Honeywell

HC900 Hybrid Controller

Installation and User Guide

Doc. No.: 51-52-25-107
Revision: 5
Date: 9/03

Notices and Trademarks

Revision 5 Sept. 2003

Warranty/Remedy

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Contact your local sales office for warranty information. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is **in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose**. Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

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About This Document

Abstract

This document provides descriptions and procedures for the installation, operation and maintenance of the HC900 Hybrid Controller hardware.

References

The following list identifies all documents that may be sources of reference for material discussed in this publication.

Document Title	ID #
HC900 Hybrid Controller Technical Overview Specification	51-52-03-31
HC900 Hybrid Controller Operator Interface User Guide	51-52-25-108
HC900 Hybrid Control Designer User Guide	51-52-25-110
HC900 Hybrid Controller Function Block Reference Guide	51-52-25-109
HC900 Hybrid Controller Communications User Guide	51-52-25-111

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

Honeywell Organization	WWW Address (URL)
Corporate	http://www.honeywell.com
Industrial Measurement and Control	http://www.honeywell.com/imc

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Contact us by telephone at the numbers listed below.

	Organization	Phone Number	
United States and Canada	Honeywell	1-800-423-9883	Tech. Support
		1-888-423-9883	Q&A Faxback (TACFAQS)
		1-800-525-7439	Service

Symbol Definitions

The following table lists those symbols that may be used in this document and on the product to denote certain conditions.

Symbol	Definition
⚠ DANGER	This **DANGER** symbol indicates an imminently hazardous situation, which, if not avoided, **will result in death or serious injury**.
⚠ WARNING	This **WARNING** symbol indicates a potentially hazardous situation, which, if not avoided, **could result in death or serious injury**.
⚠ CAUTION	This **CAUTION** symbol may be present on Control Product instrumentation and literature. If present on a product, the user must consult the appropriate part of the accompanying product literature for more information.
CAUTION	This **CAUTION** symbol indicates a potentially hazardous situation, which, if not avoided, **may result in property damage**.
	**WARNING** **PERSONAL INJURY:** Risk of electrical shock. This symbol warns the user of a potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 Vdc may be accessible. **Failure to comply with these instructions could result in death or serious injury.**
	ATTENTION, Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices
	CAUTION, HOT SURFACE: This symbol warns the user of potential hot surfaces which should be handled with appropriate caution.
	Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	Functional earth terminal. Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to protective earth at the source of supply in accordance with national and local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

Contents

Tables

Figures

Introduction

Purpose

This publication describes the Honeywell HC900 Hybrid Controller, and facilitates its installation, operation, and maintenance. This publication includes the following sections.

Section Title	Section Content
Introduction	Describes the content and purpose of this manual relative to other manuals for the HC900 Hybrid Controller.
System Overview	Functional features and physical characteristics of the system and of each major component of the HC900 Hybrid Controller. This section includes background information on Ethernet networking components and methods of interconnection.
Pre-Installation Planning	Includes pre-planning considerations, environmental operating limits, and procedural guidelines for planning an installation.
Installation Guide	Procedures for installing the major components of the system: controller rack, I/O expansion racks (C50 CPU only), and communication interconnections.
Input/Output Installation and Wiring	Procedures for installing I/O modules in the controller rack and I/O expansion racks (C50 CPU only), and for wiring field devices to the terminal block associated with each I/O module.
Communications Installation	Provides guidelines for installing RS-232, RS-485, and Ethernet cabling and associated components.
Controller Operating Characteristics	Characteristics of the HC900 Hybrid Controller as they relate to configuration of a control strategy, and to operation of an installed and running system.
Diagnostics and Troubleshooting	Descriptions of the mechanisms that detect and react to faults in the operation of HC900 Hybrid Controller hardware and/or software components.
Analog Calibration	Describes hardware configuration required for calibrating AI and AI modules from the configuration software.
Removal and Replacement Procedures	Provides guidelines for replacing system components; includes Cautions and Warnings as applicable.
Specifications	Tables that provide details of HC900 Hybrid Controller design and functioning.
Index	Alphabetical listing, with page references, of terms, components, and topics included in this manual.

Functional Description

The Honeywell HC900 Hybrid Controller is an integrated loop and logic controller that is designed specifically for small- and medium-scale unit operations

It comprises a set of hardware and software modules that can be assembled to satisfy any of a broad range of process control applications. The HC900 Hybrid Controller can consist of a single rack, as indicated in Figure 1, or can be can be networked with other controllers via Ethernet links to expand the dimensions of control over a wider range of unit processes, as indicated in Figure 2.

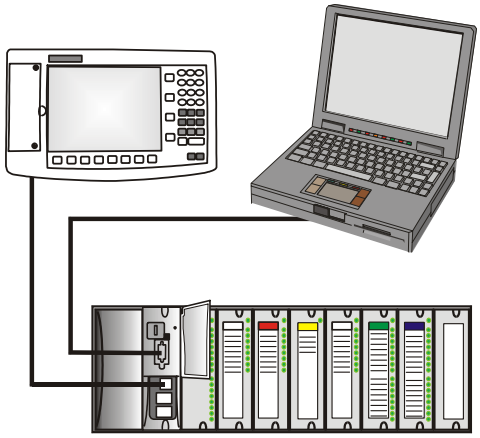


Figure 1 – Small HC900 Controller Configuration

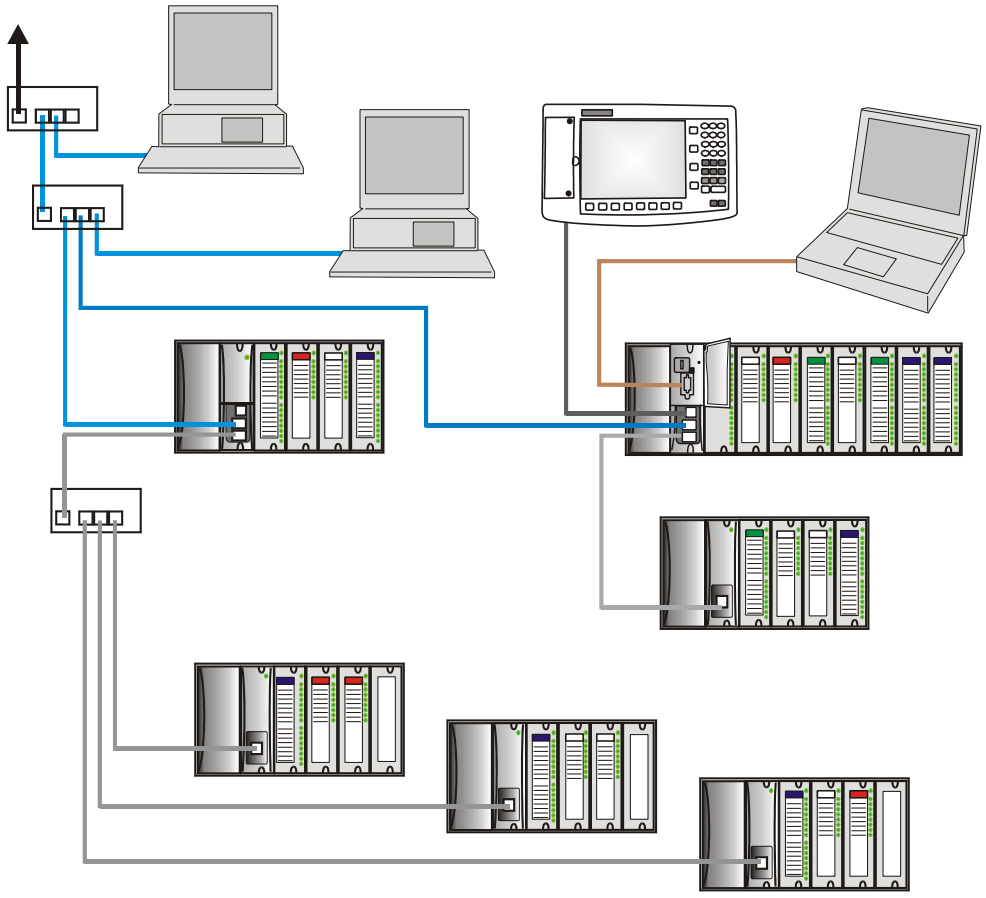


Figure 2 – Expanded HC900 Controller Configuration (C50 CPU only)

The HC900 Controller design enables users and OEMs who are adept in system integration to assemble a system that fits a broad range of requirements. Any configuration can be readily modified or expanded as requirements dictate. In initial configuration and in subsequent modifications, the HC900 Controller affords an optimum balance of performance and economy.

Configurations such as those shown in Figure 1 and in Figure 2, as well as many variations, can be assembled from modular components. Many of the components are available from Honeywell, and some are available from third-party suppliers. These modular components are available in any quantity and mix that make the most sense for a given application.

As indicated in Figure 2, the HC900 Controller includes provisions for communication via Ethernet with host systems such as the Honeywell PlantScape HMI and other HMI software that supports Ethernet Modbus/TCP protocol. Also, the communication structure of the HC900 Controller enables remote placement of input/output components, allowing significant economies in cabling and wiring.

Feature Summary

Hardware

- Modular rack structure; components are ordered individually as needed
- CPU embodies Ethernet connectivity
- Easy to assemble, modify, and expand
- Local(C30,C50) and Remote input/output racks(C50 only), private Ethernet-linked in sub network
- Parallel processing - a CPU in each I/O module performs signal processing, to preserve update rates

Communications

- RS-232 Link to PC configuration tool (up to 50 feet or 12.7 meters) or modem. Port configurable as Modbus RTU/TCP master or slave
- RS-485 2-wire link to the Operator Interface (up to 2000 feet or 601meters). Port configurable as Modbus RTU/TCP master or slave
- Ethernet 10BaseT connection to: up to 5 PC hosts via Modbus/TCP protocol, Peer-to Peer communication with other HC900 Controllers, and the Internet
- Private Ethernet 10BaseT connection to I/O expansion racks (C50 CPU only)

Control Functions

- Comprehensive set of Function Blocks; includes:
  - PID:
    Model C50 - up to 32 loops
    Model C30 – up to 8 loops
  - Setpoint Programmers: up to 8; SP Profiles: pool of 99, with up to 50 Segments/Profile; SP Schedulers: 1 or 2; Setpoint Schedules: up to 20, with up to 50 Segments/Schedule
  - Sequencers: up to 4; Sequences: up to 20; Steps per Sequence: up to 64
  - Recipes: up to 50; up to 50 parameters per recipe;
  - Logic, Fast Logic
  - Counters/Timers
  - Math, Calculations
  - Signal Selector
  - Auxiliary
  - Communications
- Up to 400 (Model C30) or 2000 (Model C50) user-configured blocks per control strategy

Input/Output

- AI:
  Model C30 - Up to 96 analog inputs; 0.1% of span accuracy
  Model C50 - Up to 256 analog inputs; 0.1% of span accuracy
- AO:
  Model C30 - Up to 48 analog outputs
  Model C50 - Up to 64 analog outputs
- Up to 512 inputs and outputs (192 for Model C30) (combined local and remote, analog and digital)
- Analog Module Types:
  - Universal Analog Input - 8 point
  - Analog Output - 4 point
- Digital Input Module Types:
  - 120/240Vac & 24Vdc Input - 16 point
  - Contact Input - 16 point
- Digital Output Module Types:
  - 120/240Vac Output - 8 point
  - 24Vdc Output - 16 point
  - Relay Output - 8 point

Alarms/Events

Up to 240 Alarms (20 groups of 12)

Up to 64 Events

E-Mail notification of Alarms and Events to up to three addresses per controller, by alarm priority (1-5)

Components and Architecture

Overview

This section provides a description of each of the major components that can be included in an HC900 Controller physical configuration, and indicates some of the methods by which they can be combined.

Components

The Honeywell HC900 Hybrid Controller includes a set of hardware modules that can be combined and configured as required for a wide range of small to medium process control applications.

Some of the modules are required in all configurations. Others are optional; they are selected as appropriate to provide optional functions and/or to "size" the system, either in initial planning, or in modifying and/or expanding the system to meet changing requirements.

An HC900 Controller configuration with multiple controllers is illustrated in Figure 3. This illustration includes key-numbers that identify components that are described in Table 1.

CAUTION

Communications lockout is possible in high network traffic conditions.

When inter-connecting your HC900 controller sub-net to a plant network where there may be significant network traffic not directed to the HC900 controllers or to related supervisory control or data acquisition software interfaces, we highly recommend you use a router to protect the controller from this extraneous traffic.

Failure to do so could, in high traffic cases, result in communications lockout requiring the controller to be power-cycled. See Figure 59 on page 178 for an example of an installation for a typical interface to another network sub-net.

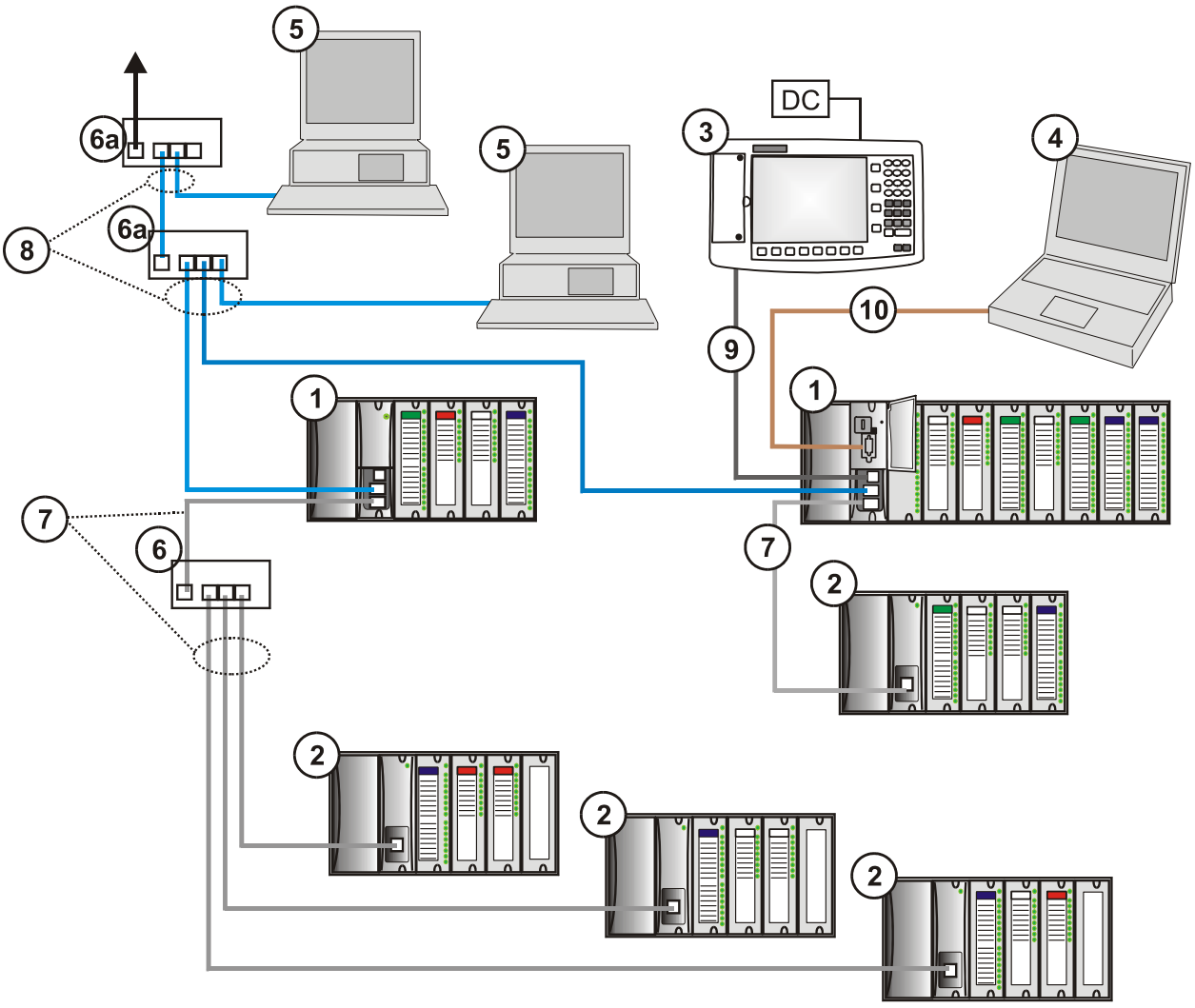


Figure 3 - Configuration with Multiple Controllers

Table 1 – Descriptions of Major Components (Figure 3)

Key No.	Component Name	Description	Source
1	Controller (Local) Rack	Includes: Rack, Power Supply, Controller Module, and I/O modules	Honeywell
2	I/O Expansion Rack (C50 CPU only)	(Optional) Includes: Rack, Power Supply, Scanner Module, and I/O modules	Honeywell
3	Operator Interface	(Optional) link to RS-485 port on a Controller Module; provides operating and utilities displays. Includes buttons and (optional) AT-keyboard interface.	Honeywell
4	PC Configuration Tool	(Optional) PC (laptop or desktop) connects to RS-232 port on any (one) Controller module. Includes Honeywell Hybrid Control Designer (configuration software).	PC is from third-party supplier. Configuration software is from Honeywell.
5	HMI (Human-Machine Interface)	(Optional) PC link to Ethernet network, which may include other HMIs, other HC900 Controllers, and other networks (including Internet). Typically includes HMI operating software. May also include Hybrid Control Designer (configuration tool and utility software).	PC is from third-party supplier. HMI software is available from Honeywell (PlantScape or SpecView32) or from third-party supplier.
6	Ethernet 10BaseT Hub	Enables connection of the private Ethernet 10BaseT port on a Controller Module to the Scanner modules on 2, 3, or 4 I/O Expansion racks. (C50 CPU only) (If a single I/O expansion rack is connected directly to a Controller Module, the Hub is not required.)	Honeywell
6a	Ethernet 10BaseT Switch or Router	Enables inter-connection of several 10BaseT Ethernet devices in an Ethernet network. Devices include other HC900 Controllers, HMIs, and can also include routers, brouters, servers, and other devices in wider networks.	Third-party suppliers.
7	Ethernet CAT5E shielded cable	Connects I/O expansion racks (C50 CPU only) to controllers and/or to 10baseT Ethernet hubs. 10'or 20' (3.04 or 6.08m)	Third-party suppliers or Honeywell
8	Ethernet CAT5E shielded cable	Connects devices in Ethernet Open Connectivity network. Cross-over cable is used for Controller-to-PC connection; straight-through for Controller-to-Hub connection. 20' (6.08m).	Third-party suppliers or Honeywell
9	RS-485 cable	Belden #9271 or equivalent, up to 2000' (601m).	Third-party suppliers
10	RS-232 cable	Null modem cable, up to 50' (15.24m) (PC modem cable if used with Modems.)	Third-party suppliers or Honeywell

Hardware Components

This section contains general descriptions of each of the major components of the HC900 system. For environmental specifications, refer to the section on Pre-Installation Planning.

