procedures described in this chapter:

To run diagnostics software:

- PC with WINDIAG software, and either OpenBSI LocalView, NetView, or TechView for communications.
- Null modem interface cable
- Loop-back plug, 9-pin female D-Sub (for RS-232) (see *Figure 5-12*)
- Loop-back plug, 9-pin female D-Sub (for RS-485) (see *Figure 5-13*)
- Loop-back plug, 8-pin RJ-45 male (for twisted pair Ethernet) (see *Figure 5-15*)

To perform firmware upgrades:

- Null modem interface cable
- PC with the following software:
  - o OpenBSI LocalView
  - o OpenBSI System Firmware Downloader and either NetView, LocalView, or TechView for communications.
  - o HyperTerminal (included in Windows®)

To replace the SRAM backup battery:

- Depending on the type of battery holder, either a small flat head screwdriver, or tweezers/needle nose pliers.

To test the Power Supply/Sequencer module (PSSM):

- Digital multi-meter (DMM) with 5-1/2 digit resolution

- DC supply, variable to 30Vdc @ 2.5A (with vernier adjustment)

Note: When you service a ControlWave Micro distributed I/O system on site, we recommend that you close down (or place under manual control) any associated processes. This precaution prevents any processes from accidentally running out of control when you conduct tests.

Caution **Harmful electrical potentials may still exist at the field wiring terminals even though the ControlWave Micro distributed I/O system's power source may be turned off or disconnected. Do not attempt to unplug termination connectors or perform any wiring operations until you verify that all associated power supply sources are turned off and/or disconnected.**

Always turn off any external supply sources for externally powered I.O circuits before you change any modules.

5.1 Upgrading Firmware

The ControlWave Micro distributed I/O system CPU ships from the factory with system firmware already installed. If you need to upgrade the system firmware (stored in Flash memory) to acquire new functionality or restore firmware, you can use one of several methods.

System Firmware Downloader Use this tool to download system firmware to an unattended remote ControlWave Micro distributed I/O system. To use this utility, you must set CPU module switch SW2-6 **ON** (the factory default position).

Note: For further information and detailed use instructions, refer to *Appendix J* of the *OpenBSI Utilities Manual* (D5081).

LocalView One of the standard OpenBSI utilities, LocalView requires OpenBSI version 5.1 (or newer). If you have an older version of OpenBSI, use HyperTerminal.

Note: For further information and detailed use instructions, refer to the Flash Mode section of *Chapter* 5 of the *OpenBSI Utilities Manual* (D5081).

HyperTerminal HyperTerminal is a communications utility program included with Microsoft® Windows® XP.

Notes:

- If you are using a version of OpenBSI older than 5.1, or do not have OpenBSI software, you can only perform a firmware upgrade using HyperTerminal.
- While HyperTerminal is included in Microsoft® Window® XP, some newer versions of Window® do not include it.

- HyperTerminal requires *.BIN files; newer ControlWave firmware upgrade files use *.CAB files. In cases such as those, you should use the Remote System Firmware Downloader.

1. Connect a null modem cable between COM1 of the ControlWave Micro and any RS-232 port on the associated PC.
2. Click **Start** > **Programs** > **Accessories** > **Communications** > **HyperTerminal**
3. If using HyperTerminal for the first time, set the communication properties (for the PC port) via the Properties Menu as follows: Bits per second: = 115200, Data bits: = 8, Parity: = None, Stop bits: = 1, and Flow control: = None and then click **OK**.
4. Either set the PSSM's Mode Switch (SW1) for Recovery Mode, that is, set both switches in the **OPEN** or **CLOSED** position or set CPU Switch SW1-3 **ON** (ON = Force Recovery).
5. Apply power; to the ControlWave Micro distributed I/O system. The resident BIOS initializes and tests the hardware, this process is referred to as POST (Power On Self Test). Unless there is a problem, PSSM status LEDS show status code 10 (LED #5 ON). If you see a different status code, see *Section 5.3.1*
6. From the HyperTerminal Mode menu (*Figure 5-1*), press the **F** key to enter FLASH download. A message warns that the FLASH is about to be erased; press the **Y** key at the prompt. The screen displays dots as the system erases the flash memory; this could take a few minutes.

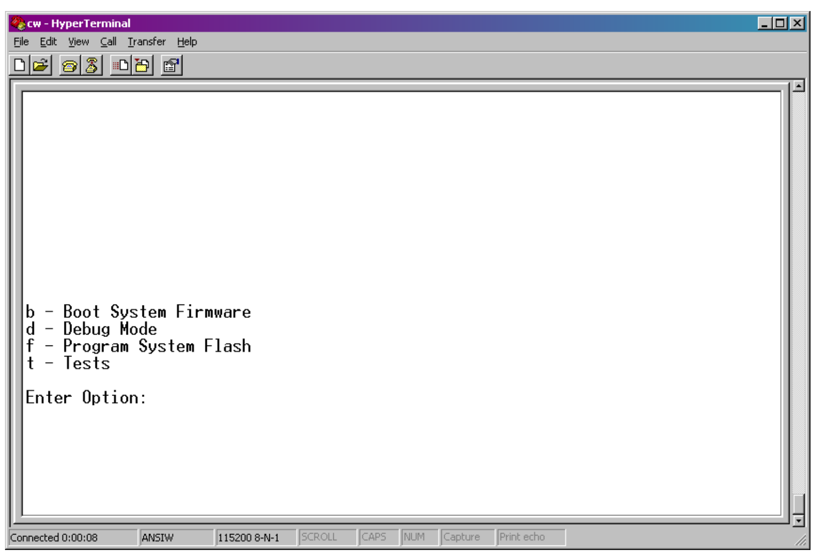


Figure 5-1. HyperTerminal Mode Menu

7. When the FLASH is ready for download, HyperTerminal repeatedly displays the letter C on the screen. In the

HyperTerminal menu bar click **Transfer** > **Send File** (see *Figure 5-2*).

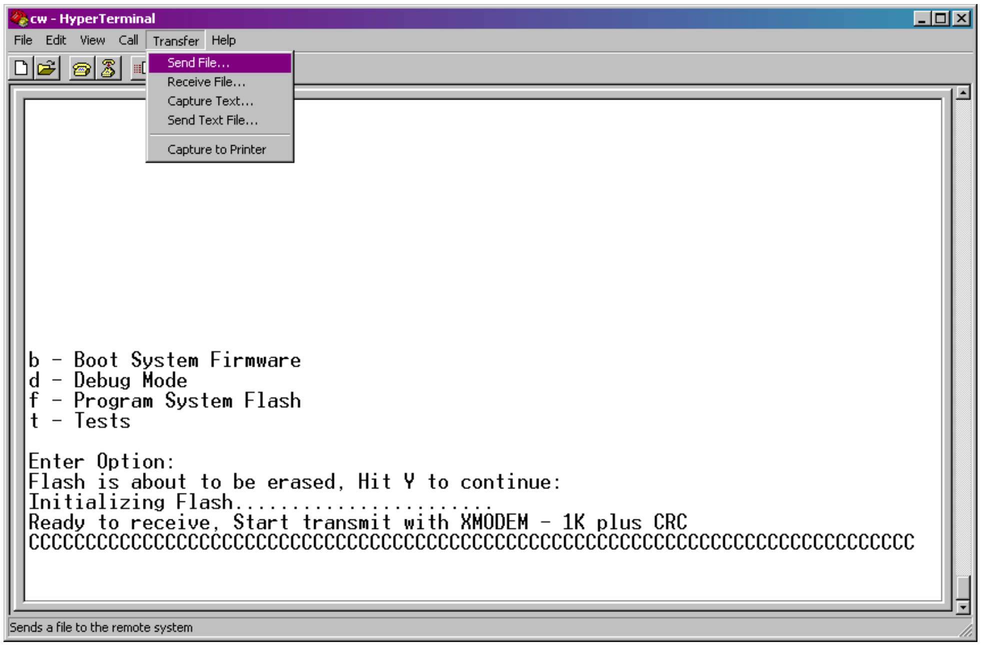


Figure 5-2. HyperTerminal (Ready to Download)

8. In the Send File dialog box (see *Figure 5-3*), select **1KXmodem** for the protocol, enter the filename of the appropriate .bin file in the format “CWM*xxxxx*.bin” (where *xxxxx* varies from release to release) and click **Send** to start the flash upgrade (see *Figure 5-4*). When you see the HyperTerminal Mode Menu again, it means the download has completed.

9. Exit HyperTerminal and power down the ControlWave Micro distributed I/O system. If desired, you can disconnect the null modem cable between the device and the PC.

10. Set the PSSM’s Mode Switch (SW1) for Local Mode, i.e., SW1-1 in the **OPEN** (**Right**) position and SW1-2 in the **CLOSED** (**Left**) position or if CPU Module Switch SW1-3 was set for Recovery Mode, set it to the **OFF** position (OFF = Recovery Mode Disabled).