HC900 Controller Rack

An HC900 Controller ("local rack") is shown in Figure 4. As indicated in this figure, the Controller Rack includes:

1. a Rack, available in 4- 8-, or 12-slot versions
2. a Power Supply
3. a Controller Module
4. Grounding bars (for I/O wiring; optional)
5. Input/Output modules.
6. I/O Terminal Blocks

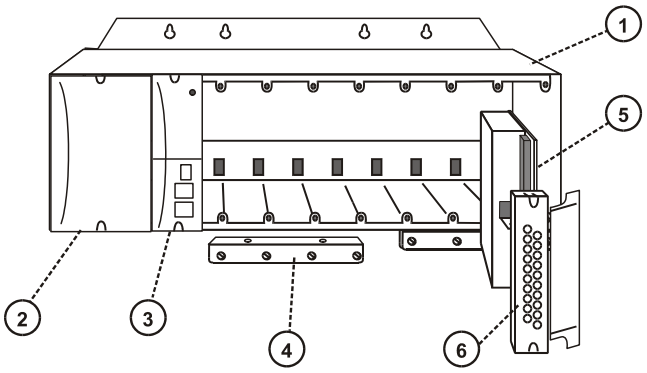


Figure 4 - Controller Rack Components

I/O Expansion Rack (C50 CPU only)

I/O expansion ("remote") racks, shown in Figure 5, are available to accommodate additional input/output modules, and/or to enable location of I/O modules close to the process and remote from the controller.

Most of the components in an I/O expansion rack are identical to those used in the Controller Rack. The only difference is the Scanner Module (item 3) that occupies the same rack location as the Controller Module in a Controller Rack. An I/O expansion rack includes:

1. a Rack, available in 4- 8-, or 12-slot versions
2. a Power Supply
3. a Scanner Module
4. Grounding bars (for I/O wiring; optional)
5. Input/Output modules
6. I/O Terminal Blocks

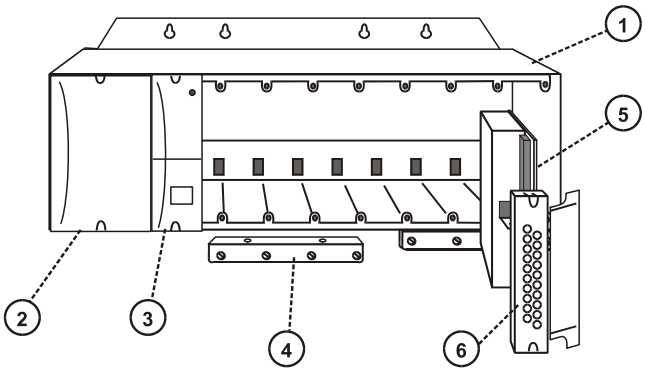


Figure 5 - I/O Expander Rack Components (C50 CPU only)

Rack Options

Racks are available in 4-slot, 8-slot, and 12-Slot versions. Racks are interchangeable between the Controller rack and an IO expansion rack (C50 CPU only), and all three versions shown in Figure 6 are available for either purpose.

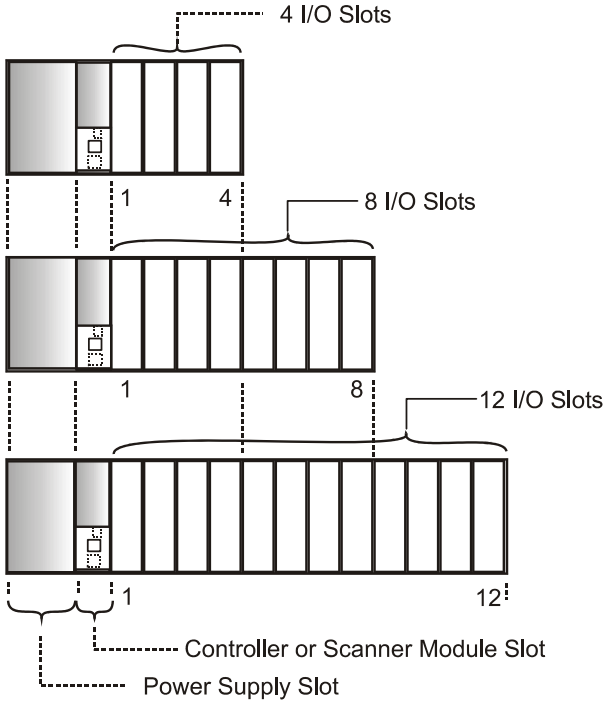


Figure 6 - Rack Options

Power Supply

The P01 Power Supply, shown in Figure 7, provides 5 Vdc and 24 Vdc to the backplane connectors in the local and remote racks. The Power Supply is identical for the Controller Rack and for I/O expansion racks(C50 CPU only), and for all rack versions (4-slot, 8-slot, and 12-Slot).

The less expensive lower capacity P02 power supply is available for reduced I/O applications. See page 37 to determine correct power supply.

Each power supply includes an internal 5.0-amp fuse that is not field-replaceable. (An external fuse may be added by the user.)

Items shown with key numbers:

1. Voltage test points (P01model only)
2. AC Input terminal block
3. Wiring label
4. Grounding lug (Reference; lug is not part of Power Supply; it is staked to bottom of Rack.)

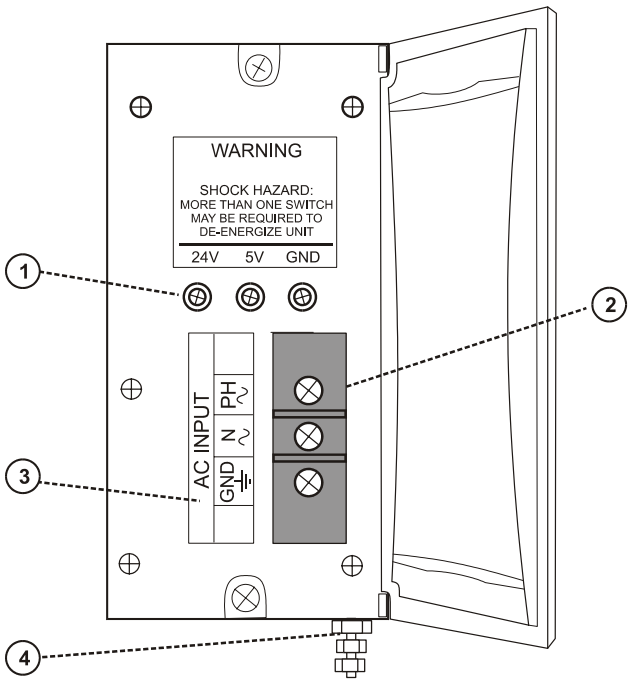


Figure 7 – Power Supply

Controller Module

The Controller Module is shown in Figure 8 with the hinged protective door open. Features at the front of the Controller Module include:

1 - a lithium battery (beneath cover), which is readily accessible for field replacement.

2 - RS-232 Port; interface to the PC configuration tool, external modem, or Modbus device

3 - Mode switch (Program Lock, Run/Program, Run Lock)

4 - RS-485 Port for Honeywell Operator Interface or Modbus device

5 - Ethernet 10BaseT Port; interface to peer controllers, HMIs, and other networks

6 – Private Ethernet 10BaseT Port; interface to I/O expansion racks (C50 CPU only)

7 - Status indicator for controller functions

8 - Status indicators for communications functions

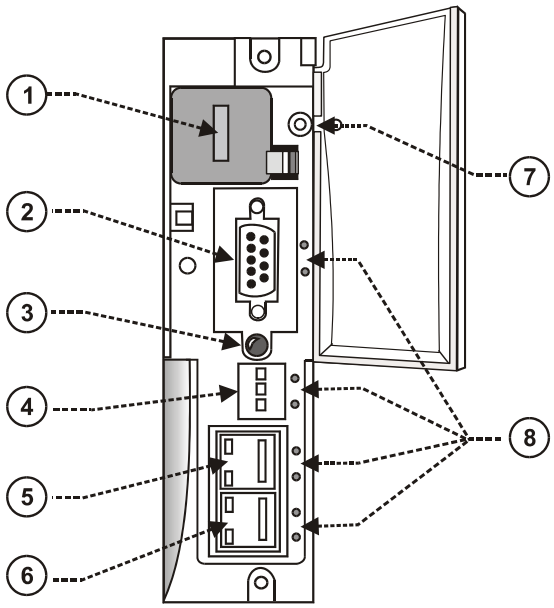


Figure 8 - Controller Module

Scanner Module (C50 CPU only)

The Scanner Module is shown in Figure 9; features at the front of the module include:

1 - Status indicator for scanner functions.

2 - Private Ethernet 10BaseT Port; connects to the I/O expansion port on Controller Module (or to a port on a Hub that connects to the Controller Module)

3 - Status indicators for communications functions

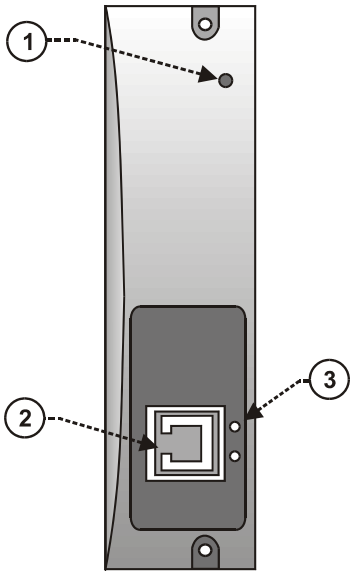


Figure 9 - Scanner Module

Input/Output Modules

Eight input/output types are available:

- Analog
  - Universal Analog Input, 8-point
  - Analog Output, 4-point
- Digital
  - 120/240 Vac input, 16-point
  - 24 Vdc input, 16-point
  - Contact input, 16-point
  - 120/240 Vac output, 8-point
  - 24 Vdc output, 16-point
  - Relay output, 8-point

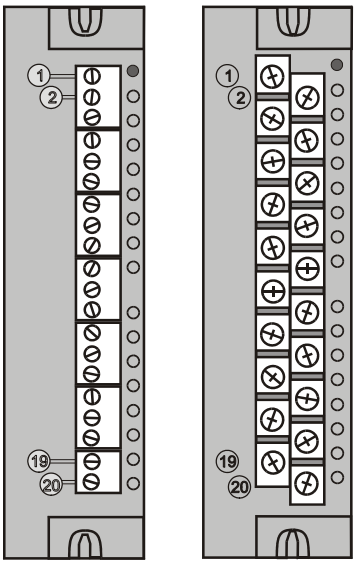


Figure 10 - I/O Module Terminal Blocks

Each I/O module includes a status indicator for the module. Digital Input and Digital Output modules also include a status indicator for each channel. Terminal blocks available include the Euro style (on the left in Figure 10) and the Barrier style (on the right).

For more information on I/O modules and associated terminal blocks, refer to the section in this manual on Input/Output Installation and Wiring.

Personal Computer

A Personal Computer is required for creating the control and data acquisition strategy (configuration file) that runs in the controller, using the Hybrid Control Designer configuration software. The PC can also be used to download/upload configuration files to/from the controller, and can be used to download program updates to firmware in the Controller Module and/or Scanner Modules.

A PC can be connected to the controller via the RS-232 Port on the Controller module, and can also be networked to the controller via the Ethernet 10BaseT Open Connectivity Network port.

NOTE: For specific PC requirements and for specific software requirements, refer to the Hybrid Control Designer Users Manual.

RS-232 Modem Devices

The PC configuration tool connects from the RS-232 connector on the upper part of the Controller Module to a serial port on the PC. The PC can be located remote from the Controller by using Modems and telephone links. Modems and suitable cabling are available from third-party vendors.

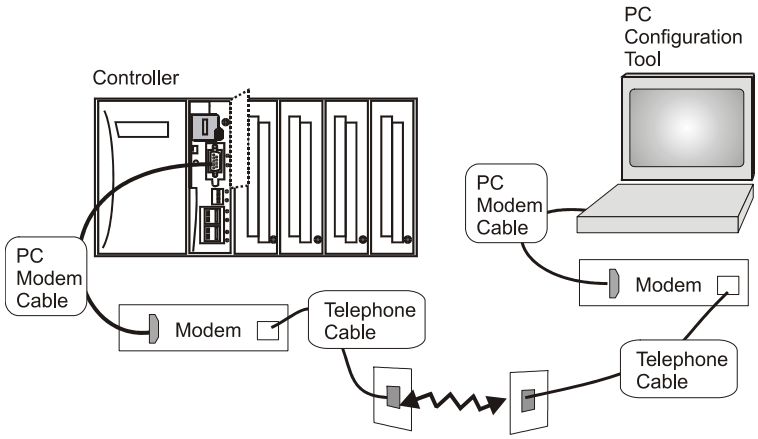


Figure 11 - RS232 Modem Devices

Ethernet Devices/Considerations

Ethernet device requirements vary with specific applications. Regarding intended use, however, they fall into two categories:

- Components of the Ethernet Open Connectivity Network, which links an HC900 Hybrid Controller to Peers, to HMI Supervisory Stations, and to other Ethernet 10Base-T devices that support TCP/IP.
- Components of the I/O expansion network(C50 CPU only), which is an independent, private network that is designed to work exclusively with the HC950 expansion racks.

Installation of the I/O expansion network is relatively straightforward; it includes only a few devices and requires only configuration of jumpers in Scanner modules.

The Ethernet Open connectivity Network is potentially more complex than the I/O expansion network, and in some cases, may require the services of an IT networking professional.

I/O Expansion Network(C50 CPU only)

Examples of HC900 Controller I/O expansion configurations are shown in Figure 12.

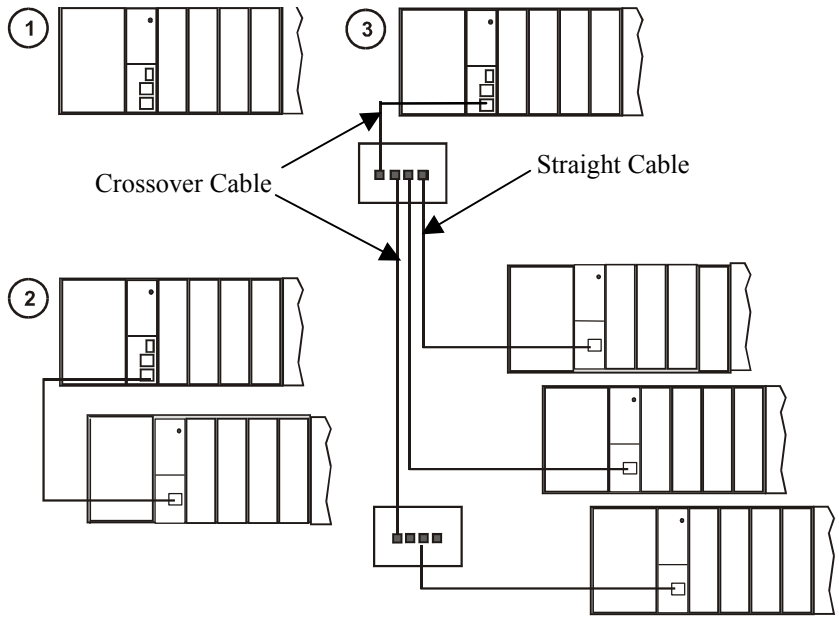


Figure 12 – HC900 Controller Configurations

In Figure 12, any of the racks shown in each controller configuration can be 4-, 8-, or 12-slot versions. Note that in configuration **2** (C50 CPU only), the Ethernet cable connects directly from the 10BaseT connector on the Controller Module directly to the Scanner Module on the single I/O expansion rack. In configuration **3** (C50 CPU only), the Ethernet cable goes from the 10BaseT port on the Controller Module using a crossover cable to the Hub, and a straight through cable from each of the Hub ports to the 10BaseT port on the Scanner Modules.

The Ethernet cabling for the I/O expansion links (C50 CPU only) are standard shielded Cat 5E cabling, with standard RJ45 connectors. Each cable segment can be up to 100 meters (328 feet) long. Note that in configuration **3**, a second Hub is used in-line with the I/O expansion rack shown on the bottom of the illustration, so as to extend the distance (up to an additional 100 meters) to the remote rack. The total number of hubs allowed is limited to two in series between the controller and scanners. One combination of two in series is illustrated.

The Ethernet Hubs used in the I/O expansion network (C50 CPU only)are available from Honeywell.

I/O implementation requirements include:

- Constructing a configuration file, and loading it into the Controller Module. This file includes I/O numbering assignments for each I/O Function Block regarding Rack Number, Module Number ("slot" number, or position in the rack, starting from the left), and Channel Number.
- Physically assigning Rack Numbers, by positioning jumpers in the Scanner Module for each rack.
- Placing the appropriate module type in each slot in each rack.

The I/O expansion network uses Honeywell private protocol that optimizes I/O performance and security.

The configuration and operation of the I/O expansion network is automatic, it is entirely under control of built-in private software that resides in the Controller Module and in each Scanner Module included in the HC900 system. The controller examines the control strategy stored in its memory, verifies that the physical configuration (Rack Numbers, and I/O Module type- by Module Number) matches the stored control strategy, and establishes communication with each of the I/O modules in each of the I/O racks.

Ethernet Open Connectivity Network

The configuration of the Ethernet Open Connectivity Network varies with specific applications in purpose and in complexity. In some applications, configuration is straightforward and within the capabilities of experienced installation technicians. In other applications (for example, those that include inter-connection to other networks such as Intranet and Internet), a working knowledge of networking is required.

The Ethernet Open Connectivity Network for a given HC900 Controller enables:

- Peer-to-peer communication with up to eight other HC900 Controllers
- Connection to up to five PC hosts (for example, PCs that include HMI supervisory software and/or Hybrid Control Designer configuration software)
- Inter-connection to other networks (such as for sending Alarm/Event messages via e-mail.)

CAUTION

Communications lockout is possible in high network traffic conditions.

When inter-connecting your HC900 controller sub-net to a plant network where there may be significant network traffic not directed to the HC900 controllers or to related supervisory control or data acquisition software interfaces, we highly recommend you use a router to protect the controller from this extraneous traffic.

Failure to do so could, in high traffic cases, result in communications lockout requiring the controller to be power-cycled. See Figure 59 on page 178 for an example of an installation for a typical interface to another network sub-net.

Peer-to-Peer Communication

Peer-to-peer communication enables any given HC900 Controller to exchange signal and variable data with up to eight other HC900 Controllers. Peer-to-peer communication uses the Ethernet Open Connectivity network and employs standard User Datagram Protocol (UDP) for fast and efficient transfer of information. Peer-to-peer communication is based on fail-safe and data expiration mechanisms that provide for fault and loading considerations without requiring reserved network bandwidth allocation. Peer-to-peer is designed to be easy to configure as part of a device's standard configuration and does not require the distribution of a global database.

Implementing peer-to-peer communications involves:

- Interconnecting controllers with Ethernet media and networking devices (cables, hubs, switches, etc)
- Configuration (via Hybrid Control Designer):
  - Controller configuration, which includes entry of an IP address (and if applicable, a Subnet Mask) and a Controller Name for each controller. (The Controller Name is used only by the Honeywell proprietary software for network access between controllers; it should not be confused with a Network Domain Name or Workgroup Name.)
  - Peer Data Exchange (PDE) function blocks, which are included in the control strategy (configuration file). PDE function blocks include PDE Control, PDE Write, and PDE Read. (Refer to the HC900 Hybrid Controller Function Block User Guide for additional information.)

An illustration of HC900 Controller Peer-to-Peer on a Local Area Network (LAN) is given in Figure 13. Typically, a Router is used for interconnection to another network (LAN, WAN, or other).

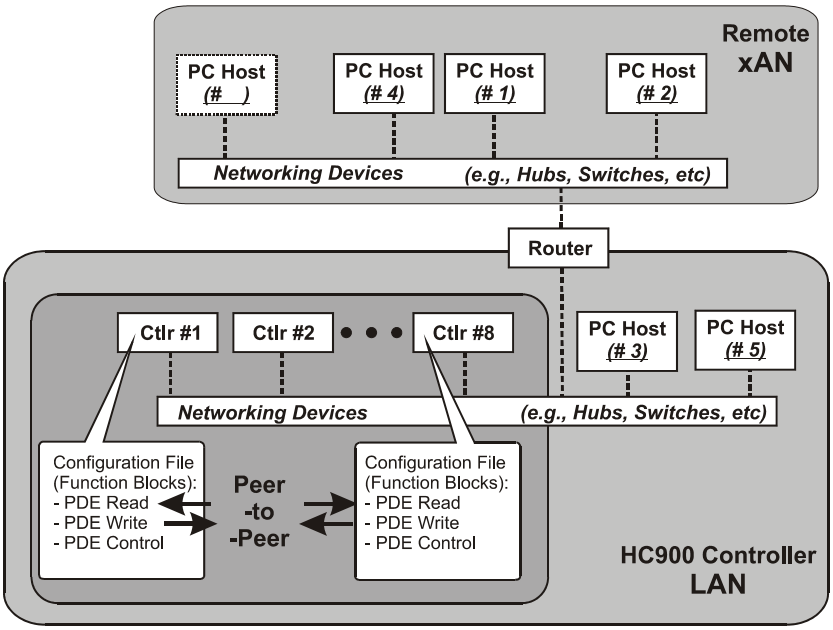


Figure 13 - Modular Network Structure

Connection to PC Hosts

Connection to PC hosts can be via Modbus/TCP as well as serial Modbus RTU over either the RS485 or RS232 communications ports. Both ports support Modbus RTU and are configurable as master or slave. The 5 TCP hosts can be concurrent with Modbus hosts on one or both of the other ports. Any given controller is capable of concurrent communication with up to five PC hosts. (The meaning of the term "host" varies, but for this definition, a PC host is any PC that is on the same LAN as the controller, or on any LAN or WAN (Wide Area Network) that is network-connected to the controller.

Each HC900 Controller has five "sockets" (software and memory resources), each of which can service data requests from any networked PC on a client (host)/server (controller) basis. The sockets are available on a first-come, first-served basis. Typically, when the data service for any PC Host request is completed or times out, it allows the socket to become available to any other PC Host in the hierarchy of networks.

Note: PDE communications, discussed previously, do not use the PC host connection sockets. PDE communications are separate from (and are transmitted concurrent with) PC host-to-controller communications.

The PC host can include software that closely relates to and supports controller functioning and can also include other software that is related remotely or not at all. Closely related software can include:

Either

Hybrid Control Designer - for generating and managing configuration files,

Or

HMI (Supervisory/Data Acquisition Software) or Operator Panel with Modbus/TCP driver

Or

Both configuration and HMI software (and or panel)

All communications between a controller and a PC host use Open Modbus/TCP protocol, whose widespread use is making it an industry standard. Modbus/TCP is basically an adaptation of the Modbus messaging structure that uses TCP/IP for a message carrier. Modbus messaging is available in two versions: ASCII, in which each eight-bit byte is sent as 2 ASCII characters, and RTU, in which each byte is sent as two four-bit hexadecimal characters. Each Modbus message frame is embedded into a TCP/IP datagram as indicated in Figure 14.

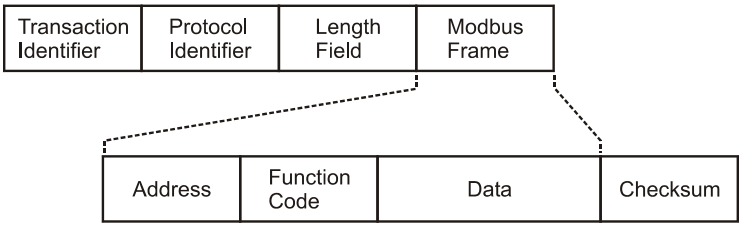


Figure 14 - Modbus/TCP Framing

The HC900 Controller uses either Modbus/TCP or Modbus RTU. The Modbus mapping structure for the HC900 Controller is based on the mapping structure employed in Honeywell's UMC800 Controller, and the function codes and methods for parameter access are also virtually identical.

From an implementation and installation aspect, the use of the Modbus protocol for HC900 Controller configuration differs from the use for Controller-to-HMI communications. The Hybrid Control Designer configuration package, which is supplied by Honeywell, is ready for use as soon as it is installed. This package uses a subset of Modbus function codes that provide for very efficient and secure configuration transactions. Communications details are transparent to the user; all communication drivers are included with the package, and no mapping or other detailed setup is required.

HMI Supervisory/SCADA software is available from various suppliers, and functionality and setup requirements vary with suppliers and with specific products. In all cases, the software selected must be compatible with Open Modbus/TCP protocol.

The user can use the standard Modbus command set to generate a custom set of drivers for his specific application, or may purchase additional software (for example, OPC with Modbus /TCP protocol) to reduce or virtually eliminate development tasks.

HMI software available for use with the HC900 Controller includes, but is not necessarily limited to the packages whose descriptions follow.

- ***available from Honeywell***
  - PlantScape SCADA or Vista Software, which operates under Windows 2000 operating software, provides PC-based supervisory control and data acquisition. This package includes a large selection of standard operating display templates, which can reduce development time significantly. PlantScape includes a full graphic display development environment, enabling development of custom graphics that include animated responses to changing process conditions. A batch reporting option is available in release 400, which includes a standard template for creating batch reports.
  - SpecView32 (SpecView Corporation)
- ***Other software (available from third-party sources)***
  The following software, which incorporates Modbus/TCP connectivity, is available from third-party sources:
  - The Fix Family (Intellution Incorporated)
  - Wonderware (Wonderware Corporation)
  - Citect (CI Technologies)
  - OPC server/client software (various; available from Kepware and others)

Note: The items in this list are not sold by Honeywell. They have not all been tested and certified by Honeywell, and are not *necessarily* recommended or endorsed by Honeywell for any specific use.

Inter-Connection to Other Networks

In many cases, an HC900 Controller application will include a single, free-standing controller that involves no connections via the Ethernet Open Connectivity network. In other cases, the HC900 Controller will be a member of a Local Area Network (LAN) as indicated in Figure 13. The HC900 controller LAN may be very simple, or it may include many devices in a complex and very sophisticated structure. In any case, it must always be regarded as a single, modular entity that can be protected from intrusion by any other networking device to which this LAN is connected.

Various types of networking devices that enable selective connection to other networks are available. A "Router" is commonly used for this purpose.

The feature that gives the Router its name is its ability to examine and "filter" message packets, permitting passage of wanted messages and denying passage of all others.

Many Routers have a secondary, but important feature in that they enable translation of IP addresses, which enables networks with dissimilar network IP addresses to communicate as though they were members of the same network. This feature is particularly useful when an HC900 Controller LAN is installed under "local addressing rules". That is, IP addressing can be assigned without approval of or conflict with world Internet governing bodies. Later, when connecting to networks with more stringent addressing requirements, it is necessary only to configure the Router with address mapping and connect it between the existing LAN and the other existing network.

Connections to other networks vary in purposes and methods; some of these are described below.

E-Mail Communications

The HC900 Controller includes e-mail software that enables communication of Alarms and Events to up to three Internet addresses. Implementing this feature consists of:

- Using the Hybrid Control Designer to configure:
  - Alarm Groups and Event Groups
  - Assignment of specific alarms to priority and e-mail enabling
  - E-Mail address lists
  - SMTP mail server IP address
- Installing and configuring hardware
  Note: This data is included for reference. The following items should be implemented by qualified IT/MIS personnel.)
  - Install and configure a Router to provide isolation and security. (This should be part of standard network installation.)
  - Install and configure internet access to Simple Mail Transport Protocol (SMTP) server. This may include the location of an existing server on an existing network.

Note: Consult your service provider for availability of access to network, local cable, or DSL in your area.

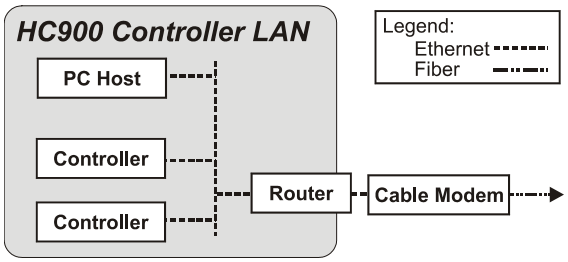


Figure 15 - Typical installation using a Cable Modem

Serial Ports (RS232 and RS485)

Overview

- Ports configurable as ELN, Modbus RTU or Modbus TCP protocol.
- Controller can act as Modbus master or slave through either port.
- Controller can be master to slaves such as
  - Honeywell Operator Interface (1040, 559). Must be on 485 port. Will not work on 232 port with 232/485 converter.
  - Honeywell HC Designer PC software
  - Third party PC HMI software
  - Third party Operator Interface
- Controller can slave to masters such as
  - Any Honeywell Modbus device (e.g., recorders, controllers, flame safety)
  - Any non-Honeywell Modbus device.
- Only one master port at a time, can't have RS232 and RS485 both as master ports.
- For multiple slaves on RS232 port, a 232-to-485 converter is required.
- Baud rates to 57,600

Table 2 shows the ways the two ports can be configured simultaneously.

Table 2 Simultaneous serial port configurations

See	RS232 Port Configured as	RS485 Port configured as
Figure 16 #1	ELN device*	ELN device*
Figure 16 #2	Controller is Modbus Slave	ELN device*
Figure 16 #6	Controller is one of multiple Modbus slaves**	ELN device*
Figure 16 #3	ELN device*	Controller is Modbus Slave
Figure 16 #4	Controller is Modbus Master to single slave	ELN device*
Figure 16 #5	Controller is Modbus master to multiple slaves**	ELN device*
Figure 17 #7	Controller is Modbus slave	Controller is Modbus master to multiple slaves
Figure 17 #8	Controller is Modbus master to multiple slaves	Controller is Modbus slave
Figure 17 #9	Controller is Modbus slave	Controller is Modbus slave
Figure 17 #10	ELN device*	Controller is Modbus master to multiple slaves
Figure 17 #11	Controller is Modbus slave via modem	ELN device*

*Such as Honeywell HCDesigner configuration software running on a PC or Honeywell 1040/559 Operator Interface
**Requires RS232-RS485 converter

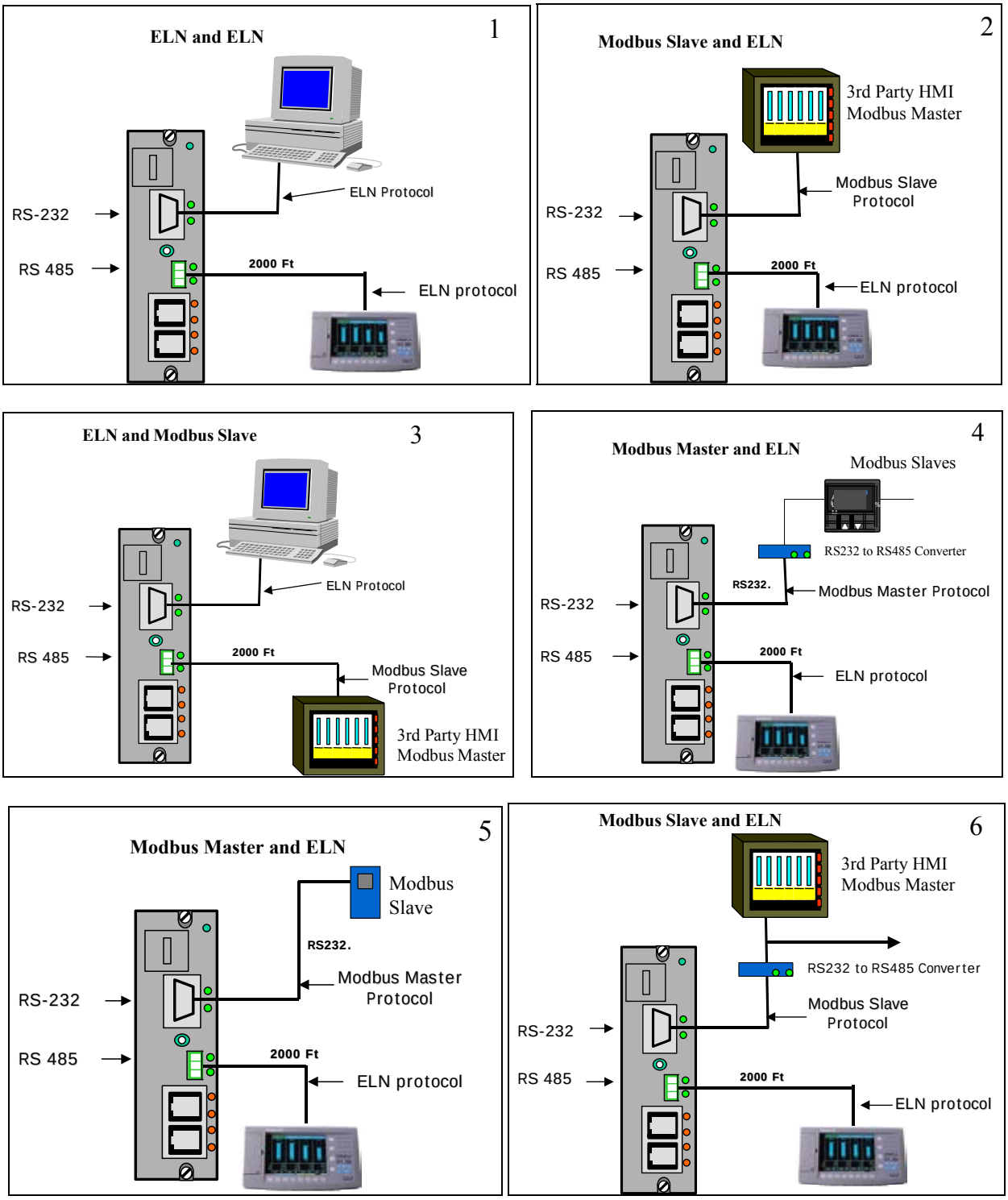


Figure 16 Serial Port Configurations 1 - 6

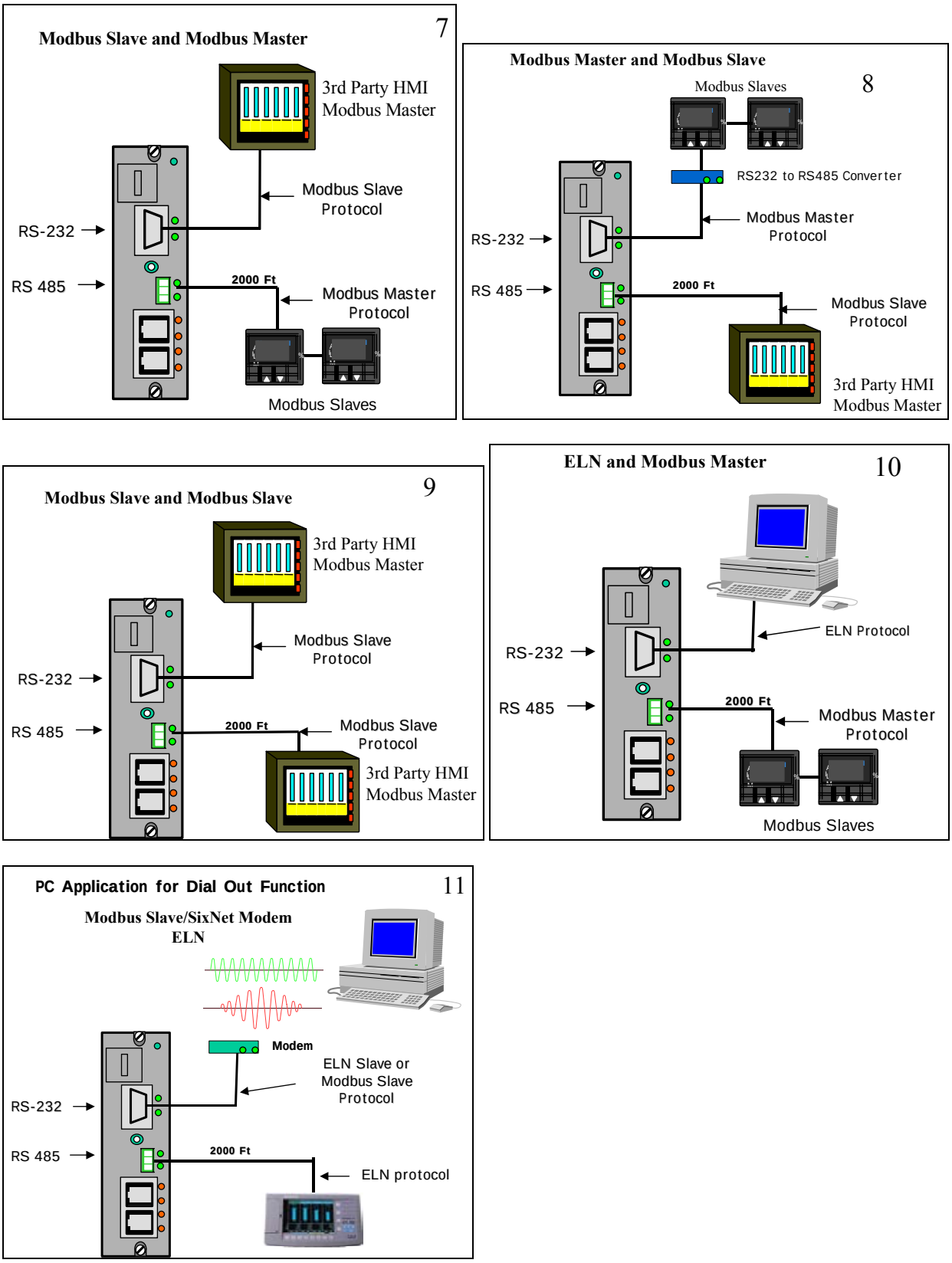


Figure 17 Serial Port Configurations 7 – 11

See also

Refer to Communications Installation on page 85 for details on communications.