11. Restore power to the ControlWave Micro distributed I/O system.

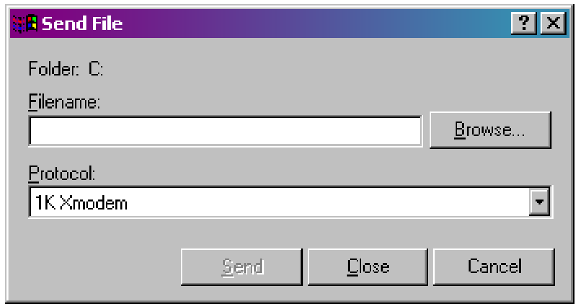


Figure 5-3. Send File dialog box

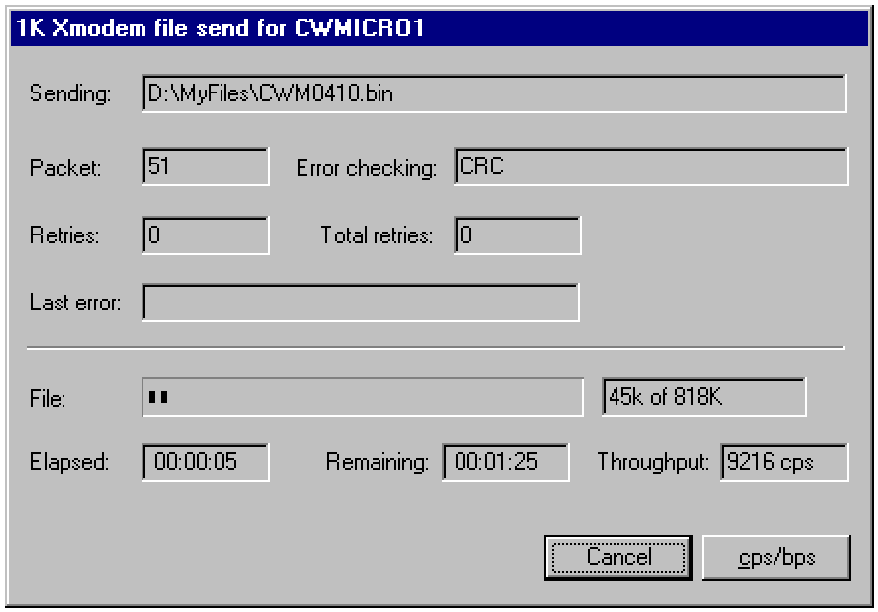


Figure 5-4. HyperTerminal (Download in Process)

5.2 Removing or Replacing Components

This section provides information on accessing Micro modules for testing, as well as removal/replacement procedures.

⚠ Caution **Field repairs to ControlWave Micro distributed I/O systems are strictly limited to the replacement of complete modules. Replacing module components constitutes tampering and violates the product warranty. Return defective modules or housings to the factory for authorized service.**

5.2.1 Accessing Modules for Testing

Only technically qualified personnel should test and/or replace Micro modules. Read completely the disassembly and test procedures described in this manual before starting. Any damage to the ControlWave Micro distributed I/O system resulting from improper handling or incorrect service procedures is not covered under the product warranty agreement. If you cannot properly perform these procedures, obtain authorization and then return the device to the factory for evaluation and repairs.

5.2.2 Removing/Replacing the Bezel

1. Grasp the sides of the bezel assembly and gently lift it up and then off its associated I/O module covers.
2. To replace the bezel, align the latches (left and right, top and bottom) with the associated notches in the I/O module cover. Press the bezel in so that the notches capture its latches and slide it downward until it securely seats.

5.2.3 Removing/Replacing the CPU Module

Use this procedure to remove or replace the CPU module.

1. If the Micro distributed I/O system is running, place any critical control processes under manual control.
2. Shut down the device by disconnecting the power.
3. Disconnect any CPU module communication cables. Label or otherwise identify them so you can easily return them to their assigned communication ports. .
4. Press down on the cover's built-in top latch (with one hand) and up on the cover's built-in bottom latch (with the other hand).
5. Carefully slide the CPU module out of the front of the housing. If any binding occurs, gently rock the module up and down to free it.
6. To replace a CPU module, power must be off. Carefully align the CPU module with the guides for slot 2 in the device and insert the module into the housing. When the module correctly seats, its cover should latch to the housing.
7. Replace any communication cables, apply power, and test the module.

5.2.4 Removing/Replacing the PSSM

Use this procedure to remove or replace the PSSM module.

1. If the Micro distributed I/O system is running, place any critical control processes under manual control and shut down the unit by turning off the power.
2. Unplug the PSSM's modular connectors TB1 (Power), TB2 (Watchdog), and J1 Display Interface Connector (if present).

3. Press down on the cover's built-in top latch (with one hand) and up on the cover's built-in bottom latch (with the other hand).
4. Carefully slide the PSSM module out of the front of the housing. If binding occurs, gently rock the module up and down to free it.
5. To replace a PSSM module, power must be off. Carefully align the PSSM module with the guides for slot 1 in the device and insert the module into the housing. When the module correctly seats, its cover should latch to the housing.
6. Replace power and watchdog cables (and if provided the Display Interface cable) and then apply power and test the unit.

5.2.5 Removing/Replacing an I/O Module

Use this procedure to remove or replace an I/O module.

1. If the Micro distributed I/O system is running, place any critical control processes under manual control and shut down the PSSM module.
2. Remove the applicable bezel (see *Section 5.2.2*).
3. Unplug local termination cable headers from I/O module connectors TB1 and TB2 or remote termination cables headers from connectors P3 and P4 and set the cables aside. Label or otherwise identify these cables so you can easily return them to their assigned connectors.
4. Press down on the cover's built-in top latch (with one hand) and up on the cover's built-in bottom latch (with the other hand).
5. Carefully slide the I/O module out of the front of the housing. If binding occurs, gently rock the I/O module up and down to free it.
6. To replace an I/O module, power must be off. Carefully align the I/O module with the applicable I/O slot and insert the unit into the housing. When the module correctly seats, its cover should latch to the housing.
7. Connect local termination cables to I/O module connectors TB1 and TB2 or remote termination cables to I/O module connectors P3 and P4.
8. Apply power and test the unit.

5.2.6 Removing/Replacing the Backup Battery

Note: The CPU module draws power from the battery only if the module loses power. For a ControlWave Micro distributed I/O system containing 2MB of SRAM, a worst-case current draw of 42 uA allows a battery life of approximately 5238 hours. This means you should not need to replace a battery until the ControlWave Micro distributed I/O system has been in service for an extended period (normally many years).

The CPU module accommodates a lithium coin cell backup battery housed in a coin-cell socket (S1). A supervisory circuit on the CPU switches to battery power when the regulated 3.3 Vdc falls out of specification. The battery then provides backup power for the real-time clock (RTC) and the system SRAM on the CPU module.

Caution

You lose SRAM contents when you remove the backup battery.

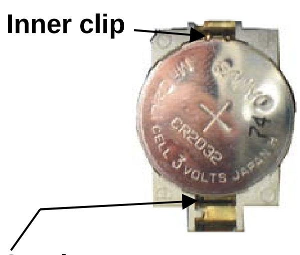
If you replace a backup battery, wait at least one minute before re-powering the system. This enables the SRAM to completely discharge.

After you install the new battery, ensure that you have placed jumper JP8 on pins 1-2 (to enable the battery).

The procedure for replacing the battery varies slightly depending upon the type of battery holder – snap type or clip type.

Removing / Replacing the Battery – Snap Type Holder

Battery Part Numbers: CR2032 DL2032



1. If the ControlWave Micro distributed I/O system is running, place any critical control processes under manual control.
2. Remove power from the device.
3. Remove the CPU module from the housing.
4. To remove the lithium battery, insert the tip of a small flat head screw driver into the gap between the battery and the holder. (The gap is on the side of the holder that doesn't have the inner clip against the battery.) Gently push the screwdriver at an angle underneath the battery and it will pop out of the holder.
5. To install the replacement battery, press one side of the battery against the inner clip of the holder then press the battery down into the slot so it snaps in.
6. Replace the CPU module in slot 2 of the housing.
7. Re-connect power to the device.
8. Once the battery has been replaced, the unit executes its Flash-based application ("boot project") at power-up, but all of the current process data is lost. At power-up, the ControlWave Micro distributed I/O system acts as though it had just been booted and reverts back to the initial values specified in its application.

Removing / Replacing the Battery – Clip Type Holder

Battery Part Numbers:

BR2330, BR2335, BR2335-B

1. If the ControlWave Micro distributed I/O system is running, place any critical control processes under manual control.
2. Remove power from the device.
3. Remove the CPU module from the housing.
4. To remove the lithium battery, gently pry up the tab holding the battery in the coin cell socket and remove the battery with a pair of tweezers or needle-nosed pliers. Install the replacement battery.
5. Replace the CPU module in slot 2 of the housing.
6. Re-connect power to the device.
7. Once the battery has been replaced, the unit executes its Flash-based application ("boot project") at power-up, but all of the current process data is lost. At power-up, the ControlWave Micro distributed I/O system acts as though it had just been booted and reverts back to the initial values specified in its application.

5.2.7 Enabling / Disabling the Backup Battery

For maximum shelf life, the CPU module ships from the factory with the installed lithium backup battery disabled. You must enable it when you install the CPU module.

Enabling To enable the battery, install jumper JP8 on pins 1-2.

Disabling For maximum shelf life, you can isolate the battery from the circuit by placing jumper JP8 on pins 2-3.

5.3 General Troubleshooting Procedures

This section presents some procedures to troubleshoot problems with the ControlWave Micro distributed I/O system.

5.3.1 Checking LEDs

Most Micro modules contain light emitting diodes (LEDs) that provide operational and diagnostic functions.

Table 5-1 shows LED assignments on Micro modules.