Networking Basics Reference

The following information provides a basic reference for identifying and applying networking concepts, components, and methods. It is intended primarily as a language bridge between users who have a limited knowledge of networking, but who need to incorporate networking mechanisms in process control systems, and Information Technology (IT) professionals who are adept in network implementation.

Networking topics are many and broad. To be useful, the networking language bridge given here includes topics that apply to HC900 Controllers and to closely related computer and networking devices.

Ethernet

Ethernet is a networking standard (IEEE 802.3) that features:

- Local Area Network (LAN), which means that networked devices are near to each other (usually in the same building)
- "bus" or "star" topology. Bus topology means that all networked devices (also called nodes) connect to a common cable at different locations. Star topology means that a networking device (called a hub or "concentrator") provides interconnections for cables from network nodes.
- Transmission speed of 10 Mbps or 100 Mbps
- CSMA/CD access. CSMA/CD stands for Carrier Sense Multiple Access/Collision Detection. All devices on the LAN are free to transmit at will. If two nodes that are inter-connected at Hubs transmit simultaneously, the collision of the multiple access is detected by the hardware devices associated with the nodes. Each device will wait a random time, and will attempt to re-transmit. If the device detects another collision, it will double wait time before transmitting again. Doubling the wait time is called "exponential back-off".

Node Addressing

Every node on a network has a unique number and or name that is used by transmission protocols to identify it as the Source or the Destination of a message. When it is manufactured, every node is given a hard-coded Media Access Control (MAC) address that can be sensed by other nodes on the network. When it is placed on an Ethernet network, each node is also given an Internet Protocol (IP) address, which is stored in non-volatile memory, and which identifies it uniquely on that network.

Open Systems Interconnection Reference Model (OSI)

The OSI Model provides a reference source of all the methods and protocols needed to connect one computer to another over a network. Although details of networking systems often differ from those specified in the OSI Model, this model is used widely for design and manufacture of networking components as well as networking systems from networks are constructed. The Features of the OSI Model are summarized in Table 3.

Networking Protocols

A network protocol is a set of rules, or syntax, for exchanging data between nodes. In a very simple system, a single protocol is required. For most networking systems used in commercial and industrial applications, several protocols are required. Some protocols operate in one layer of the OSI model, while others operate in more than one layer. For example, Transport Control Protocol/Internet Protocol (TCP/IP) is commonly on the Internet and is used in private networks such as an HC900 Controller LAN. TCP

operates in Layer 3, IP operates at Layer 2, and Ethernet itself includes protocols that operate at Layers 1 and 2.

Characteristics of Networking Devices

Table 2 summarizes the characteristics of a set of "generic" networking devices. The information in this table is intended to provide a basic overview of each type of device. Many devices that are currently available are hybrids that combine features of more than one device type included in the table.

Glossary of Networking Terms

A glossary of networking terms is given in Table 5. Each term entry and description in this table is included as an element of a language bridge between users of an HC900 Controller network and personnel who are employed to implement the construction of the network. This glossary is not represented as complete and sufficient for implementing a network. Rather, it is intended as a starter and as a pointer to other more complete and authoritative works that are available commercially and in formal study programs.

Table 3 - Open System Interconnection Model

Layer Number .. Name	Function	Components reside in:	Protocols (examples)	Network components affected (examples)
7. Application	Identifies communications partners, quality of service, authentication and privacy, and syntax constraints	PC Networking Software (e.g., Windows Client, Novell Client32)	FTP SMTP Modbus drivers	Networking software packages in PC hosts
6. Presentation	Translation between application format and network format, including data encryption; also compression/de-compression			
5. Session	Establishes, manages, and terminates connections between applications (client to server or peer to peer.)			
4. Transport	Transparent transfer of data between hosts. Error recovery and flow control.	PC Software (e.g., Windows NT/2000, Novell NetWare)	TCP UDP	Networking packages in PC hosts and in controllers
3. Network	Routing and Forwarding, addressing, inter-networking, error handling, congestion control, packet sequencing	Software (e.g., Modbus/TCP)	IP	Routers
2. Data-Link (Includes 2 sub-layers: 1. **MAC** (Media Access Control) 2. **LLC** (Logical Link Control)	MAC: Frame assembly/disassembly, error detection/correction, addressing LLC: call setup/termination	NIC drivers	Ethernet 802.3	Network nodes (devices with MAC addresses, usually Network Interface Cards) and networking devices such as Switches.
1 . Physical	Electrical transmission of bits from one node to another	Cable, NICs	Ethernet 802.3	

Table 4 - Networking Device Types

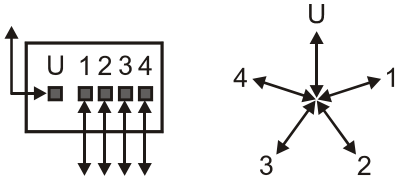
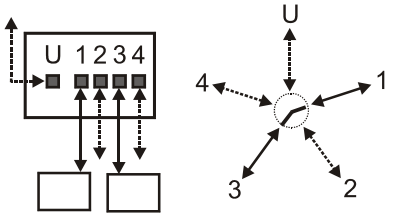
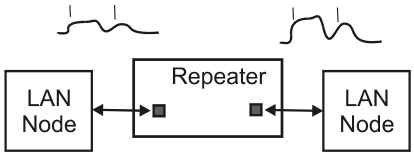
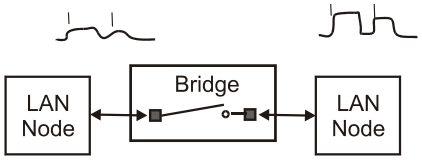
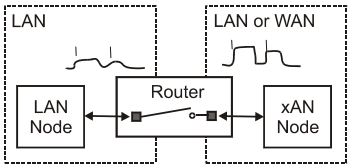
Network Device	Description	Notes
Hub	A Hub is so called because a diagram of its connections resembles a hub of a spoked wheel. Characteristics: Echoes a message on any port to all other ports; constitutes a collision domain for all connected devices. Isolates the device(s) on a "bad" port.	
Switch	A Switch is similar in appearance to a Hub, but connects only the ports specified as Source and Destination devices in each message packet. Collision domains are partitioned; that is, they are isolated to Source/Destination devices.	
Repeater	Extends the distance over which network traffic can be transported; all message packets at input port are repeated at the output port (no domain partitioning). Signals are amplified, but are not re-shaped or re-timed.	
Bridge	An intelligent Repeater that connects input and output ports, but only if the message specifies the device on the output port as the Destination.	
Router	An intelligent Bridge that is often used for wide area networks (WANs). Usually includes a computer with its own network address, memory, and network-based software. It can be configured to determine which data packets received will be transferred to a LAN node based on destination address (such as an HC900 controller and/or protocol port number).	
Gateway	A PC set up to inter-connect two disparate network models at any combination of layers of the OSI Model.	

Table 5- Glossary of Networking Terms

Name/Acronym	Name/Definition	Comments
10Base-Tx	Specification for 10mbps carried over twisted-pair cable.	In the name 10Base-T, the "10" refers to 10 Mbps transmission speed, the "Base" refers to Baseband, which means that no frequency multiplexing is applied, and the "-T" refers to Twisted Pair conductors in the cable.
ARP	Address Resolution Protocol	Precedes IP communication between two stations. Deduces Layer 2 MAC address information from IP address information.
AUI	Attachment Unit Interface	(See MAU, MDI)
Bit	A unit of binary data.	A binary bit has two values: 1 or 0.
bps	Bits Per Second	Units of transmission speed
Bridge	A networking device that connects two LANs and forwards or filters data packets between them, based on their destination addresses.	Bridges operate at data link level (or MAC layer) of the OSI model Bridges are transparent to protocols and to higher-level devices like routers.
Broadband Network	A network that uses multiple carrier frequencies to transmit multiplexed signals on a single cable.	Several networks can coexist on a single cable without interference with each other.
Brouter	A hybrid networking device that includes functions of a router and of a bridge.	A Brouter routes specific protocols such as TCP/IP and bridges others.
Bus	A LAN topology in which all nodes are connected to a single cable.	A data transmission from any node is received by all other nodes on the Bus.
Byte	A data unit of eight bits	
Cat-3, Cat-5, Cat-5E	Category -3, -5 Ethernet twisted-pair cable, available as Unshielded Twisted Pair (UTP) or Shielded Twisted Pair (STP)	10Base-T can use Cat-3 or Cat-5 cable. Cat-3 includes 4 wires (2 twisted pairs). Cat-5 includes 8 wires (4 twisted pairs). 100Base-T can only use Cat-5 cable. (Note: Cat-5 cabling and connectors are more reliable than those for Cat-3. Cat-5E refers to the Enhanced version of Cat-5.) Both Cat-3 and Cat-5 cables are limited to 100 meters (328 feet) per segment, and both use RJ-45 connectors.)
CGI	Common Gateway Interface	A programming standard that connects databases and web browsers.
Channel	Path through network devices from one node to another.	
Coaxial Cable	Electrical transmission medium with solid wire conductor at center, insulated from and surrounded by tubular outer metal conductor.	Examples are Thin Ethernet (RG-58/AU or RG48/CU) and Thick Ethernet (RG-8) with BNC connectors. Coaxial cable was commonly used for earlier networks; Twisted-Pair is popular in current use.

Name/Acronym	Name/Definition	Comments
Collision	Simultaneous transmission of two nodes on the same channel.	Collisions can be reduced (and network capacity increased) by use of Switches, which partition and isolate collision domains.
Collision Detection	An indication to the Data Link Layer that node contention (simultaneous transmission) is present at the Physical Layer.	Collision Detection causes both nodes to abort transmission, set a random delay, and attempt re-transmission. If contention recurs, each device doubles delay time before re-transmission; successive redoubling is called “exponential back-off”.
Crosstalk	Electrical noise coupled between media elements	
Cross-over Cable	Ethernet cable that enables connection of DCE to DCE equipment, or DTE to DTE equipment.	In a "cross-over" cable, wiring crosses over from the Transmit connection pair at one end to Receive connection pair at the other end.
CSMA/CD	Carrier Sense Multiple Access w/ Collision Detection	All nodes on the same network are free to initiate message transmission. If two nodes transmit simultaneously, the collision is detected, and both nodes abort transmission and attempt to re-transmit after a pause.
CSU/DSU	Channel Service Unit/Data Service Unit	Converts data from format used by telephone company to format usable on LAN.
Cut-Through	Method used by switches for filtering messages, based on the first few bytes.	Enhances transmission speed, but reduces transmission security and/or reliability.
Data Link	A logical connection between two nodes on a network.	
Data Link Layer	Layer 2 of the OSI Model that is media-independent, and functions above Layer 1 (Physical Layer).	Defines protocols for data packets and how they are transmitted between networking devices. Includes two sublayers: Media Access Control (MAC), and Logical-Link Control (LLC).
Datagram	A series of bits in an ordered, intelligible sequence.	Datagrams are commonly referred to as “Packets”, because they are data entities, although Packets apply only the top layer (Application Layer of the OSI Model.
DCE	Data Communications Equipment	Devices that transport data between DTE devices.
DHCP	Dynamic Host Configuration Protocol	Runs in a DHCP server, which assigns an IP address to each node that connects to the network. (Can not be used in a an HC900 LAN.)
DNS	Domain Name System	An Internet system (resident in a Web Browser) that resolves domain names to IP addresses. (For example, Http://www.yahoo.com resolves to Http://204.71.202.160.)
Domain	On the Internet, a named network. In MS Windows, an elemental administrative (security-oriented) unit.	User Names/Passwords, and related data on a network.

Name/Acronym	Name/Definition	Comments
Domain Name	A text name, appended to the Host name.	Identifies a node as a member of a domain.
DS1, DS3	Dedicated leased telephone lines	DS1 (T-1) carries 1.544 Mbps, DS3 (T-3) carries 44.736 Mbps
DTE	Data Terminal Equipment	Computers, Controllers, and other devices that communicate via networking devices.
Ethernet	IEEE networking standard 802.3, which defines configuration rules for an Ethernet network	10 or 100 Mbps, Baseband network that uses various media (thick coax, thin coax, twisted pair, or fiber optic cable). Example: 10BaseT is 10 Mbps Twisted Pair.
FTP	File Transfer Protocol	Use for send and receive files between an FTP client and an FTP Server.
Filtering	Selection process used by a Switch or a Bridge to forward a message or block its passage.	The Switch or Bridge reads the content of a packet (such as destination address) to determine whether the message should be blocked or forwarded.
Firewall	Inter-network security system	Application software that runs in a computer, or a dedicated firewall device that includes a dedicated computer and software. In either case, it is placed in the data path between networks.
Firmware	Semi-permanent storage medium.	In some cases, the content of firmware is fixed, and cannot be altered. In other firmware (e.g., Flash), the content can be re-written.
Forwarding	Bridge or Switch, passing a message from one network to another, based on packet filtering.	See “Filtering”.
Framing	Dividing messages into groups of bits, each group having specific significance.	Framing techniques vary with protocols used. Typically, message data is preceded by an identifying “header” and is followed by an error-check sequence.
Host Name	The name assigned to identify a computer connected to a network.	The name is resident in each Host computer.
Host Table	A list of TCP/IP Host Names/IP Addresses for a network	
hostid	Host Identifier	The portion of the IP address (right part) that uniquely identifies a Host device on a network.
Hub	See “Port Multiplier”.	
HTTP	Hypertext Transfer Protocol	Application-Layer protocol that controls transactions between the web client and the web server.
Internet	A system of networks (local, regional, national, and international) linked by TCP/IP.	Access to the Internet is governed by a world-wide set of rules. IP (Internet Protocol) addresses are assigned by Internet Corporation for Assigned Names and Numbers(ICANN)

Name/Acronym	Name/Definition	Comments
IP Address	Internet Protocol Address	Guaranteed unique address, assigned by the Internet Corporation for Assigned Names and Numbers (ICANN). IP address includes four "octets" (eight bits, translating to integers from 0 to 255), separated by periods. ICANN assigns three classes of addresses: Class A – first (leftmost) octet is assigned; the three rightmost octets are assignable to the owner of the Class A address. Class B – first and second (leftmost) octets are assigned, the remaining two are assignable by the owner of the Class B address Class C – the three leftmost octets are assigned; only the rightmost octet is user-assignable. The number 0 is reserved for router connections to another network, 127 for loopback testing, and 255 for broadcast to all computers on the network.
ISDN	Integrated Services Digital Network	Digital service provided by telephone companies.
Jabber	Corrupted and/or incessant data transmitted onto a network.	Caused by a failed Network Interface Card, or by a computer device that transmits packets whose length violates network rules.
Kbps	Kilobits per second	Transmission speed.
Kermit	A program used widely for file transfer and terminal emulation.	
LAN	Local Area Network	Networked devices, logically isolated from other networks and devices.
Latency	Delay in transmission caused by a Switch or Bridge in forwarding a message.	
Layer	One of the seven layers in the OSI model.	
LLC	Logical Link Control layer	Layer 2 of the OSI Model
Load balancing	Transferring tasks from heavily-loaded resources to less-loaded resources.	
Logical Link	A temporary connection between source and destination devices.	
MAC	Media Access Control	Ethernet Interface (transceiver, software to physical media)
MAC Address	MAC coded ID	Unique code "burned" into firmware by the device manufacturer.
MAU	Medium Attachment Unit	(Also see AUI, MDI, MAC)
MDI	Medium Dependent Interface	Physical connector at cable end (e.g., RJ-45 plug on Ethernet CAT 5 cable.) (Also see AUI, MAU)

Name/Acronym	Name/Definition	Comments
Modbus TCP/IP	Variant of Modbus protocol	Modbus TCP/IP is a derivative of related Modbus protocol used with RS-232 or RS-485 data acquisition and supervisory structures. Basically, Modbus TCP/IP encapsulates Modbus messages in TCP frames for transport in an Ethernet network.
Modem	Modulator-Demodulator; a device for translating data in differing media and/or format.	Modems are commonly used for transmitting digital data over analog telephone lines. A modem is required at each end of the link.
Multicast	Transmission of a message with multiple destinations.	
Name Server	Network software that translates text-format names into numeric IP addresses	See also "DNS".
NetBIOS /NetBEUI	Microsoft networking protocols	Used with Microsoft LAN Manager and Windows NT products.
netid	Network Identifier	The portion of the IP address (left part) that identifies the network.
Netware	Network operating System (NOS) by Novell	
Network	A system of interconnections in which networking devices such as Hubs, Bridges, etc transport messages between computing devices.	"Computing devices" often include Personal Computers (PCs), but also can include other computer-based devices such as process controllers, operator interface units, and graphical trending devices.
Network Address	A code that resides in a networked device, and that identifies the device uniquely on the network(s) to which it is connected.	The identifying code is usually numeric, but additional, text-oriented Name codes can for added user convenience in device identification. Network addresses usually include a MAC address and an IP address, and may also include Host Name (for a PC) or other text-oriented user name.
Network Management	Administrative services that include configuration, tuning, performance monitoring, and problem diagnosis and repair.	Many commercial and industrial facilities have large networks that are managed by full-time, professional IT employees. Other facilities contract the services of professional IT agencies. For networks that are dedicated for special purposes (process control, for example), and are uncomplicated and easy to control, Network Management is sometimes assigned to local employees as a part-time, add-on responsibility. Advised judgment is recommended.
NIC	Network Interface Card	The NIC is plugged into one of the PC's expansion slots. It includes the hardware and software (OSI Layer 1 and Layer 2) required for connecting the PC to the network.