Table 5-1. LED Assignments on Modules

Module	LED Name	LED Color	Function
PSSM	IDLE	Red	ON = Idle
PSSM	WD	Red	ON = Watchdog condition OFF = Normal

Module	LED Name	LED Color	Function
PSSM	6 STATUS	Red	See *Table 5-2* and *Figure 5-5*
CPU	C1 RX (Comm 1)	Red	ON = RX activity (top left; see *Figure 5-6*)
CPU	C1 TX (Comm 1)	Red	ON = TX activity (top left; see *Figure 5-6*)
CPU	C2 RX (Comm 2)	Red	ON = RX activity (middle left; see *Figure 5-6*)
CPU	C2 TX (Comm 2)	Red	ON = TX activity (middle left; see *Figure 5-6*)
CPU	C3 RX (Comm 3)	Red	ON = RX activity (bottom left; see *Figure 5-6*)
CPU	C3 TX (Comm 3)	Red	ON = TX activity (bottom left; see *Figure 5-6*)
CPU	ENET Port 1	Green	ON = TX activity (J6 bottom; see *Figure 5-6)*
CPU	ENET Port 1	Yellow	ON = RX activity (J6 top; see *Figure 5-6*)
ECOM1	EC 4/8 RX (Comm 4)	Red	ON = RX activity (top left; see *Figure 5-7*)
ECOM1	EC 4/8 TX (Comm 4)	Red	ON = TX activity (top right; see *Figure 5-7*)
ECOM1	EC 5/9 RX (Comm 5)	Red	ON = RX activity (2nd from top left; see *Figure 5-7*)
ECOM1	EC 5/9 TX (Comm 5)	Red	ON = RX activity (2nd from top right; see *Figure 5-7*
ECOM1	Radio RX (Comm6)[1]	Red	ON = RX activity (3rd from top left; see *Figure 5-7*) (Note: Radio no longer offered- ignore - always ON)
ECOM1	Radio TX (Comm6)[1]	Red	ON = TX activity (3rd from top right; see *Figure 5-7*) Note: Radio no longer offered (always OFF)
ECOM1	Modem RX (Comm7)[1]	Red	ON = RX activity (bottom left;; see *Figure 5-7*)
ECOM1	Modem TX (Comm7)[1]	Red	ON = TX activity (bottom right; see *Figure 5-7)*
ECOM2	EC4/8 RX (Comm 4/8) [1]	Red	ON = RX activity (top left; see *Figure 5-8*)
ECOM2	EC4/8 TX (Comm 4/8) [1]	Red	ON = TX activity (top right; see *Figure 5-8*)
ECOM2	EC5/9 RX (Comm 5/9) [1]	Red	ON = RX activity (2nd from top left; see *Figure 5-8*)
ECOM2	EC5/9 TX (Comm 5/9) [1]	Red	ON = TX activity (2nd from top right; see *Figure 5-8*
ECOM2	EC6/10 RX (Comm 6/10) [1]	Red	ON = RX activity (3rd from top left; see *Figure 5-8*)
ECOM2	EC6/10 TX (Comm 6/10) [1]	Red	ON = TX activity (3rd from top right; see *Figure 5-8*)
ECOM2	EC7/11 RX (Comm 7/11) [1]	Red	ON = RX activity (bottom left;; see *Figure 5-8*)
ECOM2	EC7/11 TX (Comm 7/11) [1]	Red	ON = TX activity (bottom right; see *Figure 5-8*)
IDI	INPUT (16 LEDs,1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
IDO	OUTPUT (16 LEDs,1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)
DI/O IDI/O	INPUT (12 LEDs, 1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
DI/O IDI/O	OUTPUT (4 LEDs, 1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)
HSC	INPUT (4 LEDs, 1 per point)	Red	LED ON = Input activity on input is present LED OFF = No activity on input (see *Figure 5-*

Module	LED Name	LED Color	Function
			9)
MI/O	DI INPUT (6 LEDs, 1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
MI/O	DI INPUT (6 LEDs, 1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)
MI/O	HSC INPUT (2 LEDs, 1 per point)	Red	LED ON = Input activity on input is present LED OFF = No activity on input (see *Figure 5-9*)
IDI (Vac)	INPUT (8 LEDs, 1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
IDO (Vac/dc)	OUTPUT (8 LEDs, 1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)

[1]Radio or modem with Type 1 comm board only

PSSM System Status LED Codes

As the Micro runs, status codes post to the six LEDs on the PSSM. *Table 5-2* provides activity descriptions of the LEDs; *Figure 5-5* shows what the LEDs look like for each hex code.

Table 5-2. System Status LED Codes on PSSM

Status in Hex	LED 6	ED 5	LED 4	LED 3	LED 2	LED 1	Activity Indicator
00	0	0	0	0	0	0	Application Running
01	0	0	0	0	0	1	Unit in Diagnostic Mode
03	0	0	0	0	1	1	Unit Running Diagnostics
04	0	0	0	1	0	0	Flash XSUM Error
05	0	0	0	1	0	1	Error Initializing Application Device
07	0	0	0	1	1	1	Flash Programming Error
08	0	0	1	0	0	0	Using Factor Defaults (flashed at start)
09	0	0	1	0	0	1	Battery Failure Detected (flashed at startup)
0A	0	0	1	0	1	0	Currently Loading the Boot Project
0B	0	0	1	0	1	1	System Initialization in Progress
10	0	1	0	0	0	0	Waiting in Recovery Mode
11	0	1	0	0	0	1	Error Testing SDRAM
12	0	1	0	0	1	0	Error Testing SRAM
20	1	0	0	0	0	0	Application Loaded
28	1	0	1	0	0	0	Stopped at Break Point
30	1	1	0	0	0	0	No Application Loaded
38	1	1	1	0	0	0	Running with Break Points
3B	1	1	1	0	1	1	Waiting for a Power-down (after NMI)
3E	1	1	1	1	1	0	Waiting for Updump to be Performed
3F	1	1	1	1	1	1	Unit Crashed (Watchdog Disabled)

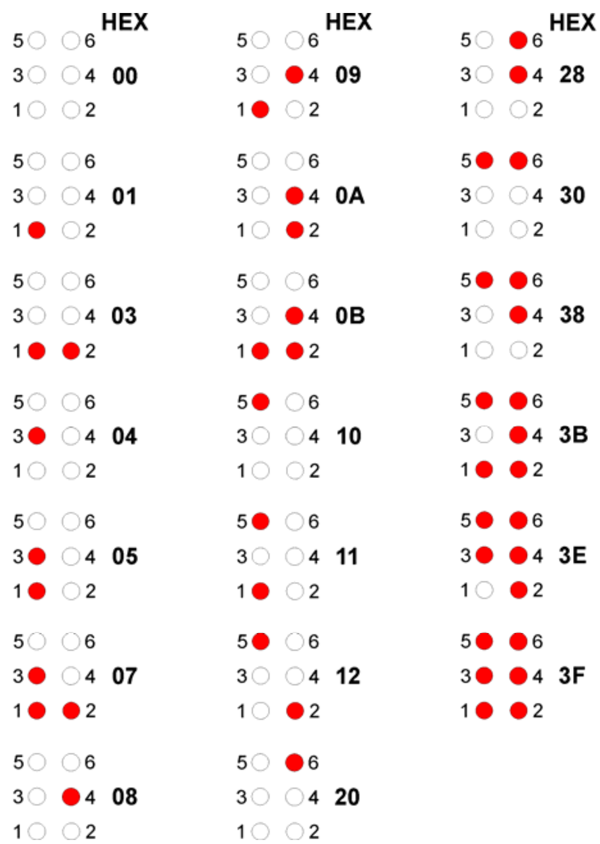


Figure 5-5. PSSM Status LED Hexadecimal Codes

CPU Module LEDs

The CPU module has four or six comm port activity LEDs on the CPU board. Units equipped with an Ethernet port have two additional LEDs located on the Ethernet RJ-45 connector. *Table 5-3* details assignments for the LEDs on the CPU module.

An ON LED indicates an associated transmit (TX) or receive (RX) activity.

Table 5-3. CPU Module LEDs

LED Ref	LED Function
C1	Transmit (TX) COM1
C1	Receive (RX) COM2
C2	Transmit (TX) COM2
C2	Receive (RX) COM2
C3	Transmit (TX) COM3
C3	Receive (RX) COM3
J5 - Bottom	Ethernet Link Transmit (TX)
J5 - Top	Ethernet Link Receive (RX)
J6 – Bottom	Ethernet Link Transmit (TX)
J6 – Top	Ethernet Link Receive (RX)

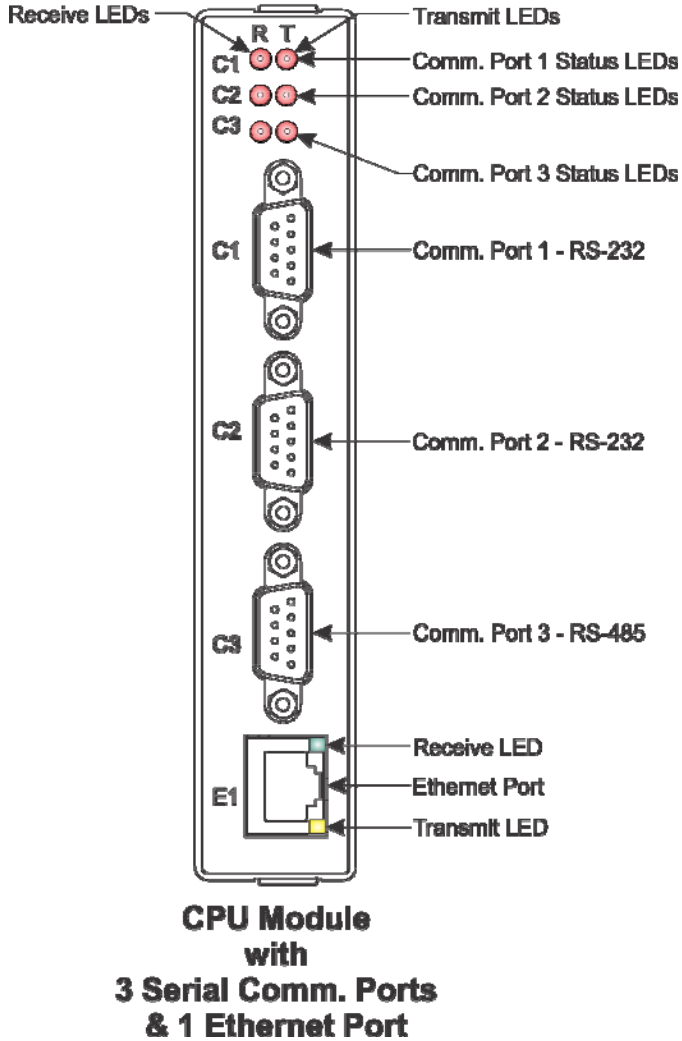


Figure 5-6. CPU Module Comm Connectors and LEDs

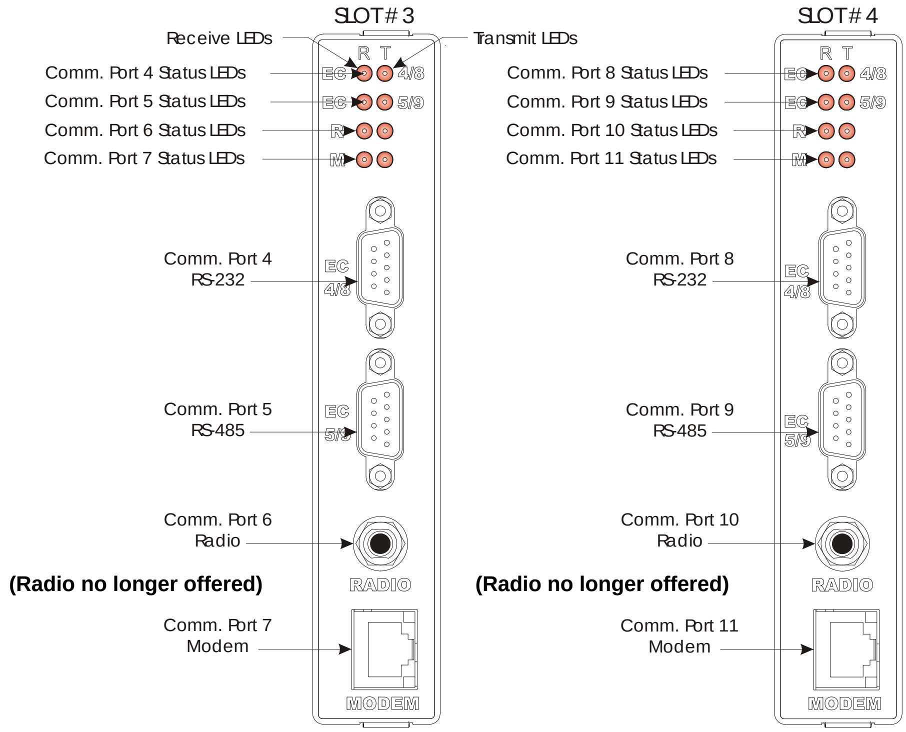


Figure 5-7. Type 1 Expansion Comm Module Comm Connectors and LEDs

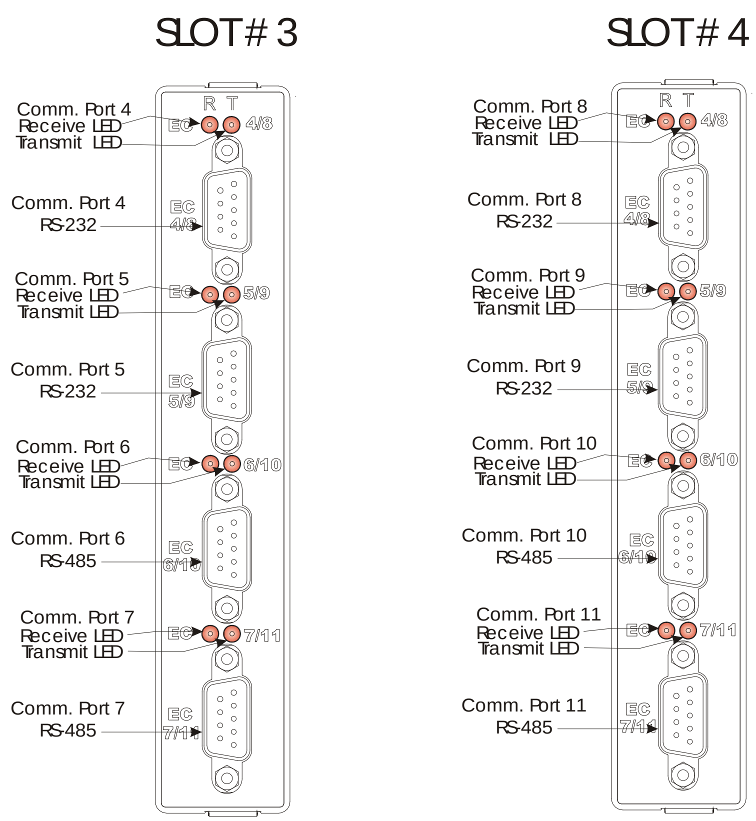


Figure 5-8. Type 2 Expansion Comm Module Comm Connectors and LEDs

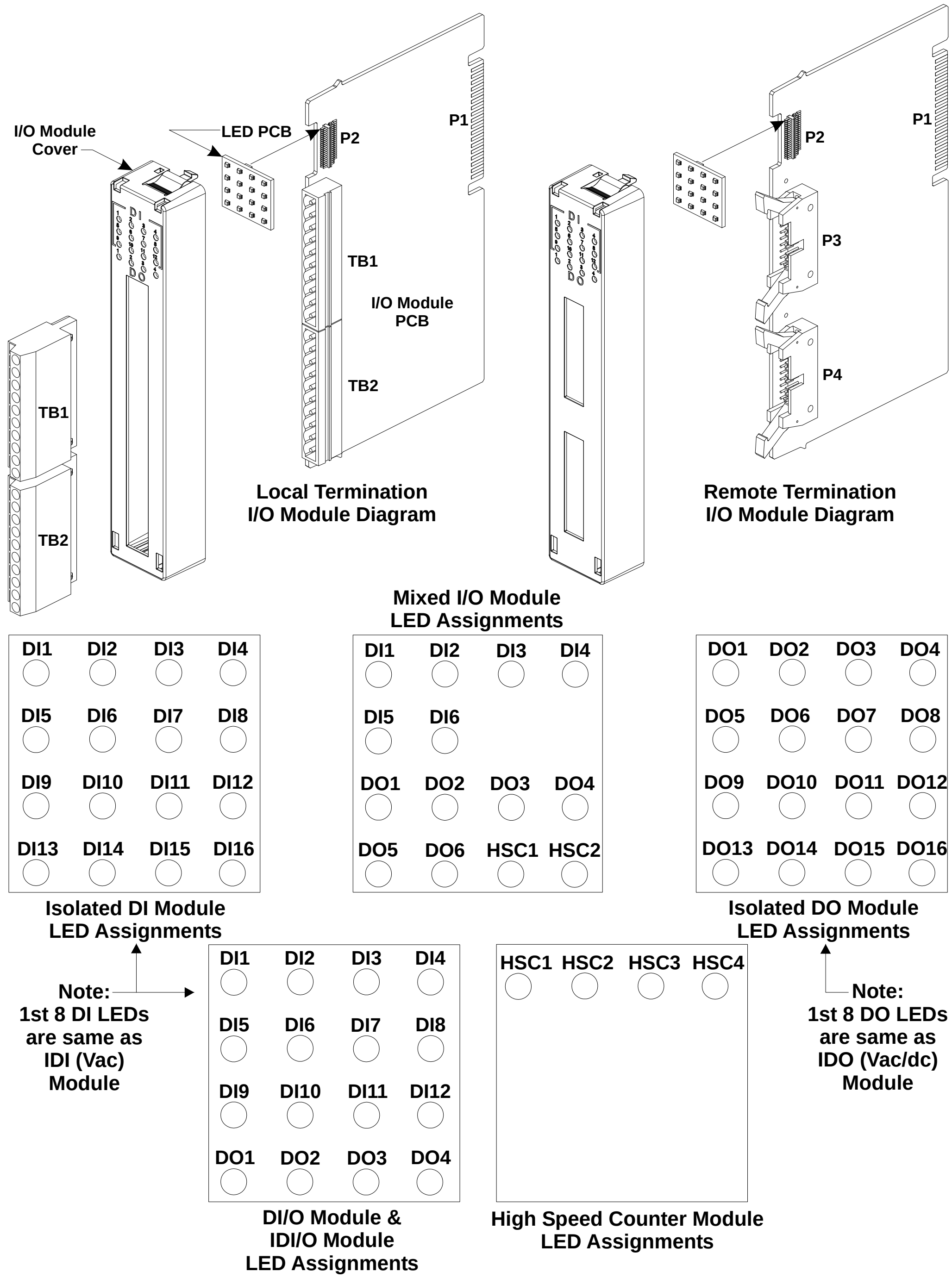


Figure 5-9. I/O Module LEDs

5.3.2 Checking Wiring/Signals

Check I/O field wiring at the terminal blocks and at the field device. Inspect the wiring for continuity, shorts, and opens. Check I/O signals at their respective terminal blocks (see *Table 5-4*).