Name/Acronym	Name/Definition	Comments
Node	Any intelligent device that includes a hardware address that can be recognized by other network devices.	The “node” terminology is sometimes limited to computing devices such as PC hosts, but can also include networking devices such as Switches and Routers.
OPC	Object Linking and Embedding (OLE) for Process Control	OPC is an open standard that defines the exchange of information between cooperating software applications. OPC is based on the Distributed Common Object Model (DCOM) defined by Microsoft Corporation. OPC server and client software runs in computers interconnected on a network, and enables exchanges between process control devices and PCs configured as HMIs.
OSI Model	Open Systems Interconnection Reference Model	The OSI model is established by International Standards Organization (ISO) to enable computer communications using disparate media and protocols. Includes seven “Layers”; refer to "OSI Reference Model” for more information.
Packet	A bit sequence that is transmitted as an entity on a network.	The content of a packet varies with the protocols that are applied. It includes the data message itself and various routing and control information such as source and destination addresses. In many cases, a packet includes a set of frames for one protocol embedded (or encapsulated) in a set of frames for another protocol. (Several levels of encapsulation could be incorporated in a packet.)
Port	The physical connection on a networking device.	For 10BaseT networking devices, ports are RJ-45 connectors.
Port Multiplier	A “concentrator” (e.g., a Hub) is a multi-port device that enables one device to be connected to several others.	The Port Multiplier (a.k.a. Hub) forwards a message at any of its ports to all of its other ports, with no isolation between the devices on these ports. Hence, a Hub constitutes a “collision domain” for all connected devices.
PPP	Point-to-Point Protocol	Provides Router-to-Router and host-to-network connections over both synchronous and asynchronous circuits.
Print Server	A PC dedicated to printer management.	Services print requests from other nodes on the network.
Protocol	A system of rules for communicating over a network.	
Remote Access	Access to a network from a remote computer	Remote access usually uses a telephone line or the Internet. The remote computer becomes a node on the accessed network by assuming control of a node actually on the network.
Repeater	Receives signals on an incoming cable, reshapes signal form and restores timing, then repeats the signal on an outgoing cable.	A Repeater can extend the distance over which a message can be transported, but it also expands the time for transport.

Name/Acronym	Name/Definition	Comments
RJ-45	Style of connector at end of Ethernet twisted-pair cable	
Router	A device that is capable of filtering messages based on IP addresses.	Routers differ from Bridges and Switches in that those devices can only read MAC addresses.
Shared Ethernet	Configuration that binds several network segments in a single collision domain.	(See “Port Multiplier”.)
SMTP	Simple Mail Transport Protocol	Enables transmittal of E-Mail. Details are available in RFC 821.
SNMP	Simple Network Management Protocol	Enables a TCP/IP Host to collect network statistics from other Hosts.
SQE	Signal Quality test	Often referred to as “heartbeat”.
Straight Cable	Ethernet cable that enables connection of DCE to DTE equipment.	In a "straight" cable, the Transmit wiring pair at one end is wired directly to Transmit wiring pair connections at the other end, and the Receive pair at one end is wired to the Receive pair at the other end.
Subnet Mask	Defines the ***netid*** (Network ID) and the ***hostid*** (Host ID) parts of an IP address.	The ***netid*** uniquely identifies a network, and the ***hostid*** uniquely defines a computer on the network. The Subnet Mask can be used to partition the network into sub-networks, using parts of the ***hostid*** to define new ***netid***s, or more correctly, ***subnetid***s. Portioning a network in this way enables switches and routers to use the ***subnetid***s to reduce collision domains and to promote security.
Switch	Multi-port device that connects several network segments on an address-selective basis	A Switch uses (MAC) source and destination addresses in each packet to establish the appropriate channel from the sending node to the receiving node. The Switch looks very much like a Hub, but differs in that ports are isolated from each other, eliminating the multi-segment collision domain that is characteristic of a Hub.
T-1, T-3	(See DS1, DS3.)	
TCP/IP	Transport Control Protocol/Internet Protocol	Transmission Control Protocol (TCP): - operates at the Transport Layer of the OSI Model. - manages connections between computers. (Also see User Datagram Protocol [UDP]). Internet Protocol (IP): - operates at the Network Layer (one step below TCP) - defines how data is addressed (source/destination)

Name/Acronym	Name/Definition	Comments
Telnet	Application that provides a terminal interface between hosts using TCP/IP.	Telnet defines a protocol that allows a remote terminal session to be established with an Internet host, so that a remote user has can use the remote host as though he was sitting at a terminal connected directly to the Host.
Throughput	Data volume transmitted per unit of time.	Example: 10 Mbps
Token Ring	A network topology in which the nodes are addressed and can transmit in a fixed sequence.	The "token" is a special code that is passed from node to node in the same fixed sequence. Each node can hold the token for a limited time, and can transmit only as long as it holds the token.
Topology	The configuration scheme for a network.	Types of network topology include Ring, Bus, Star, and Tree.
UDP	User Datagram Protocol	Similar to Transport Control Protocol (TCP), but less complex regarding reliability features, and hence, faster than TCP.
Uplink Port	Ethernet Port that enables inter-connection of networking devices	Some Hubs and some Switches include an additional port that enables connection form hub to hub, hub to switch, etc. Typically, the Uplink Port is a cross-over connector; on some devices, the Uplink Port can be configured (or selected) as either cross-over or straight.
VLAN	Virtual Local Area Network	Provides access to multiple IP subnets at a physical location.
VPN	Virtual Private Network	Remote access via a secure (encrypted) "tunnel" though the Internet.
WAN	Wide-Area Network	Typically, a network that includes several LANs at different geographical locations, interconnected using common carrier transmission services.
WINS	Windows Internet Name Service	

Pre-Installation Planning

Overview

Methodical pre-planning of an installation will preclude false starts and errors that can cause costly hardware re-configuration and/or poor system performance. Some considerations in pre-installation planning should include:

- Power Supply Budgeting
- Environmental conditions such as temperature, humidity, and other characteristics of the physical plant site.
- Equipment placement, particularly if the locations of field devices warrant the use of separate and/or remote IO hardware.
- Selection and placement of ancillary equipment such as equipment enclosures, conduits, and raceways for wiring and cabling.

Power Supply Selection

To determine which power supply to use, calculate power requirements below.

ATTENTION

Using inadequate power supply will cause the controller to cycle power on and off.

Enter quantity of each module type in column A and calculate the 5V and 24V maximum current in columns D and E. Sum the maximum current for all module types and determine if the 900P02 power supply is appropriate.

	A	**B**	**C**	**D**	**E**
		Max Current	Max Current	5V	24V
Module type	**Quantity**	@ 5 V in mA	@ 24 V in mA	mA Sub. Tot	mA Sub. Tot
				(D = A * B)	**(E = A * C)**
Controller	**( )**	600	0	**( )**	**( )**
Scanner	**( )**	600	0	**( )**	**( )**
Analog Input (8 pts)	**( )**	40	25	**( )**	**( )**
Analog Output (4 pts)	**( )**	40	200	**( )**	**( )**
AC Digital Input (16 pts)	**( )**	230	0	**( )**	**( )**
DC Digital Input (16 pts)	**( )**	230	0	**( )**	**( )**
Contact Input (16 pts)	**( )**	230	40	**( )**	**( )**
AC Digital Output (8 pts)	**( )**	220	0	**( )**	**( )**
DC Digital Output (16 pts)	**( )**	430	0	**( )**	**( )**
Relay Output (8 pts)	**( )**	140	100	**( )**	**( )**
Total mA				**Total 5V= ( )**	**Total 24V= ( )**

1. Is total 5V less than 2000? Yes/No
2. Is total 24V less than 900? Yes/No
3. If the answer to 1 and 2 are YES, go to 4. If the answer to 1 or 2 is NO, use power supply 900P01-0001.
4. Multiply 5V total by 5.1. ( )
5. Multiply 24V total by 24.5. ( )
6. Sum results of 4 and 5. ( )
7. Divide results of 6 by 1000 ( )
8. Is the result of 7 less than 28? Yes/No
9. If the answer to 8 is Yes, use power supply 900P02-0001
10. If the answer to 8 is No, use power supply 900P01-0001

Environment

Environmental Operating Limits

The environmental conditions required for operating the HC900 Hybrid Controller are listed Table 6.

Table 6 - Operating Limits and Installation Guidelines

Condition	Specifications
Ambient Temperature	32°F to 131°F (0°C to 55°C) or (0°C to 60°C) with derating
Relative Humidity	10 % to 90 % RH at 40°C (104°F)
Vibration Frequency Acceleration	 14 Hz to 250 Hz 1 g
Mechanical Shock Acceleration Duration	 1 g 30 ms
Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI)	Meets the requirements of the EMC directive, 89/336/EEC. Evaluated to EN61326:1997 + A1 for emissions and immunity.
Power Voltage Frequency (Hz)	 100 Vac to 240 Vac 47 to 63 Hz
Power Consumption	Typical 110VA@ 115VAC, maximum 130VA @ 264VAC
Class 1, Division 2 Installations	CONTROLLER RACK MUST BE MOUNTED INSIDE A SECURE ENCLOSURE
General Installation	Install per NEC requirements for Open Type Equipment

The HC900 Controller must be mounted in suitable equipment enclosures. That is, all components such as the Controller rack, IO Expander Racks, and the Operator Interface manufactured by Honeywell must be mounted in approved furniture designed for industrial applications.

Orientation of Rack Mounting

Racks must be mounted as indicated in illustrations throughout this manual, so as to provide for vertical airflow through the racks. That is, racks must never be mounted vertically, and must never be mounted with the backplane horizontal (for example, flat on a horizontal panel or tabletop). Environmental specifications apply only to the normal mounting configuration.

Heat Rise De-rating

The HC900 is rated to operate at 60° C. However, for maximum reliability, the following guidelines should be observed for applications above 52° C.

1. Locate lower-power modules (Analog Input , Contact Input, etc) beside the Controller Module, and keep higher-power modules (AC Output, AC Input, etc) away from the Controller Module. For power consumption of each module, refer to Table 7.
2. For 240 Vac applications and temperatures above 56° C, or 264Vac, 52° C , de-rate the number of ON inputs per AC input module. (See AC Input de-rating data, see Figure 18.)
3. Limit the number of Analog Output modules to a maximum of 10 per rack. . (See Figure 19.)

Table 7 - Power Applied, by Module Type

Module	HC900 Controller Power (Watts)	Field Power (Watts)	Total Power (Watts)
Controller	2.3	0.0	2.3
Analog Input	1.0	0.0	1.0
Analog Output	4.3	0.0	4.3
Contact Input	2.0	0.0	2.0
Relay Output	2.4	0.0	2.4
DC In (@ 24V)	1.0	2.6	3.6
DC In (@ 32V)	1.0	5.1	6.1
DC Out	2.3	1.2	3.5
AC In (@120V)	1.0	1.9	2.9
AC In (@ 240V)	1.0	7.7	8.7
AC Out	1.0	12.0	13.0

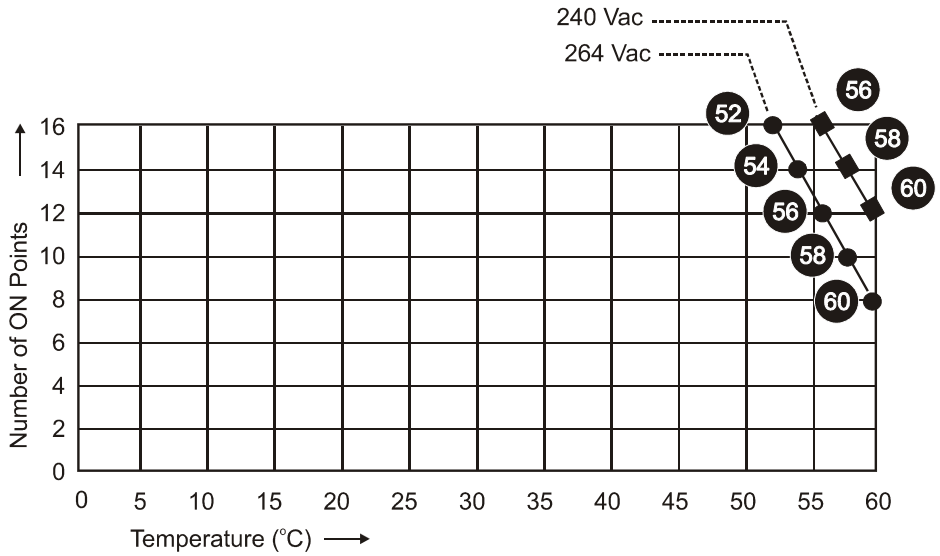


Figure 18 - AC Input Module de-Rating

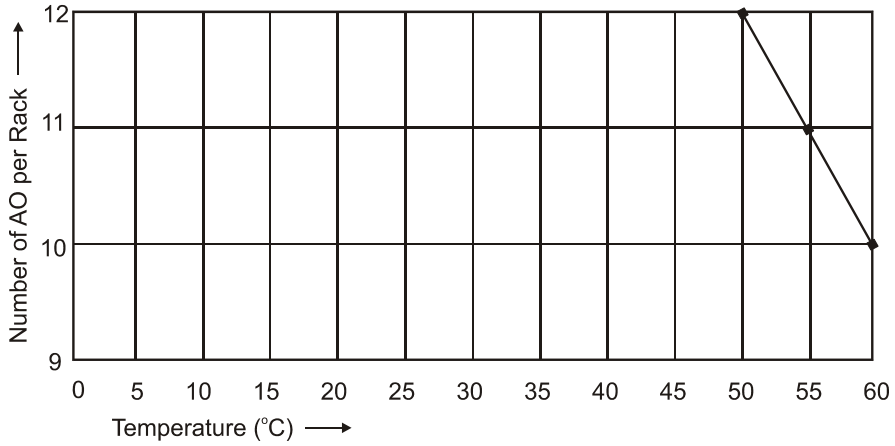


Figure 19 - Power Supply De-rating

Equipment Placement Considerations

Factors that determine where equipment should be located within the site include at least the following:

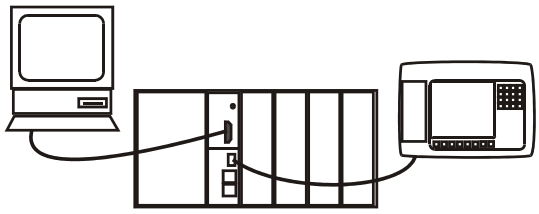
- Environmental conditions (see above).
- Wiring/cabling characteristics. The HC900 Controller includes (optional) I/O expansion racks (C50 CPU only), which provide options regarding methods of connecting field devices into the system. That is, the length of I/O wiring can be reduced significantly by locating I/O expansion racks remote from the Controller rack, but close to process equipment. Following are samples of valid system architecture.

NOTE: Cable lengths specified in this manual are absolute. When planning for routing of cables and wires, be certain to include vertical and horizontal routing within cabinets, raceways, and conduits. For planning hints, refer also to Appendix A of this manual.

Controller Rack, with Local I/O (only). In this case, all wiring is from field devices to I/O modules in the local rack.

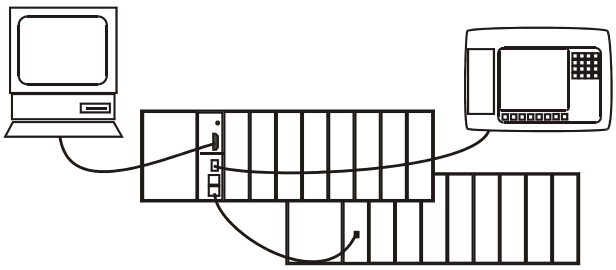
Maximum length of RS-232 cabling (Controller to PC) is 50 feet (15.2 meters).

Maximum length of RS-485 cabling (Controller to Operator Interface) is 2000 feet (609.6 meters).



Controller rack, with one I/O expansion rack.(C50 CPU only)

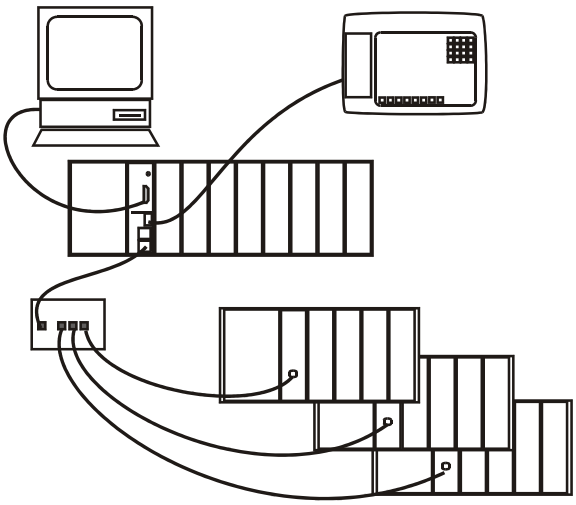
Maximum length of Ethernet cabling (Controller to I/O expansion rack) is 328 feet (100 meters).



Controller rack connected via Ethernet Hub to up to four I/O expansion racks. (C50 CPU only)

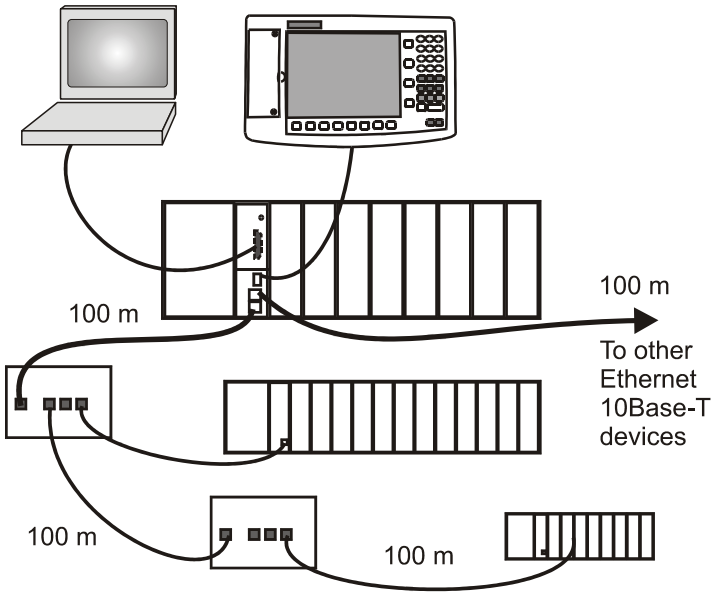
Length of Ethernet cable:

- (Local Rack to Ethernet Hub): ≤ 328 feet (100 meters)
- Hub to any I/O expansion rack - ≤ 328 feet (100 meters)



Controller rack connected via two Ethernet Hubs to I/O expansion racks (C50 CPU only)

Length of Ethernet cable, each segment: 328 feet (100 meters).



Note: The use of Ethernet cables in excess of 100 meters and/or devices other than approved Hubs (2 Maximum) will cause transmission delays that could have adverse affects on Controller performance.

It is advantageous to minimize length of I/O wiring. However, it is also a good idea to locate racks (and wiring) away from adverse environmental conditions such as sources of RFI, EMI, and away from areas with high levels of moisture, dust, and corrosive materials.

Electrical Considerations

The HC900 Controller should be mounted in an appropriate metal enclosure. A diagram that shows recommended wiring practice for the cabinet enclosure is given in Figure 20 - Cabinet Wiring, Single Chassis, and Figure 21 - Cabinet Wiring, Multiple Chassis.

Deviations from the installation conditions specified in this manual may invalidate this product's conformity with Low Voltage and EMC Directives.

⚠ WARNING

Hazardous voltages exist in the equipment enclosure.

- Identify and avoid contact with voltage sources.