Table 5-4. I/O Field Wiring - Terminal Block Reference

I/O Subsystem	Notes
Isolated Digital Inputs	See *Section 3.3*
Isolated Digital Outputs	See *Section 3.4*
Non-isolated Digital I/Os	See *Section 3.5*
Non-isolated Analog I/Os	See *Section 3.6*
Non-isolated HSC Inputs	See *Section 3.7*
Isolated Analog Inputs	See *Section 3.8*
Isolated Analog Outputs	See *Section 3.9*
Non-isolated Mixed I/Os	See *Section 3.10*
Isolated Digital Inputs (Vac)	See *Section 3.11*
Isolated Digital Outputs (Vac/dc)	See *Section 3.12*
Isolated Digital I/Os	See *Section 3.13*
Isolated RTD Inputs	See *Section 3.14*
Isolated Low Level Analog Inputs	See *Section 3.15*
Watchdog Circuit	See *Section 2.3.7*

5.3.3 Common Communication Configuration Problems

If serial communications do not function, it is often due to one of the following issues:

- Baud rate mismatch – the baud rate at both ends of the communication line must match. If communications fail during a download of a new flash configuration profile (FCP) file, you may have changed the baud rate of the active communication line, since baud rate changes occur immediately on FCP download. You can always re-establish factory default baud rates for communication ports by powering down the unit, and then setting CPU switch SW2-3 to **OFF** and restoring power.
- Incorrect BSAP local address – this address must be an integer from 1 to 127 and must be unique on this particular BSAP communication line. You set the BSAP local address using the flash configuration utility. If this ControlWave Micro is a BSAP slave node, and the range of addresses defined for the BSAP master port end of the communication line does not encompass the local BSAP address defined for this ControlWave Micro, BSAP communications will not function.
- Incorrect EBSAP Group number – if you use expanded BSAP the EBSAP group number must be correct; if you are not using EBSAP, the group number must be 0.

If IP communications do not function, it is often due to incorrect IP addresses or masks. Check to see that the IP address you defined for the

ControlWave Micro is compatible with the range of IP addresses defined for the communication line on which the unit resides. Also check that the IP address of the default gateway is correct.

5.4 WINDIAG Diagnostic Utility

WINDIAG is a software-based diagnostic tool you use to test the performance of I/O modules, CPU memory, communication ports, and other system components. .

WINDIAG is a PC-based program, so the Micro must be attached to and communicating with a PC running WINDIAG. Set configuration switch SW2-8 **OFF** (closed) on the CPU module to enable the diagnostic routines.

Establish communication between the Micro (with/without an application loaded) and the PC with a local or network port under the following conditions:

- Turn CPU module switch SW2-8 **OFF** to run the WINDIAG program. Setting this switch off prevents the boot project from running and places the Micro in diagnostic mode.
- Use a null modem cable to connect RS-232 ports between the Micro and the PC; use an RS-485 cable (see *Section 2.4.4*) to connect the RS-485 ports of the Micro and the PC.
- Reserve the port running a diagnostic test for exclusive use; you cannot use that port for any other purpose during testing.
- Connect any Micro communication port to the PC provided their port speeds match. Most PCs have a COM1 port (typically RS-232 and defaulted to 9600 bps operation).
- Configure the Micro communication port to be tested using WINDIAG for 9600 baud, 8-bits, no parity, 1 stop bit, and BSAP/ControlWave Designer protocol operation. Communication port COM1 is only forced to 9600 bps operation when you have set switch SW2-3 on the CPU module to **OFF**.

Table 5-5. COM Port Defaults for Diagnostics

Port	Module	Default Configuation
COM1	CPU	RS-232: 115.2 kbd using IP PPP protocol To run diagnostics, set RS-232 to 9600 baud by setting CPU switches SW2-3 and SW2-8 **OFF**.
COM2	CPU	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, Modbus Slave RTU-type protocol.
COM3	CPU	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM4	ECOM Types 1 or 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM5	ECOM Type 1	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or

Port	Module	Default Configuation
		ControlWave Designer protocol.
	ECOM Type 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM6	ECOM Type 1	Not applicable
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM7	ECOM Type 1	Not applicable
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM8	ECOM Types 1 or 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM9	ECOM Type 1	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
	ECOM Type 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM10	ECOM Type 1	Radio port
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM11	ECOM Type 1	Modem port
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.

You can connect an optional Ethernet port (situated on the CPU module) directly or via a network to a PC equipped with an Ethernet port (see *Section 2.4.5*).

Before starting the WINDIAG program, place any critical processes the Micro is handling under manual control. You cannot run WINDIAG while the Micro is running applications. Set the CPU modules switches SW2-3 and SW2-8 to **OFF**, and perform the following steps:

1. Start the NetView program in OpenBSI with your current network NETDEF file. A menu displays (similar to the one in *Figure 5-10*):

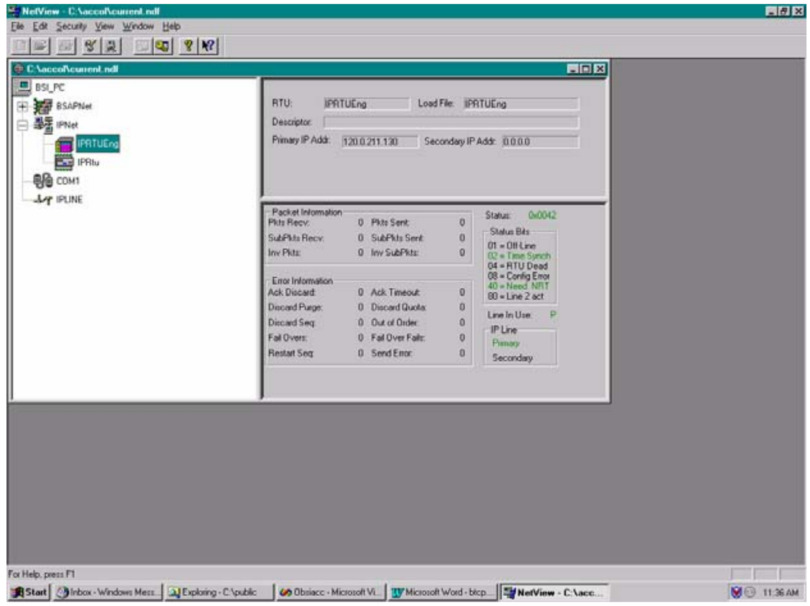


Figure 5-10. NetView

2. Select **Start** >**Programs > OpenBSI Tools** >**Common Tools** > **Diagnostics**. The Main Diagnostics menu (*Figure 5-11*) displays.

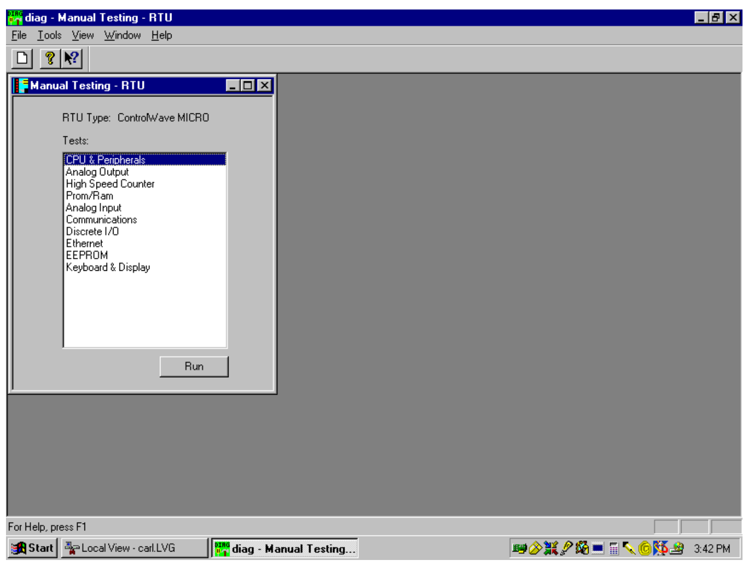


Figure 5-11. WINDIAG Main Diagnostics Menu

3. Select the module to be tested. Enter any prompted parameters (slot #, etc.). WINDIAG performs the diagnostics and displays pass/fail results.

4. After performing all diagnostic testing, exit WINDIAG and then exit the NetView if you don't have any other Micro units to test.

   When you close NetView, the system asks whether you want to close OpenBSI. Select **Yes**.

5. Set switch SW2-8 on the CPU module to **ON** (open). The Micro should resume normal operation.

5.4.1 Available Diagnostics

Using WINDIAG, you can test all Micro modules with the exception of the PSSM. WINDIAG's Main Diagnostics Menu (see *Figure 5-11*) provides the following diagnostic selections:

Option	Tests
CPU & Peripherals	Checks the CPU module (except for RAM & PROM).
Analog Output	Checks AOs on AI/O, AO, or Mixed I/O modules.
High Speed Counter	Checks HSCs on HSC or Mixed I/O modules.
Prom/Ram	Checks the CPU's RAM and PROM hardware.
Analog Input	Checks AIs on AI/O, AI, or Mixed I/O modules.
Communications	Checks Communication ports 1 through 9 (but not COM6 or COM7). The External loop-back tests require the use of a loop-back plug.
Discrete I/O	Checks DIs on DI, DI/O, or Mixed I/O modules and/or checks DOs on DO, DI/O, or Mixed I/O modules.
Ethernet	Checks Ethernet Port 1 or 2. The Loop-back Out Twisted Pair tests require the use of a loop-back plug.
Low Level AI	Checks Thermocouples and CJC on LLAI modules and check RTDs on RTD modules.

Port Loop-back Test

WINDIAG allows you to select the communication port (1 through 4) to test. Depending on the type of network (RS-232 or RS-485) and the port in question, a special loop-back plug is required:

- Ports 1, 2, 4, and 8 (RS-232) use a 9-pin female D-type loop-back plug (shown in *Figure 5-12*).

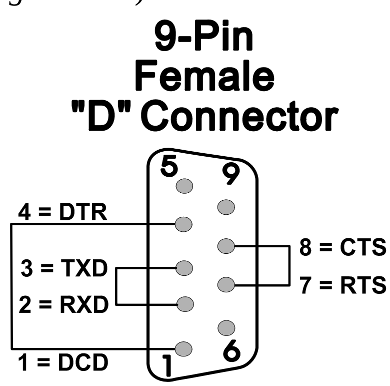


Figure 5-12. RS-232 Loop-back Plug

- Ports 3, 5, and 9 (RS-485) use a 9-pin female D-type loop-back plug (shown in *Figure 5-13*).

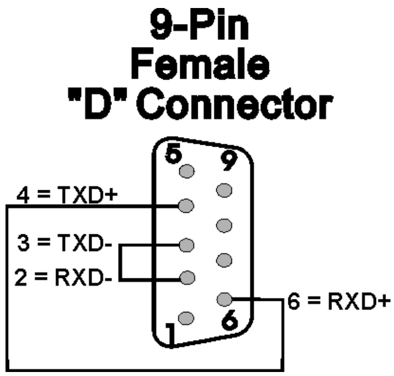


Figure 5-13. RS-485 Loop-back Plug

These tests verify the correct operation of the communication interface on ports COM1 through COM5 and COM8 and COM9.

Note: You **cannot** test a communications port while you are using it. You can only test currently unused ports. After you complete testing on all other communication ports (and verify their correct functioning), you must reconnect (using a now validated port) and test the remaining untested port.

Test Procedure

Use this procedure to test the comm ports.

1. Connect an external loop-back plug to the port on the CPU, ECOM1, or ECOM2 module to be tested. Valid ports are:
   - J3 of CPU module for COM1
   - J4 of CPU module for COM2
   - J5 of CPU module for COM3
   - J1 of ECOM1 module for COM4
   - J2 of ECOM1 module for COM5
   - J1 of ECOM2 module for COM8
   - J2 of ECOM2 module for COM9
2. Select **Communications** on the WINDIAG Main Diagnostics Menu. The Communications Diagnostic screen opens:

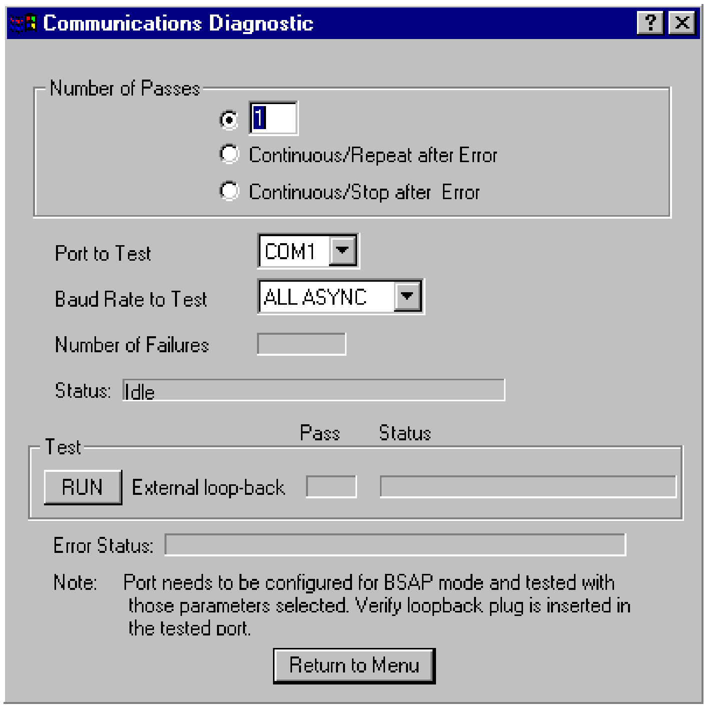


Figure 5-14. Communications Diagnostic Menu

3. Enter **5** in the Number of Passes field.

4. Select a port to test (click ▼ to display all available ports).

Note: The port you select must correlate to the port on which you placed the loop-back plug in step 1.

5. Select **115200** or **ALL ASYNC** as the baud rate (click ▼ to display all available rates).

6. Click **RUN** to start the test. At the completion of the test (which generally takes about 5 seconds), any failed results appear in the Status field to the right of the RUN button:

- TXD RXD Failure
- CTS RTS Failure

7. Click **Return to Menu** to display the WINDIAG Main Menu.

Ethernet Port Loop-back Test

The **Ethernet** option on the WINDIAG Main Menu allows you to select the Ethernet communication port (1) to test.

This test configures the Ethernet port's ability to transmit and receive via the twisted pair. The text transmits frames and compares them against received frames. You need a special loop-back plug (shown in *Figure 5-15*) to perform the Ethernet loop-back test:

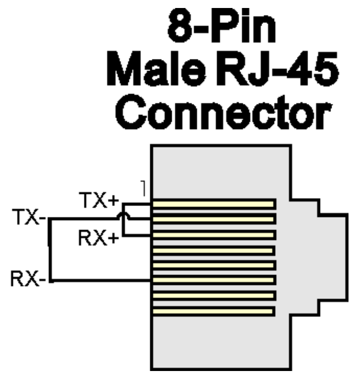


Figure 5-15. RJ-45 Ethernet Loop-back Plug

Note: You **cannot** test a communications port while you are using it. You can only test currently unused ports. After you complete testing on all other communication ports (and verify their correct functioning), you must reconnect (using a now validated port) and test the remaining untested port.

Test Procedure

Use this procedure to test the Ethernet port.

1. Connect an external Ethernet loop-back plug (see *Figure 5-15*) to the Ethernet port on the CPU module to be tested.

2. Select **Ethernet** on the WINDIAG Main Diagnostics Menu. The Ethernet Diagnostic screen opens:

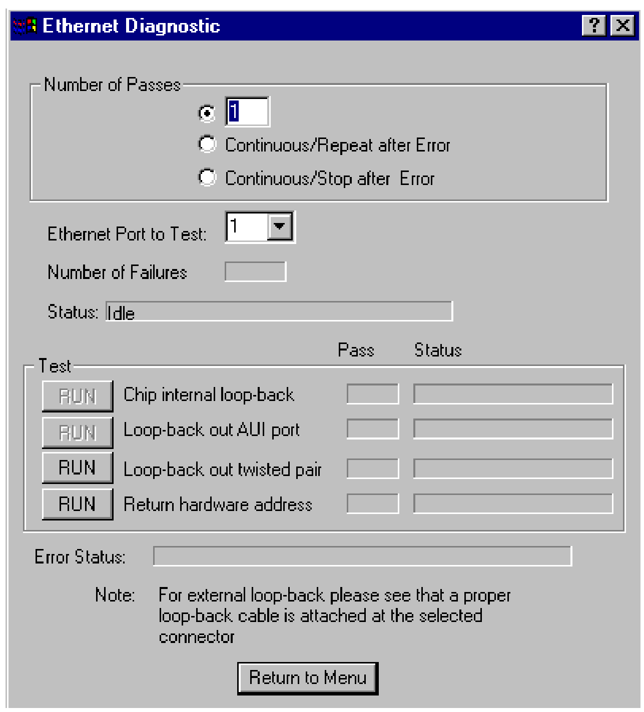


Figure 5-16. Ethernet Diagnostic Menu

3. Enter **1** in the Number of Passes field.

4. Enter **1** in the Ethernet Port to Test field.

5. Click **RUN** next to the Loop-back out twisted pair field to start the test. At the completion of the test, any failed results appear in the Status field next to the **Loop-back out twisted pair** label:
   - No Hardware Present
   - Loop-back Send Failed
   - Loop-back Receive Failed
   - Loop-back Compare Failed
   - Error Information Returned

6. Disconnect the loop-back plug and reconnect the Ethernet cable to the Micro and the Ethernet hub.

7. Click **Return to Menu** to display the WINDIAG Main Menu.

5.5 Core Updump

In some cases—such as when a Micro fails for no apparent reason—you can upload a copy of the contents of SRAM and SDRAM to a PC for support personnel and service engineers to evaluate. This upload is called a “core updump.”

A core updump may be required if the Micro spontaneously enters a watchdog state that affects all system operation. This occurs when the system crashes as a result of a CPU timeout (resulting from improper software operation, a firmware glitch, and so on). In some cases, the watchdog state can recur but you cannot logically reproduce the conditions.

The CPU module’s RAM contains “crash blocks,” a firmware function provided specifically for watchdog troubleshooting. You can view and save the crash blocks by viewing the Crash Block Statistic Web Page (see the *Web_BSI Manual*, D5087). On request, you can forward crash block files to our technical support personnel. If they need additional information to evaluate the condition, the technical support group may request a core updump. Once the core updump process generates a file, you can forward that file to the support personnel for evaluation and resolution.

Use the following steps to preserve the “failed state” condition at a system crash and perform a core updump:

1. Set switch SW2-1 on the CPU module to **OFF** (Disable Watchdog Timer). If switch SW2-4 is **ON**, set it to **OFF** (Enable Core Updump).

Note: The factory default setting for switch SW2-4 is **OFF**.