Failure to comply with these instructions could result in death or serious injury.

Controller Grounding

PROTECTIVE BONDING (grounding) of this controller and the enclosure in which it is installed shall be in accordance with National Electrical Code (ANSI/NFPA 70) and with local electrical codes.

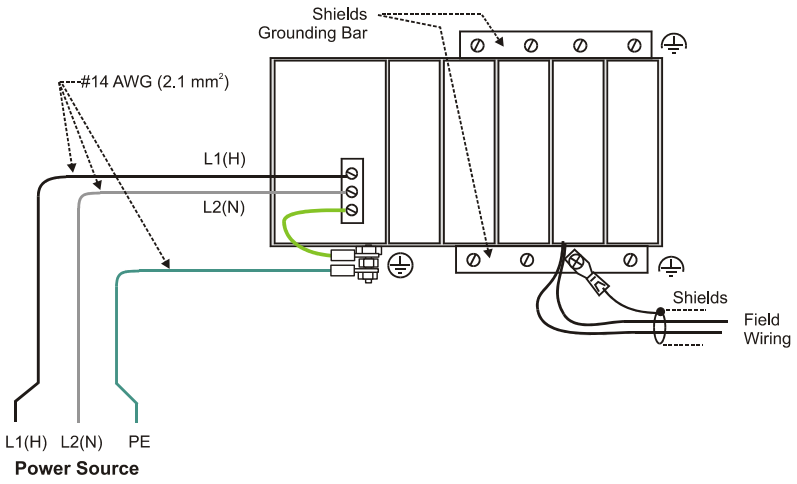


Figure 20 - Cabinet Wiring, Single Chassis

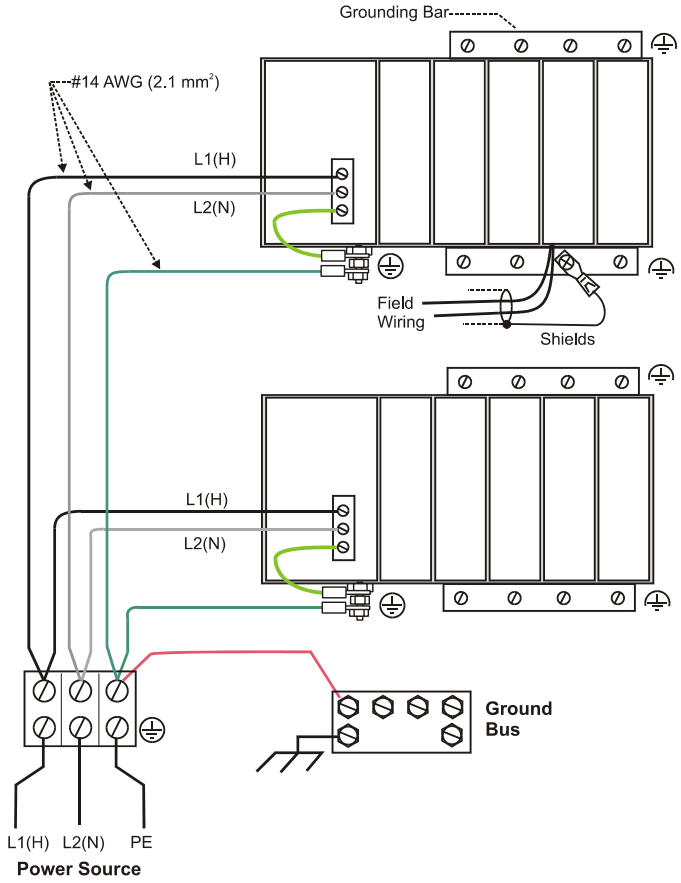


Figure 21 - Cabinet Wiring, Multiple Chassis

CE Conformity

Electrical noise produces undesirable effects in measurements and control circuits.

Digital equipment is especially sensitive to the effects of electrical noise. You should use the following methods to reduce these effects:

- Supplementary bonding of the controller enclosure to a local ground, using a No. 12 (4 mm^2) copper conductor, is recommended. This may help minimize electrical noise and transients that may adversely affect the system.
- Separate external wiring - group connecting wires into bundles (see Table 8) and route the individual bundles through separate conduits or metal trays.
- Use shielded twisted pair cables for all Analog I/O, Process Variable, RTD, Thermocouple, dc millivolt, low level signal, 4-20 mA, Digital I/O, and computer interface circuits. Ground shields as described in the section *Input/Output Installation and Wiring*.
- Use suppression devices for additional noise protection. You may want to add suppression devices at the external source. Appropriate suppression devices are commercially available.
- Refer to document 51-52-05-01 *How to Apply Digital Instrumentation in Severe Electrical Noise Environments* for additional installation guidance.

Grouping Wires for Routing

Wires that carry relatively high electrical energy can produce unwanted noise in wires that transmit signals of relatively low energy, particularly when they are placed parallel in long wiring runs. Collect and bundle wires of similar type, and route the bundle separate from bundles of other types. Table 8 provides suggested guidelines for grouping wires.

Table 8 - Guidelines for Grouping Wires

Wire Group	Wire Functions
High voltage (>50 Vdc/Vac)	• AC Line power wiring • Earth ground wiring • Control relay output wiring • Line voltage alarm wiring
Signal (<15 Vdc)	Analog signal wire, such as: • Input signal wire (thermocouple, 4 mA to 20 mA, etc.) • 4-20 mA output signal wiring • Slidewire feedback circuit wiring Communications
Low voltage (<50 Vdc/Vac)	• Low voltage alarm relay output wiring • Low voltage wiring to solid state type control circuits

System Monitor Function Blocks

The HC900 Controller includes function blocks that enable the user to monitor the status of system functions. When constructing a control configuration, add the following function blocks to the control strategy:

- ASYS - System Monitor
- FSYS - Fast System Monitor
- RK - Rack Monitor

These function blocks are described in the HC900 Function Block Reference Guide.

Master Control Relay

A Master Control Relay (MCR) structure is a safety mechanism for shutting down the process control system in emergency conditions. This mechanism, which is hard-wired (provided and installed by the User) can include several Emergency Stop switches., strategically located near process equipment. An example of an MCR structure is given in Figure 22.

Operating any of the Emergency-Stop switches opens the holding path for the MCR. When the MCR de-energizes, the MCR contact opens, disconnecting all AC power that is supplied to AC Input Modules and to AC Output Modules. Notice that AC power is disconnected only from the AC input/output modules. Power is still available to Power Supplies at the Controller Rack and at each I/O expansion rack. The Controller Module and the Scanner Modules in the racks continue to execute diagnostics and other programs.

⚠ WARNING

The Master Control Relay does not remove power from the Controller rack or from any of the I/O expansion racks.

- Before performing service tasks such as installation of terminal connections or fuse replacement, use the appropriate switch(s) to disconnect power from the power supply at each module.
- Ensure that wiring design precludes over-riding of the MCR by operator actions.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING Class 1, Division 2 Installations

- DO NOT REMOVE OR REPLACE MODULES WHILE CIRCUIT IS LIVE UNLESS THE AREA IS KNOWN NOT TO CONTAIN FLAMMABLE VAPORS.

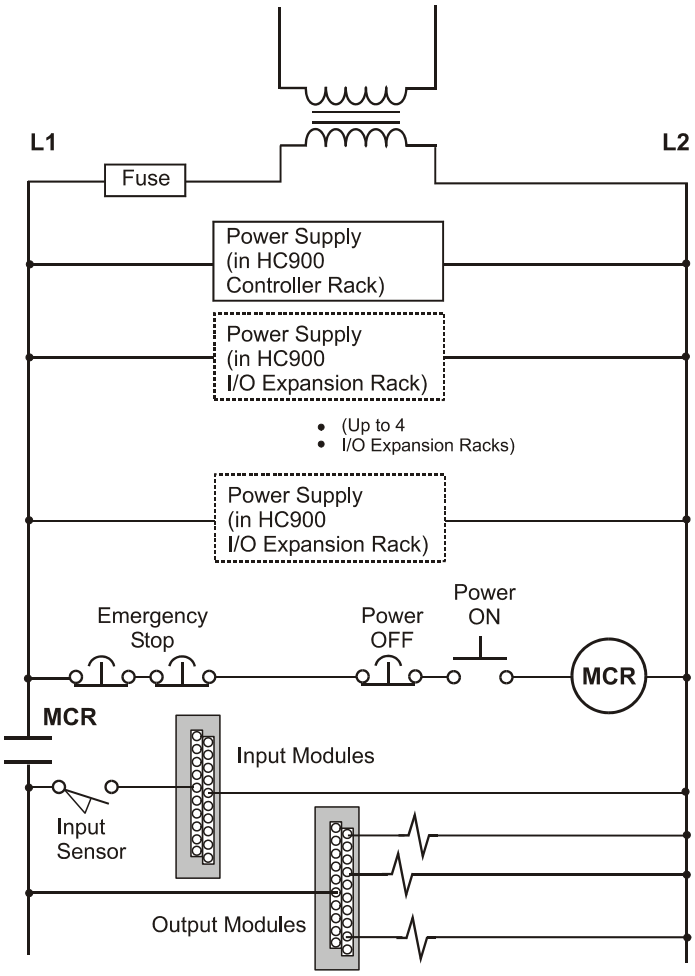


Figure 22 - Master Control Relay Wiring Example

Rack Dimensions

Rack dimensions, including overall dimensions and patterns for drilling holes for mounting, are given in Figure 23. Vertical spacing of racks, which is required for rack ventilation and for routing wires, is shown in Figure 24.

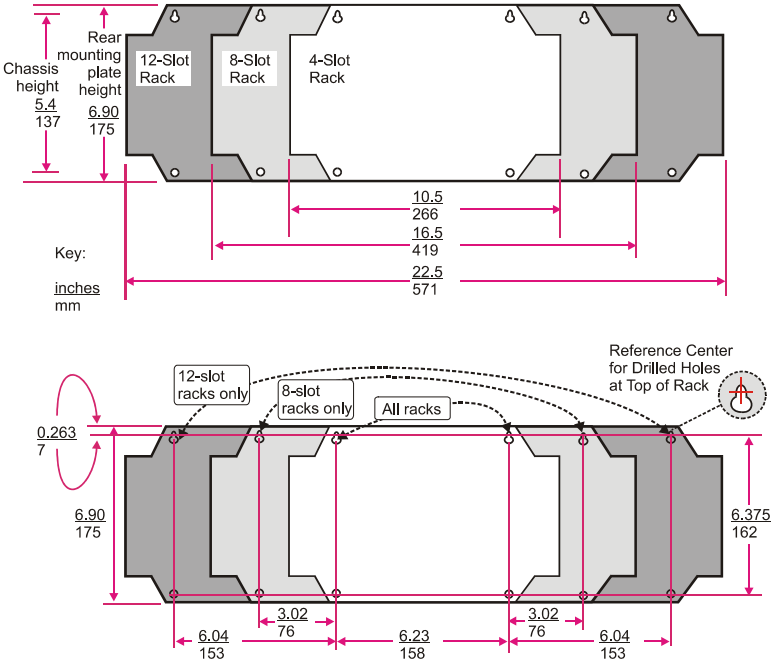


Figure 23 - Rack Dimensions

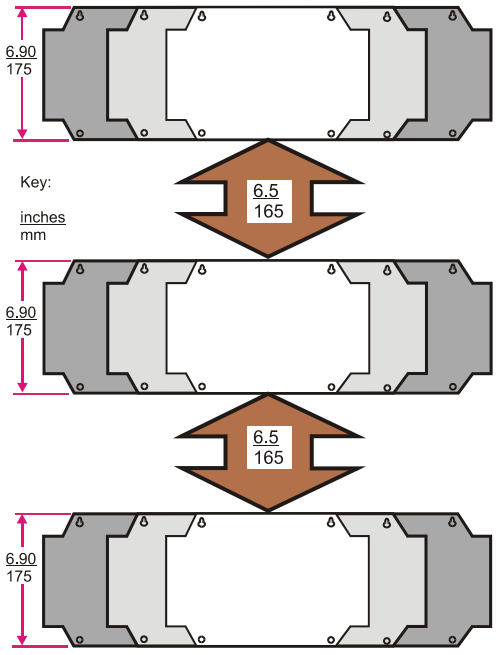


Figure 24 - Vertical Spacing of Racks

Site Plan Documentation

Documenting the plan for installing a process control structure yields significant benefits:

- The task of *installation planning* itself is facilitated.
- Properly organized documentation greatly facilitates each step of the *installation process*, particularly when planners and installers are different persons.
- After initial installation, good documentation facilitates *modification and troubleshooting.*
- For *long-term maintenance*, good documentation aids in the *orderly transfer of knowledge required for safe and secure process operations*.

Time and effort spent at the beginning of a project is quickly recovered in the efficient execution of each planning and installation procedure. To reduce the burden of documenting an HC900 Controller installation, several data-collection aids are given in Appendix A of this manual. These include:

- sample diagrams ("maps") of site facilities and of networking systems
- fill-in templates that aid in collection and organization of installation data.

Use of these documentation aids will ease the task of coordinating hardware installation tasks with software configuration tasks (for example, placement and wiring of I/O modules and configuring Rack, Module, and Channel data in the configuration file.)

Installation Guide

Overview

This section contains procedures for installing one or more HC900 Controllers. It is recommended that the Site Plan Documentation, completed as a part of Pre-Installation Planning, is used as a primary data source and checklist while performing these procedures.

It is also recommended that the Site Plan Documentation and the information in this section be reviewed together before beginning the installation. Familiarity with the overall procedure will help to prevent errors and will promote efficiency in general.

Tools Required

The primary tools required during installation are listed in Table 9.

Equipment Preparation

A checklist for site preparation is given in Table 10.

Table 9 - Installation Tools

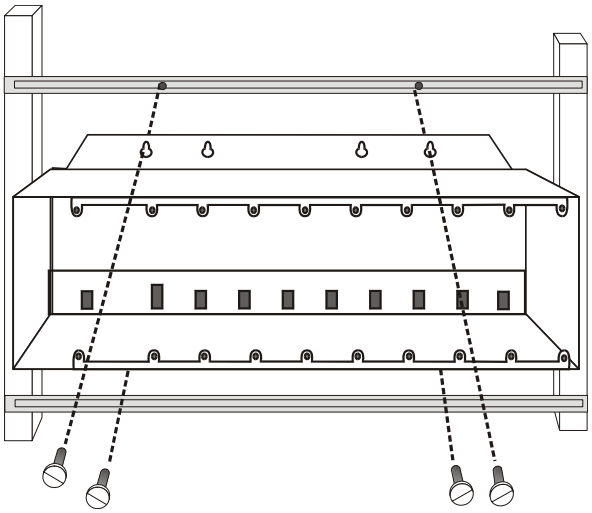
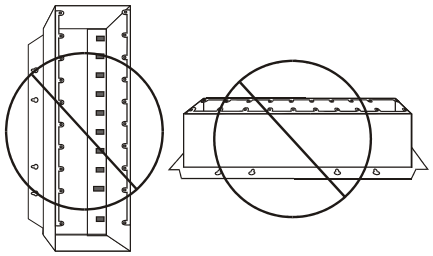
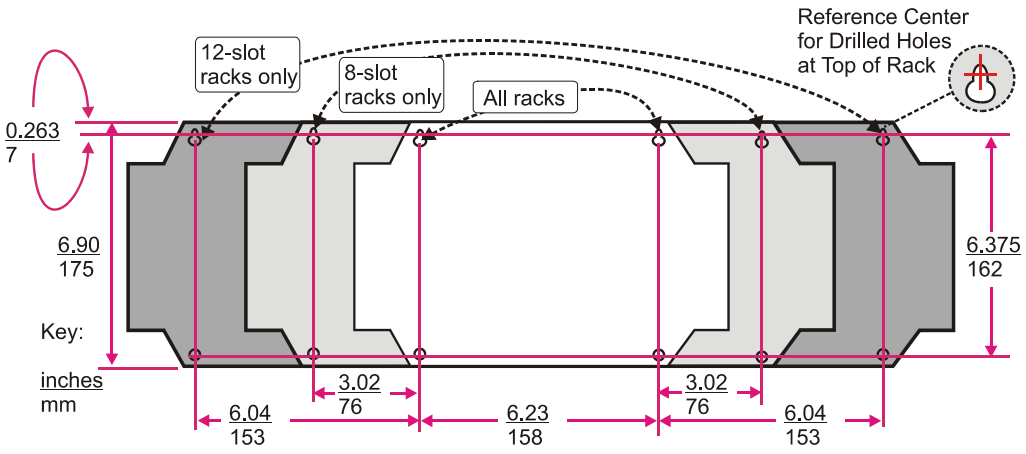
Item	Description	Comments
	Common tools	
1	• Wire strippers	For Power Supply and for I/O Wiring
2	• Crimper	For Terminal Lugs on Power Supply wiring and on I/O wiring shields
3	• Screwdrivers	
4	– Small flat-tip	For Euro-style Terminal Blocks
5	– Small/medium flat-tip or Phillips	For Barrier style Terminal blocks); also for captured screws in Terminal Blocks
6	– Large (long blade)	For use as I/O Module extractor
7	• Electric drill, with drill bits for #10 or M4 screws, and with drill-bit extender	For rack mounting
8	• Vacuum cleaner, brush	For use during and after drilling operations
9	• Pen, ball-point or felt-tip, for entering data on labels for I/O modules)	For entering data on labels for I/O modules
10	• Multi-Meter (Volt/Ohms/Amps)	For safety checks and for equipment test
11	• Soldering pencil or gun (for attaching filter capacitors to I/O wiring shields)	For attaching filter capacitors on I/O wiring shields
	Special tools	
	• Precision meters	(If required) for testing Analog calibration; refer to Analog Calibration in this manual.