2. Wait for the error condition (typically 3F on the PSSM’s status LEDs).

3. Connect the ControlWave Micro's Comm Port 1 to a PC using a null modem cable.

4. If the Micro's PSSM has a Run/Remote/Local switch, set it as follows:

Note: You must perform each step in less that one second.

a. Set Run/Remote/Local switch to **Run**

b. Set Run/Remote/Local switch to **Remote**

c. Set Run/Remote/Local switch to **Local**

d. Set Run/Remote/Local switch back to **Remote**

e. Set Run/Remote/Local switch back to **Local**

If the PSSM has an SW1 mode switch, set it for Recovery Mode: set **both** SW1-1 and SW1-2 to the right for open operation or both to the left for closed operation.

5. Start the PC's HyperTerminal program (at 115.2 kbaud) and generate a receive using the 1KX-Modem protocol. Save the resulting core updump in a file so you can forward it later to the technical support group.

By setting the CPU module switches SW2-1 and SW2-4 both off **before** the Micro fails, you prevent the Micro from automatically recovering from the failure and enable it to wait for you to take a core updump.

Once you complete the core updump, set the CPU module's switch SW2-1 to **ON** (Watchdog Enabled) and SW2-4 to **OFF** (Core Updump Enabled).

Additionally, if the PSSM has a mode switch, set switch SW1-1 to open (right) and SW1-2 to closed (left). If the PSSM has a Run/Remote/Local switch, set it to Local.

With these switches set, power up the Micro and recommence standard operations.

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Appendix A – ControlWave Micro Distributed I/O System – Special Instructions for Class I, Division 2 Hazardous Locations

1. The ControlWave Micro Distributed I/O System is listed by Underwriters Laboratories (UL) as nonincendive and is suitable for use in Class I, Division 2, Groups A, B, C and D hazardous locations and non-hazardous locations only. Read this document carefully before installing a nonincendive ControlWave Micro Distributed I/O System. In the event of a conflict between the ControlWave Micro Distributed I/O System Instruction Manual (D301772X012) and this document, always follow the instructions in this document.
2. All power and I/O wiring must be performed in accordance with Class I, Division 2 wiring methods as defined in Article 501-4 (b) of the National Electrical Code, NFPA 70, for installations within the United States, or as specified in Section 18-152 of the Canadian Electrical Code for installation in Canada.

⚠ **WARNING**	**EXPLOSION HAZARD** **Substitution of components may impair suitability for use in Class I, Division 2 environments.**

⚠ **WARNING**	**EXPLOSION HAZARD** **When situated in a hazardous location, turn off power before servicing / replacing the unit and before installing or removing I/O wiring.**

⚠ **WARNING**	**EXPLOSION HAZARD** **Do NOT disconnect equipment unless the power is switched off or the area is known to be non-hazardous.**

Appendix B – Open MODBUS Interface

The Open Modbus Interface allows access to areas of memory in the I/O expansion rack serving as Modbus registers and coils.

In order to determine which coil / register addresses to reference in your Modbus commands, please refer to the tables on the following pages.

Notes:

- By default, registers are transmitted upper byte or upper word (upper byte within a word) first.
- If, because of the requirements of your protocol, or device, you need to change the order of transmission, please follow the instructions at the end of this appendix.
- For information on internal mapping of particular I/O modules, see the *I/O Mapping* section of the *ControlWave Designer Programmer's Handbook*.

B.1 Supported Devices

The following hardware platforms support this interface:

- ControlWave Process Automation Controller (PAC) with ControlWave I/O Expansion Rack
- ControlWave Redundant Controller (CWRED) with ControlWave I/O Expansion Rack
- ControlWave Redundant I/O Switcher (CW RED I/O) with ControlWave I/O Expansion Racks
- ControlWave Micro (CWM) Process Automation Controller with Distributed I/O System
- ControlWave CW_10, CW_30, or CW_35 controller with CW_31 Remote I/O Rack

B.2 Determining the Correct I/O Slot

If you have a host ControlWave device and an I/O rack, the I/O rack's slots are treated as slots numbered consecutively from the maximum host I/O slot number. So to reference I/O slots in the I/O rack, add the maximum host I/O slot number to the I/O slot number in the I/O rack.

For example, if you have a ControlWave host controller with eight (8) I/O slots that has an attached I/O expansion rack with four (4) I/O slots, for Modbus addressing purposes you reference the I/O expansion rack I/O slots as slots 9, 10, 11, and 12. (*See Figure B-1*.)

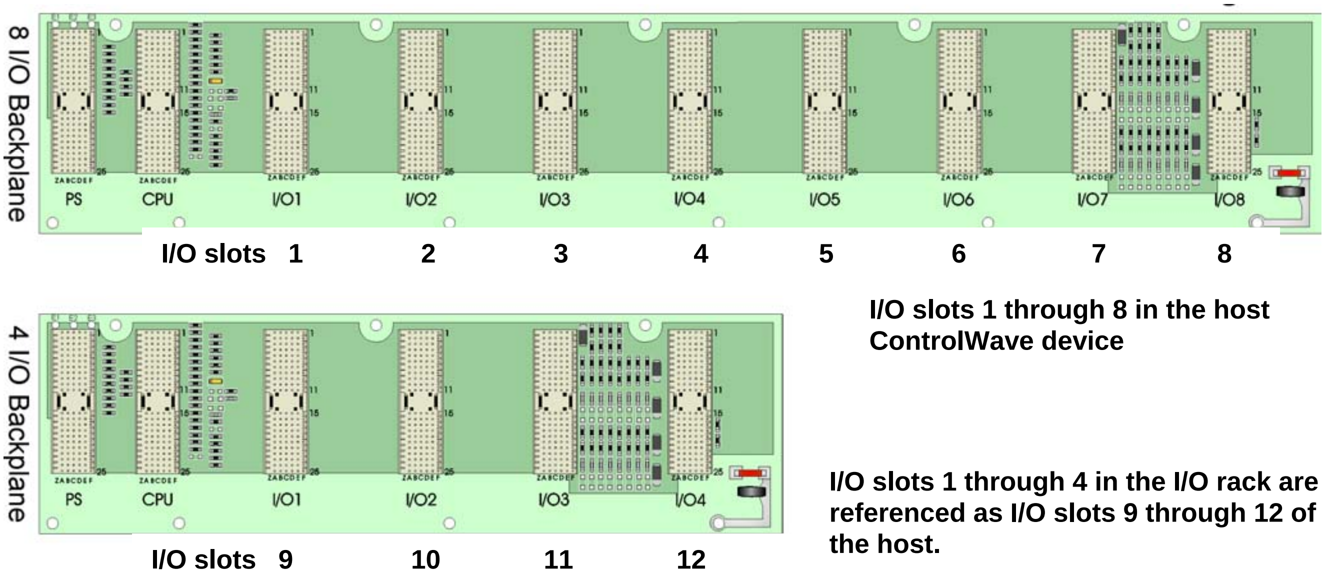

Figure B-1. Referencing I/O Slots Outside the Host

Notes:

- I/O racks that are part of a redundant pair share the same slot numbers.
- The address tables cover slot numbers up through 14. If you have multiple non-redundant I/O racks attached to the same host ControlWave, use consecutive I/O slot numbers for each successive rack, as if it was the part of the host ControlWave. Mapping addresses follow the same pattern for the higher slots.

B.3 Addressing for MODBUS Coils and Registers

B.3.1 System Data

Range: 1-100

I/O Slot	Board Status	Hot Card Replacement in Progress	Battery Status	Board Type Register (2 byte – transmitted upper byte first)
1	1	17	18	1
2	2	17	18	2
3	3	17	18	3
4	4	17	18	4
5	5	17	18	5
6	6	17	18	6
7	7	17	18	7
8	8	17	18	8
9	9	17	18	9

I/O Slot	Board Status	Hot Card Replacement in Progress	Battery Status	Board Type Register (2 byte – transmitted upper byte first)
10	10	17	18	10
11	11	17	18	11
12	12	17	18	12
13	13	17	18	13
14	14	17	18	14

B.3.2 Digital Data

Range: 101-420 (40 per board)

Example: To read DO output coil 5 on board 7, find DO output coils in the first row of the table, below, then move down that column until you reach the board 7 row to determine the range of DO output coil numbers for that board, in this case (341-372). The fifth coil in the range 341 to 372 would be 345, so your Modbus command should request coil 345.

I/O Slot	Board Status (all)	DO Readback Status (1-32)	DI Value Coils (1-32)	DO Output Coils (1-32)
1 (101-140)	140	101-132	101-132	101-132
2 (141-180)	180	141-172	141-172	141-172
3 (181-220)	220	181-212	181-212	181-212
4 (221-260)	260	221-252	221-252	221-252
5 (261-300)	300	261-292	261-292	261-292
6 (301-340)	340	301-332	301-332	301-332
7 (341-380)	380	341-372	341-372	341-372
8 (381-420)	420	381-412	381-412	381-412
9 (421-460)	460	421-452	421-452	421-452
10 (461-500)	500	461-492	461-492	461-492
11 (501-540)	540	501-532	501-532	501-532
12 (541-580)	580	541-572	541-572	541-572
13 (581-620)	620	581-612	581-612	581-612
14 (621-66)	660	621-652	621-652	621-652

I/O Slot	AI, AO Out of Range Status (1-16 or 1-8)	AI, AO Conversion Error Status (39)	HSC Input State Status (1-12)	AO Fail to State Status (9-32) Coils (9-32 (3 sets of 8) *See Note 1	HSC Reset Coils (1-12)	HSC Setup Status 13-36 Coils 13-36 (2 sets of 12)
1 (101-140)	101-116 or 101-108	139	101-112	109-132	101-112	113-136
2 (141-180)	141-156 or 141-148	179	141-152	149-172	141-152	153-176
3 (181-220)	181-196 or 181-188	219	181-192	189-212	181-192	193-216
4 (221-260)	221-236 or 221-228	259	221-232	229-252	221-232	233-256
5 (261-300)	261-276 or 261-268	299	261-272	269- 292	261-272	273-296
6 (301-340)	301-316 or 301-308	339	301-312	309-332	301-312	313-336
7 (341-380)	341-356 or 341-348	379	341-352	349-372	341-352	353-376
8 (381-420)	381-396 or 381-388	419	381-392	389-412	381-392	393-416
9 (421-460)	421-436 or 421-428	459	421-432	429-452	421-432	433-456
10 (461-500)	461-476 or 461-468	499	461-472	469-492	461-472	473-496
11 (501-540)	501-516 or 501-508	539	501-512	509-532	501-512	513-536
12 (541-580)	541-556 or 541-548	579	541-552	549-572	541-552	553-576
13 (581-620)	581-596 or 581-588	619	581-592	589-612	581-592	593-616
14 (621-660)	621-636 or 621-628	659	621-632	629-652	621-632	633-656

** Note 1: First group must be set to 1 to have 2nd two groups written to board. Also, first group will always read as 0 - cleared as soon as written.*

B.3.3 Input Registers (2 byte signed registers, transmitted upper byte first)

Range: 101-260 (20 per board)

Example: To read AI register 8 on board 2, find AI value register in the first row of the table, below, then move down that column until you reach the board 2 row to determine the range of AI value register numbers, for that board, in this case (121-136). The eighth coil in the range 121 to 136 would be 128, so your Modbus command should request register 128.

I/O Slot	AI value register (1-16)	AO clamped value register (1-8)	HSC lower 16 bits (1-12)
1 (101-120)	101-116	101-108	101-112
2 (121-140)	121-136	121-128	121-132
3 (141-160)	141-156	141-148	141-152
4 (161-180)	161-176	161-168	161-172
5 (181-200)	181-196	181-188	181-192
6 (201-220)	201-216	201-208	201-212
7 (221-240)	221-236	221-228	221-232
8 (241-260)	241-256	241-248	241-252
9 (261-280)	261-276	261-268	261-272
10 (281-300)	281-296	281-288	281-292
11 (301-320)	301-316	301-308	301-312
12 (321-340)	321-336	321-328	321-332
13 (341-360)	341-356	341-348	341-352
14 (361-380)	361-376	361-368	361-372

B.3.4 Output Registers (2 byte signed registers, transmitted upper byte first)

Range: 501-660 (20 per board)

Example: To read AO register 7 on board 5, find AO value register in the second column of the table, below, then move down that column until you reach the board 5 row to determine the range of AO value register numbers, for that board, in this case (581-588). The seventh coil in the range 581 to 588 would be 587, so your Modbus command should request register 587.

I/O Slot	AO value register (1-8)
1 (501-520)	501-508
2 (521-540)	521-528
3 (541-560)	541-548
4 (561-580)	561-568
5 (581-600)	581-588
6 (601-620)	601-608
7 (621-640)	621-628
8 (641-660)	641-648
9 (661-680)	661-668

I/O Slot	AO value register (1-8)
10 (681-700)	681-688
11 (701-720)	701-708
12 (721-740)	721-728
13 (741-760)	741-748
14 (761-780)	761-768

B.3.5 Setup Registers (2 byte signed registers, transmitted upper byte first)

Range: 1101-1420 (40 per board)

Example: To read the third AO last hold value register on board 4, find AO last hold value registers in the first row of the table, below, then move down that column until you reach the board 4 row to determine the range of AO last hold value register numbers, for that board, in this case (1237-1244). The third register in the range 1237 to 1244 would be 1239, so your Modbus command should request register 1239.

I/O Slot	AI scales register (1-32)	AO scales register (1-16)	AO last hold value register (17-24)
1 (1101-1140)	1101-1132	1101-1116	1117-1124
2 (1141-1180)	1141-1172	1141-1156	1157-1164
3 (1181-1220)	1181-1212	1181-1196	1197-1204
4 (1221-1260)	1221-1252	1221-1236	1237-1244
5 (1261-1300)	1261-1292	1261-1276	1277-1284
6 (1301-1340)	1301-1332	1301-1316	1317-1324
7 (1341-1380)	1341-1372	1341-1356	1357-1364
8 (1381-1420)	1381-1412	1381-1396	1397-1404
9 (1421-1460)	1421-1452	1421-1436	1437-1444
10 (1461-1500)	1461-1492	1461-1476	1477-1484
11 (1501-1540)	1501-1532	1501-1516	1517-1524
12 (1541-1580)	1541-1572	1541-1556	1557-1564
13 (1581-1620)	1581-1612	1581-1596	1597-1604
14 (1621-1660)	1621-1652	1621-1636	1637-1644

B.3.6 Long Input Registers (4 byte unsigned registers, transmitted upper word / upper byte first)

Range: 2101-2260 (20 per board)

Example: To read the HSC timestamp register on board 7, find HSC timestamp register in the first row of the table, below, then move down that column until you reach the board 7 row to determine the HSC timestamp register for that board, in this case (2233). So your Modbus command should request register 2233.

I/O Slot	HSC Counts Registers (1-12)	HSC Timestamp Register (13)
1 (2101-2120)	2101-2112	2113
2 (2121-2140)	2121-2132	2133
3 (2141-2160)	2141-2152	2153
4 (2161-2180)	2161-2172	2173
5 (2181-2200)	2181-2192	2193
6 (2201-2220)	2201-2212	2213
7 (2221-2240)	2221-2232	2233
8 (2241-2260)	2241-2252	2253
9 (2261-2280)	2261-2272	2273
10 (2281-2300)	2281-2292	2293
11 (2301-2320)	2301-2312	2313
12 (2321-2340)	2321-2332	2333
13 (2341-2360)	2341-2352	2353
14 (2361-2380)	2361-2372	2373

B.3.7 Floating Point (FP) Inputs (4 byte FP, transmitted upper word / upper byte first)

Range: 3101-3260 (20 per board)

Example: To read the eleventh FP input on board 7, go to the Board 7 column of the table, below, to determine the range of FP inputs for that board, in this case 3221-3240. The eleventh FP input in that range would be 3231, so your Modbus command should request FP input 3231.

I/O Slot	FP Inputs
1 (3101-3120)	3101-3120
2 (3121-3140)	3121-3140
3 (3141-3160)	3141-3160
4 (3161-3180)	3161-3180
5 (3181-3200)	3181-3200

I/O Slot	FP Inputs
6 (3201-3220)	3201-3220
7 (3221-3240)	3221-3240
8 (3241-3260)	3241-3260
9 (3261-3280)	3261-3280
10 (3281-3300)	3281-3300
11 (3301-3320)	3301-3320
12 (3321-3340)	3321-3340
13 (3341-3360)	3341-3360
14 (3361-3380)	3361-3380

B.3.8 Floating Point (FP) Outputs (4 byte FP, transmitted upper word / upper byte first)

Range: 4101-4260 (20 per board)

Example: To read the first FP output on board 2, go to the Board 2 column of the table, below, to determine the range of FP outputs for that board, in this case 4121-4140. The first FP output in that range would be 4121, so your Modbus command should request FP output 4121.

I/O Slot	FP Outputs
1 (4101-4120)	4101-4120
2 (4121-4140)	4121-4140
3 (4141-4160)	4141-4160
4 (4161-4180)	4161-4180
5 (4181-4200)	4181-4200
6 (4201-4220)	4201-4220
7 (4221-4240)	4221-4240
8 (4241-4260)	4241-4260
9 (4261-4280)	4261-4280
10 (4281-4300)	4281-4300
11 (4301-4320)	4301-4320
12 (4321-4340)	4321-4340
13 (4341-4360)	4341-4360
14 (4361-4380)	4361-4380

B.3.9 Floating Point (FP) Setup (4 byte FP, transmitted upper word / upper byte first)

Range: 5101-5420 (40 per board)

Example: To read the last FP setup register on board 3, go to the Board 3 column of the table, below, to determine the range of FP setup registers for that board, in this case 4121-4140. The last FP setup register in that range would be 4121, so your Modbus command should request FP setup register 4121.

I/O Slot	FP Setup Registers
1 (5101-5140)	5101-5140
2 (5141-5180)	5141-5180
3 (5181-5520)	5181-5520
4 (5221-5260)	5221-5260
5 (5261-5300)	5261-5300
6 (5301-5340)	5301-5340
7 (5341-5380)	5341-5380
8 (5381-5420)	5381-5420
9 (5421-5460)	5421-5460
10 (5461-5500)	5461-5500
11 (5501-5540)	5501-5540
12 (5541-5580)	5541-5580
13 (5581-5620)	5581-5620
14 (5621-5660)	5621-5660

B.3.10 Reversing the Order of Byte Transmission of a Register

Swapping the order in which bytes are transmitted will cause 2 bytes to be transmitted with the low order byte first, and 4 bytes to be transmitted upper word first, low order byte first.

To perform this swap, choose the proper register, from the tables above, then add 10000 to that register number when using it in a Modbus command.

B.3.11 Reversing the Order of Word Transmission of a Register

Swapping the order in which words are transmitted will cause 2 bytes to be transmitted as in 0 series, and will cause 4 bytes to be transmitted lower word first, high order byte first.

To perform this swap, choose the proper register, from the tables above, then add 20000 to that register number when using it in a Modbus command.

B.3.12 Reversing the Order of Byte / Word Transmission of a Register

Swapping the order in which bytes/words are transmitted will cause 2 bytes to be transmitted with the low order byte first, and 4 bytes to be transmitted lower word first, low byte first.

To perform this swap, choose the proper register, from the tables above, then add 30000 to that register number when using it in a Modbus command.

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