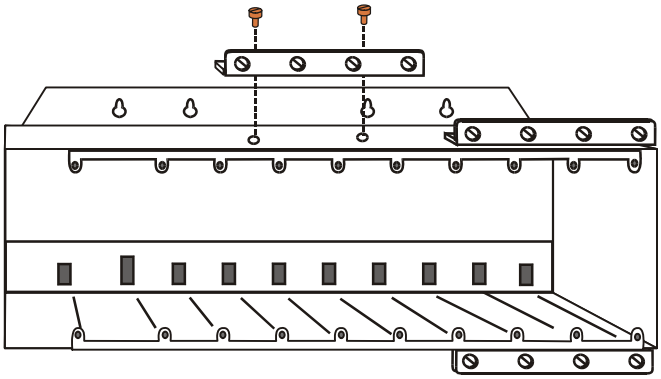
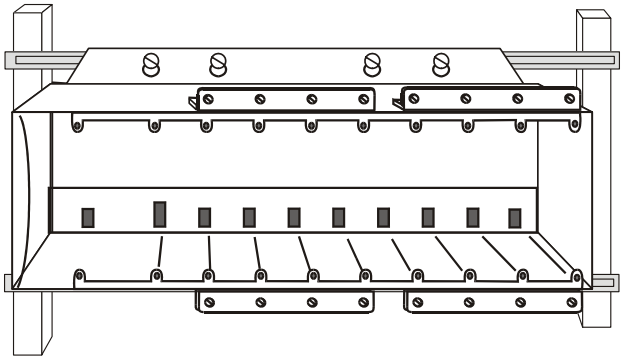
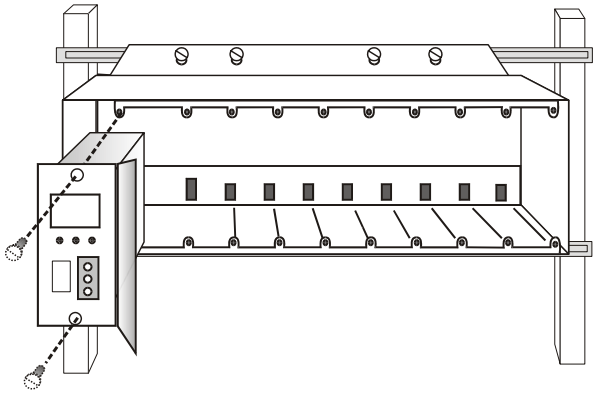
Table 10 - Site and Equipment Preparation

Step	Procedure	Reference
1	Referring to Site Planning Documentation, ensure that sufficient numbers of the following items are on hand: • Racks (4-, 8- and 12-slot) • Power Supplies (1 per rack) • Controller Module or Scanner (1 per rack) • I/O Modules (correct type for each configured slot) • Terminal Blocks, Barrier or Euro style, (1 for each I/O Module) • Jumpers 2-position or 10-position, (for designated Terminal Blocks) • Tie Wraps (1 or 2 for each Terminal Block) • I/O Label (one per terminal block, by module type) • Filler Block Cover (1 for each slot not occupied by an I/O Module) • Blank label (1 for each Filler Block Cover) • Grounding Bars for I/O wiring shields (1 or 2 for each 4-slots in each rack) • Wiring terminal lugs (for connecting I/O shields to grounding bars) • Sheet metal screws, steel #10 or M4, for mounting racks in enclosures (4 screws for 4-slot racks, 8 screws for 8- or 12-slot racks)	Site Planning Documentation In this Manual: • Section on Pre-Installation Planning. • Sections on installation • Appendix A
2	Install (or verify correct installation of) enclosures for HC900 Controllers and ancillary equipment: • Mounting rails or flat-panels • (for cabinet with multiple HC900 Chassis): – grounding bus – barrier strip for AC power • Master control Relay	Site Plan Documentation and this section of this manual
3	Install (or verify correct installation of) enclosures ("closets") for networking devices:	Appendix A. Note : Some networking devices may share enclosures with HC900 Controller components.

Step	Procedure	Reference
4	Install (or verify correct installation of): • External disconnect switches • Fuses at the power source associated with input sensor or output devices for I/O modules.	I/O Module Installation section in this manual.
5	Arrange and organize items to be installed at or near enclosures, and use the Site Plan Documentation as a checklist to verify readiness for installation.	

Table 11 - Install HC900 Controller Components

Step	Procedure	Comments/References
1	Mount the Controller Rack in the enclosure as follows. • Using the diagram below as a guide, mark the locations for rack mounting in the enclosure for the top holes in the rack. **(See CAUTION and Note at right.)** • Drill and tap for # 10 (or M4) screws. • Start the mounting screws (supplied by the user) in the drilled holes. • Hang the Rack on the screws at the top. • Mark the locations for the bottom screws. (**See CAUTION at right.)** • Drill and tap for # 10 (or M4) screws. • Remove the rack from the enclosure.	For dimensions of the pattern for drilling holes, refer to the diagram below.  **CAUTION**: When drilling holes, prevent metal flakes from falling into the rack, or onto any surface within the electrical cabinet. Note: Always mount racks as shown above. That is, never mount vertically, or with backplane horizontal. 
		

Step	Procedure	Comments/References
2	Aluminum grounding bars for I/O module wiring are optional. They can be mounted at top, at bottom, or at top and bottom of the rack, as indicated at right. If grounding bars are included, attach them with two M3 screws (supplied with grounding bars in plastic bag). **Note**: The plastic bag also includes four M4 screws for attaching the grounding wire lugs, which are attached later. Attach the M4 screws loosely to the grounding bars for safe keeping.	
3	Hang the rack in the enclosure on the top screws. Start all screws in the bottom of the rack, then tighten all screws.	
4	Carefully place the Power Supply in the leftmost slot in the Rack, ensuring that the connector at the back seats properly. Insert a slot screwdriver in the slots at the top and bottom of the power supply cover while pulling backward to open the cover. Fasten the screws (captured in the face of the power supply) into the tabs at top and bottom of the rack.	

<table>
<tr><th>Step</th><th>Procedure</th><th>Comments/References</th></tr>
<tr><td>5</td><td colspan="2">

⚠ WARNING

Hazardous Voltage

- Ensure that wiring to the Power Supply is disconnected from the site AC source before installing wiring.
- Do not remove Yellow/Green wire from grounding stud on the power supply.

Failure to comply with these instructions could result in death or serious injury.

</td></tr>
<tr><td></td><td>

Ensure that wiring to the Power Supply is disconnected from the site source, and then connect AC wiring to the power supply as shown at right.

Note: The Yellow/Green wire is supplied with the power supply. The nuts (w/star washers) for the grounding stud are provided in a kit (bagged in a plastic bag with the rack.) The power supply has an internal fuse that is not replaceable. A second external fuse may be added if desired. For P01 power supply use 3.0A, slow-blow for 115VAC operation; 2.5A, slow-blow for 230VAC operation. For P02 power supply, use 2.5A, slow-blow for 115VAC operation; 2.0A, slow-blow for 230VAC operation.

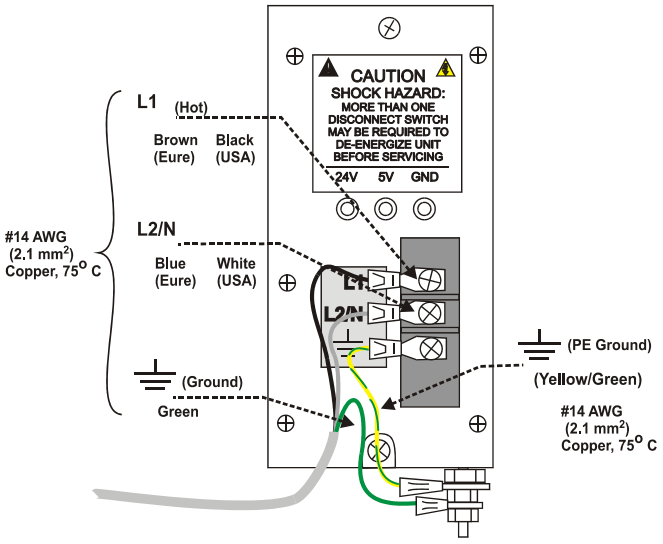
Apply power, and then test voltages at the test points provided on the face of the Power Supply.

Note: Test-points are electrically connected to the backplane of the rack. If the power supply is not properly seated in the backplane connectors, no voltage will be measured at the test points.

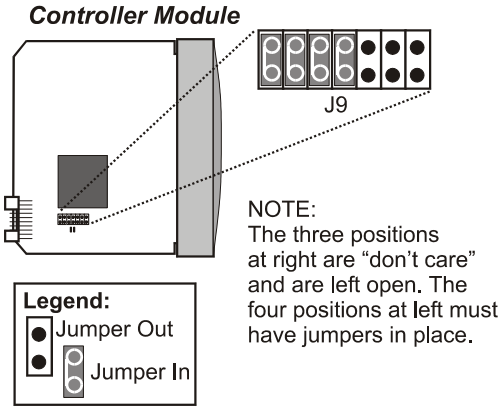
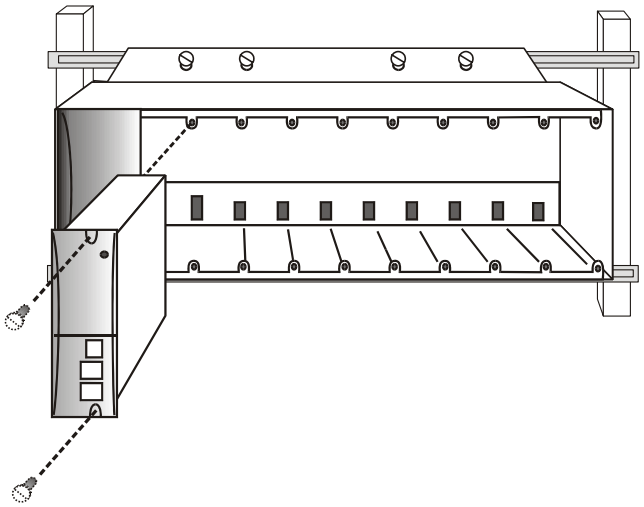
</td><td>

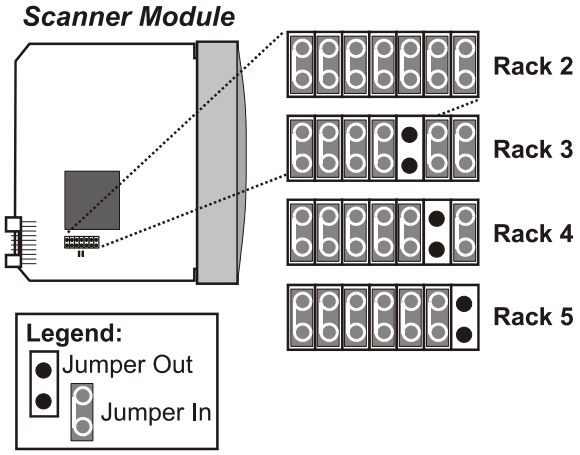
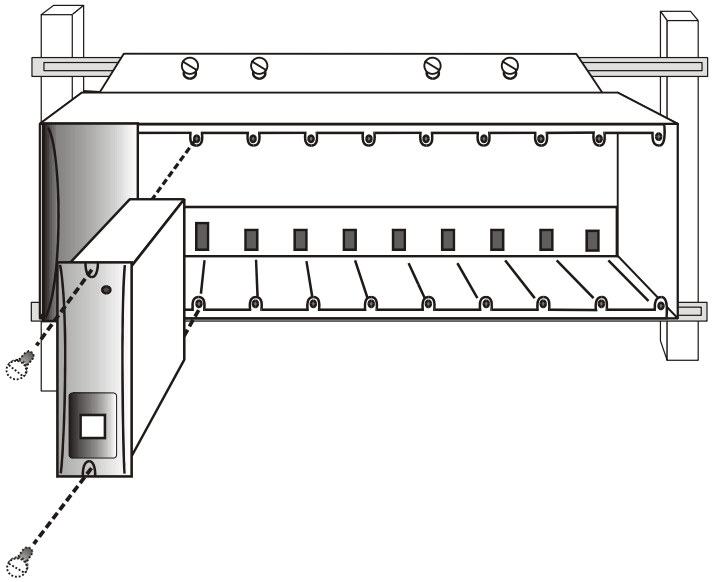
ATTENTION!

Do not connect PE Ground (Green) Wire directly to terminal on Power Supply.



</td></tr>
</table>

Step	Procedure	Comments/References
6	Ensure that jumpers are installed in J9 on the Controller Module as shown at right.	
7	**⚠ WARNING** Ensure that AC power to the rack is disconnected. Carefully place the Controller Module in the local rack, immediately to the right of the Power Supply. Fasten it in place with two captured screws at top and bottom. **ATTENTION:** **Do not install the battery at this time. Installing the battery before the controller is configured can substantially shorten battery life. Install under power after the controller configuration is complete.** (For more information, refer to Battery Installation/Replacement, page 152.)	

Step	Procedure	Comments/References
8	For each I/O expansion rack (C50 CPU only), set the Scanner Module jumpers to the appropriate Rack Address as shown at right.	
	Repeat steps 1through 5 for each I/O expansion rack (C50 CPU only). Then, for each expansion rack, insert the Scanner Module immediately to the right of the Power Supply, and secure it in place with the two captured screws in the faceplate.	

I/O Module Installation and Wiring

Overview

This section contains descriptions of and procedures for installing I/O Modules in controller racks and in I/O expansion racks(C50 CPU only).

Module Placement in Racks

Each input or output module is placed in an I/O slot in a rack as shown in Figure 25.

Each "slot" in a rack includes a set of guides that locate the circuit board in the rack and a 20-pin (4 x 5) socket in the backplane that receives the associated 4 x 5-pin plug at the back of the IO module.

At the front of each IO module, a twenty pin (in-line) plug receives the associated 20-pin socket on the back of a terminal block. When the I/O module is inserted into the rack and the terminal block is placed on the circuit board, two captured screws in the terminal block are fastened to metal tabs on the rack.

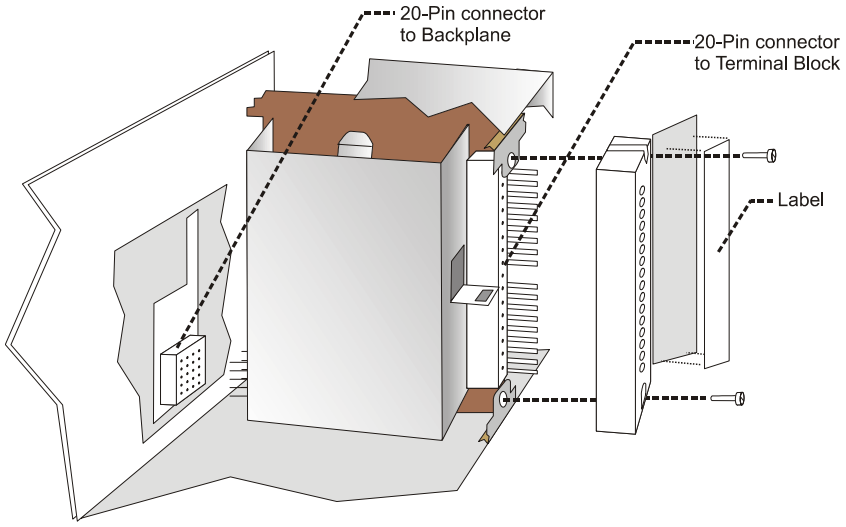


Figure 25 - I/O Module Installation

⚠ WARNING

- Do not use an input/output terminal block if the terminal block is damaged, if the door is missing, or if one or both mounting screws are missing.
- Always tighten both terminal block screws before applying field power to the module.
- Do not apply energized ("live") field wiring to an input/output module that is not installed in one of the racks in the HC900 Controller.
- Do not operate the controller without a Protective Earth connection.

Failure to comply with these instructions could result in death or serious injury.

Terminal Block Styles

The terminal block is available in the barrier style, shown at left in Figure 26, and the Euro style, shown at right.

Both styles of terminal blocks have an embossed numbering "key" that shows the numbering pattern of the 20 connections.

The frame associated with the terminal block has a transparent hinged door. The hinged door is a tool secured cover. To open the door, insert a flat screwdriver into the slot at the top and bottom of the door while pulling out. The door has molded-in tabs that hold labels, which are uniquely color-coded to identify each module type.

Each label is printed on both sides. On the front (visible when the door is closed) are I/O channel numbers, with spaces in which tagnames can be written. On the back (visible when the door is open) are wiring patterns for the type of module located in the slot.

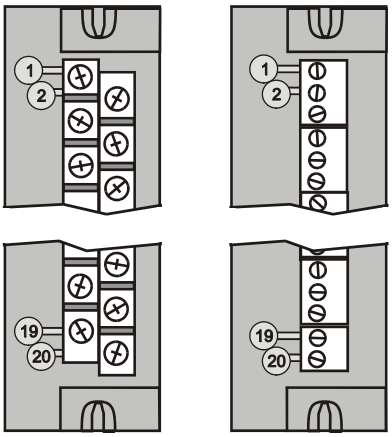


Figure 26 - Terminal Block Styles

The 20-pin, inline connectors at the back of the terminal blocks are universal; that is, any type of I/O module can be used with either the Barrier style or the Euro style terminal block.

ATTENTION

Before mounting terminal blocks in the rack, be sure they are properly keyed to the module type they will be used with. See I/O Installation Procedures, page 63.

Terminal Block Colors and Keying

Both the barrier style and the Euro style are available in two colors (red and black). Black terminal blocks, which have gold-colored contacts, are used for low-voltage, low-energy signals such as contact inputs and low DC voltages. Red terminal blocks, which have tin-colored contacts, are used for higher voltages such as 120/240 Vac.

Colors of each Terminal Blocks must correlate to that of the mating header on I/O modules with which they are used; that is:

- Black terminal blocks, which have gold-colored contacts, are for use with I/O modules that have black headers and gold-colored pins in the 20-pin connector; these include: Analog Input, Analog Output, DC Input, DC Output, and Contact Input.
- Red terminal blocks, which have white (tin) contacts, are for use with I/O modules that have red headers and white- (tin-) colored contacts in the 20-pin connector; these include: AC Input, AC Output, and Relay Output.
- Terminal blocks may be keyed by the installer to prevent high voltage terminal blocks from being installed on low voltage modules. See Table 14.

Any of the color-coded labels will fit into the door of any terminal block. Use care to ensure that all hardware components match each other, and also match the control strategy in the configuration file. Use of documentation aids in Appendix A will facilitate correct use of labels.

Remote Termination Panel (RTP)

The optional Remote Termination Panel (RTP) provides an easy way to connect the HC900 controller to the field wiring. The RTP integrates some of the typical externally connected components, reducing wiring and setup time. It also minimizes the need for multiple wires under a single screw connection by expanding the connectivity of the shared terminals of the I/O modules.

See Appendix B Installation of Remote Termination Panels (RTPs) for details.

Terminal Block-to-Field (Signal) Wiring

Although both of the two available terminal block styles can be used on all I/O module types, wiring methods vary with the module type and with the type of field devices connected to the terminal block. The descriptions that follow provide details.

Wiring can be routed through the terminal block at the top, at the bottom, or both. Wiring should be fixed in place using wire ties at the slotted tabs that are molded in at top and bottom of each terminal block.

Wiring Rules and Recommendations

In general, stranded copper wire should be used for non-thermocouple electrical connections. Twisted-pair wiring with shielded cable will improve noise immunity if wire routing is suspect.

Wire Gage

Observe all local codes when making power connections. Unless local electrical codes dictate otherwise, the recommended minimum wire size for connections is given in Table 12.

Table 12 - Minimum Recommended Wire Sizes

Wire Gauge	Wire Application
14	Earth ground to common power supply.
14 to 16	AC to power supply
10 to 14	Earth ground wire
20	DC current and voltage field wiring
22	DC current and voltage wiring in control room

Routing and Securing Wires

Typically, field wiring is routed to connections at a terminal panel near the controller and then from the terminal panel to the terminal blocks on the I/O modules.

Whatever method of routing is used, wiring must be mechanically supported along its length, and must be protected from physical damage and electromagnetic (noise) interference. (Refer to Installation Planning, Environmental Considerations, in this manual.)

Also, all wires must be securely terminated, using appropriate wiring practices.

Signal Grounding

The shield for each input should be grounded at the grounding bar (optional) at the top or bottom of each rack as indicated in Figure 27. For low-frequency noise rejection, I/O wiring shields should be grounded only at the controller end.

For high-frequency noise rejection, shields should be grounded at the controller and at the field device. If the ground voltage potential at the field device is different from that at the controller, a DC isolation capacitor should be used between the shield and the grounding bar on the rack.

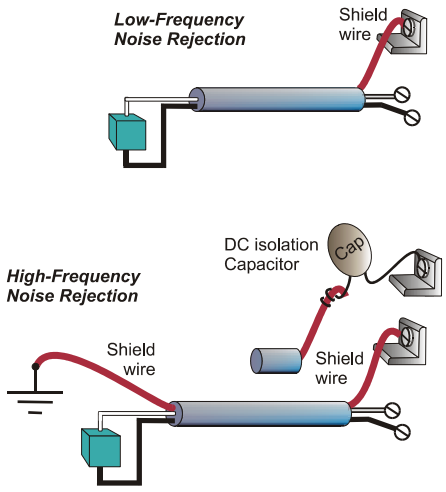


Figure 27 - Signal-Wire Grounding

Aluminum grounding bars for I/O wiring are available as options. When selected for use, they are fastened to the top and/or bottom of each rack, as indicated in Figure 28. To enable connection of multiple ground wires with a single screw, the wires can be twisted together and secured with a wire lug.

To facilitate module replacement, it is advisable in most cases to route all wiring through either the top or the bottom of the terminal block. This allows the terminal block to pivot up or down, allowing ready access to the module, and is the preferred method for a limited number of wires.

For a larger number of wires, or for wires of a heavier gauge, it is advisable to route some wires through the top of the terminal block, and some through the bottom, as indicated in Figure 28. In this case, it is necessary to adjust wire length so as to ensure adequate flexibility of the twisted wires and to provide clearance sufficient to remove the I/O module.

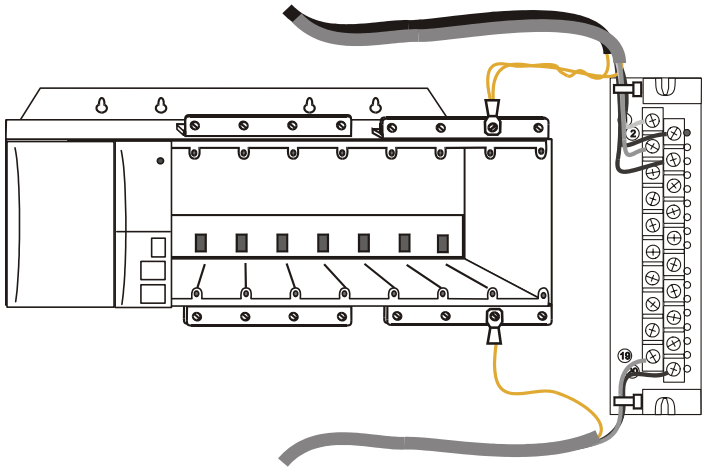


Figure 28 - Wire-Shield Grounding

Terminal Block Jumper Combs

Two styles of terminal block jumper combs are available for use with the barrier-style terminal blocks: ten-position and two position.

The ten-position jumpers are used with AC output modules to inter-connect L1 (AC Hot) of all channels.

The two-position jumpers are used to connect Common (DC negative or AC neutral) for the DC input module, the DC Output Module, and the AC Input Module. Each of these module types has groups of eight channels, with the two groups isolated from each other. The two-position jumper connects (Common) terminals 10 and 12, making one group of sixteen non-isolated channels.

The two-position jumper can also be used to connect the V+ terminals on the DC Output Module.

Refer to the wiring information on each module, given in this section of this manual.

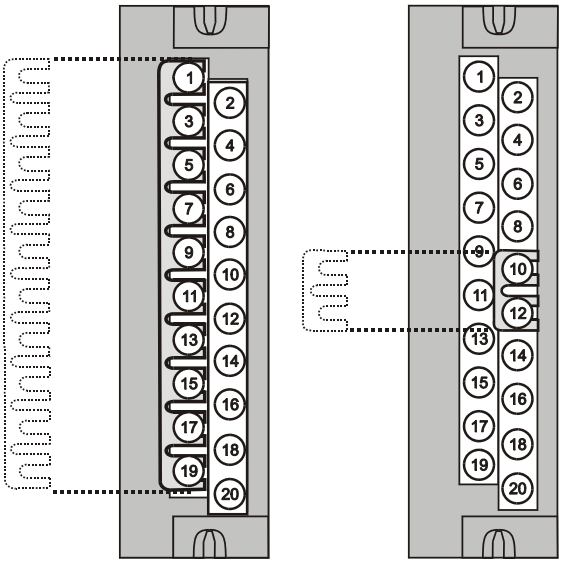


Figure 29 - Terminal Block Jumper Installation

Removal and Insertion Under Power (RIUP)

⚠ WARNING

Read and understand all of the following information regarding RIUP before attempting to remove and/or replace any I/O module, particularly in a system that is actively controlling a process.

All of the I/O Module types in the HC900 Controller System include the Removal and Insertion Under Power (RIUP) feature. That is, while the rack is powered, any of the I/O Modules can be removed or inserted:

- With no physical damage to the module, to the rack, or to other modules in the rack
- Without disturbing the functions of ***other I/O modules*** in the rack or in the system.

Under carefully controlled circumstances, this feature enables the user to remove and insert an I/O module without completely shutting down a running system. However, it must be recognized that removing or inserting an I/O module under power is potentially hazardous to property and to personnel.

Circumstances that dictate prudent actions depend on conditions and specific process applications at each user facility. It is the responsibility of site personnel to know all potential consequences of RIUP, and to take actions to prevent all adverse consequences before removing or inserting an I/O module under power. Table 13 provides some general guidelines for establishing appropriate procedures at a given installation.

Table 13 - RIUP: Potential Hazards and Recommended Actions

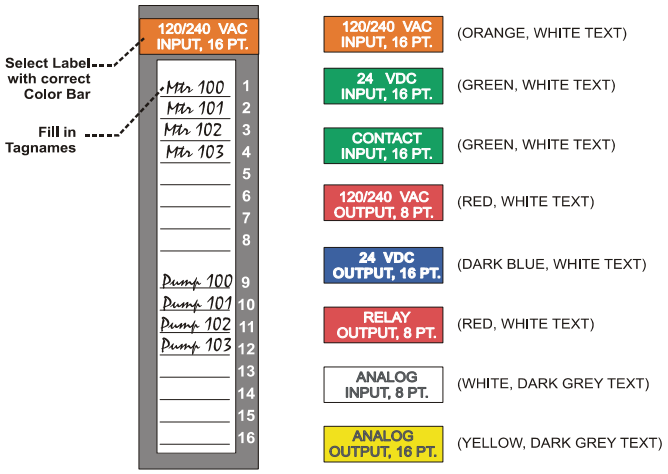
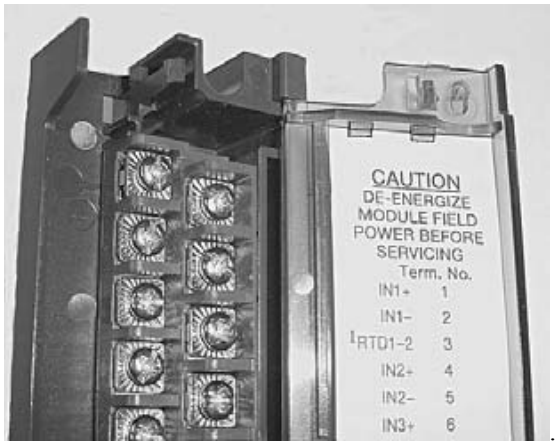
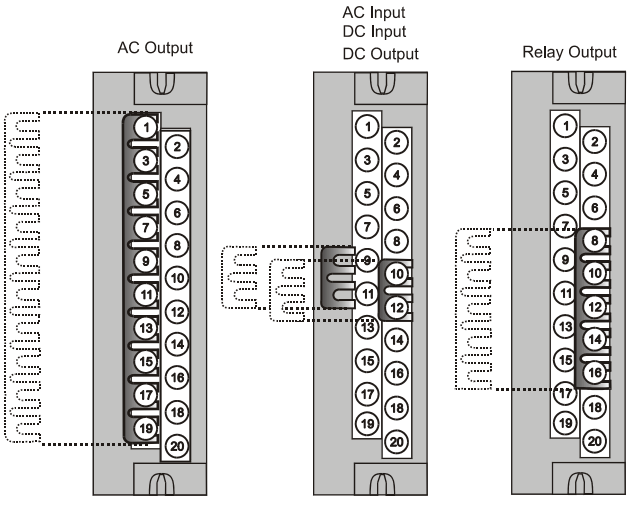
Hazard	Source	Preventive Action(s)
⚠ WARNING  **Hazardous Voltages**	Potentially lethal voltages on Terminal Boards associated with I/O Modules.	Disconnect all signals at terminal blocks from sources of power before removing the terminal block from the I/O module.
⚠ CAUTION **Loss of control or view of a running process**	Each signal at each of the terminals for an I/O module has a specific function. Any or all of the signals may be vital for safely controlling a process.	Either: Using trained personnel and appropriate control mechanisms, transfer to manual control for each signal that is necessary to maintain safe process control. Or: Bring the process to a safe stop before initiating the removal or insertion procedure.

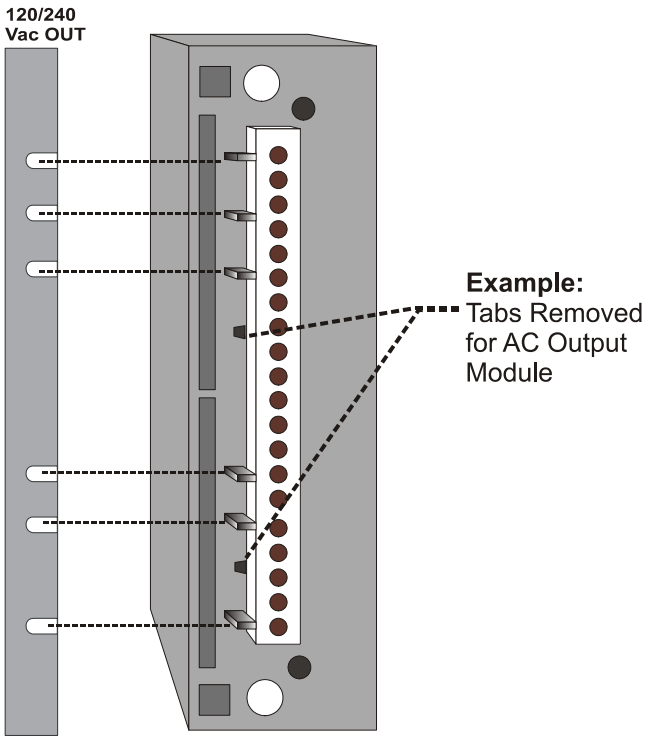
⚠ WARNING  **EXPLOSION HAZARD** Class 1, Division 2 Installations

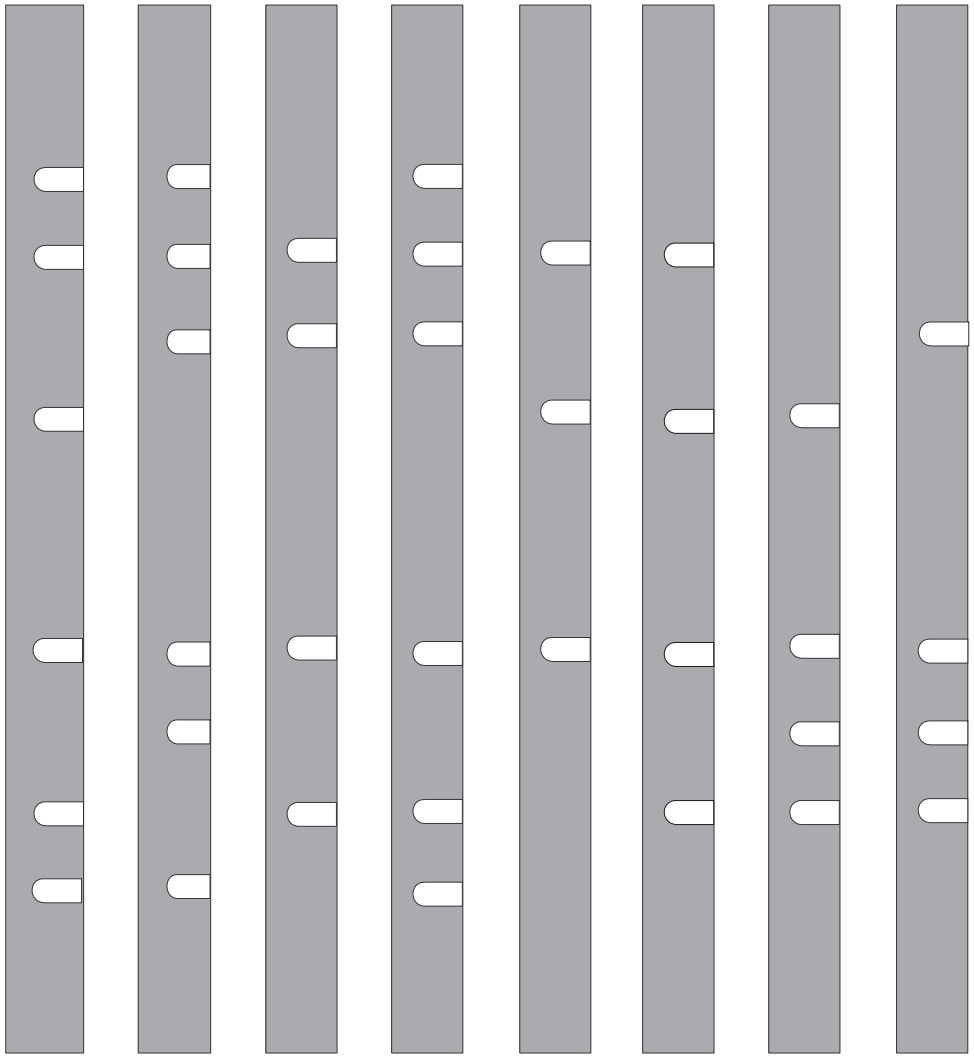
- DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

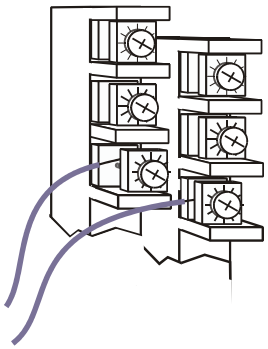
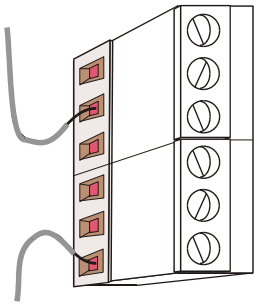
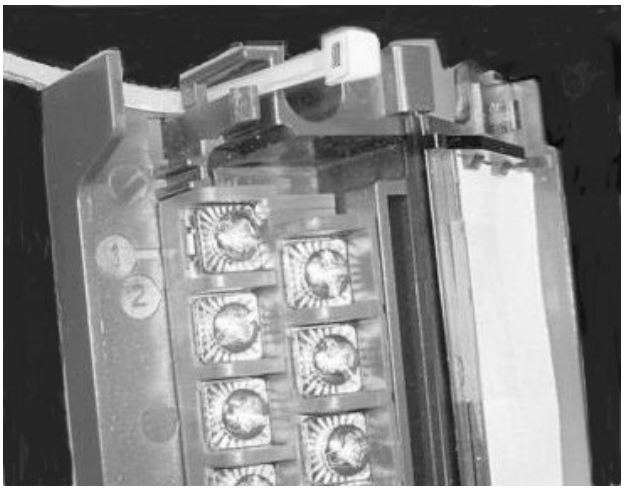
I/O Installation Procedures

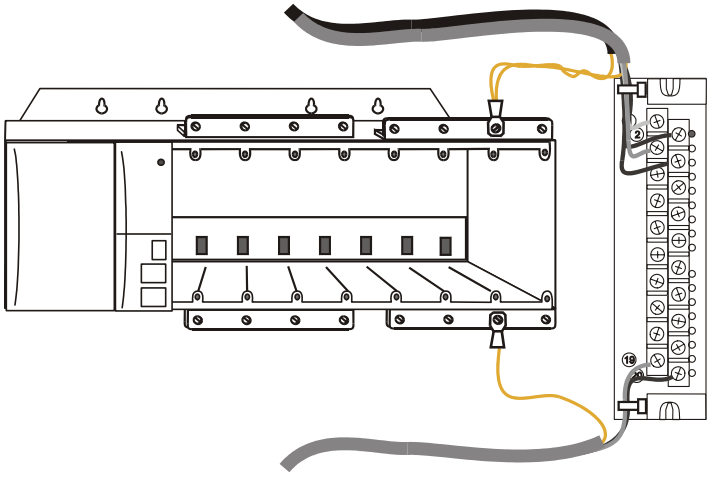
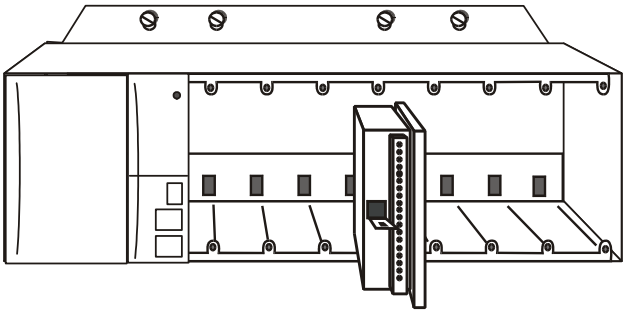
Table 14 - Connect Input/Output Wiring

Step	Procedure	Comments	Reference
1	Using Rack #, Slot #, Channel # data from a Hybrid Control Designer report and/or from documentation aids in Appendix A for reference, fill in the tagnames on the Label for each configured I/O Module. Be sure to use the appropriate label for each module type.		
2	Place the appropriate label supplied with the module (tagname side out) into the hinged door for each I/O Module. Slotted tabs, molded into the door at top and bottom, hold the label in place.		
3	(Optional): Install jumper combs into designated Barrier style Terminal Blocks, to reduce the wiring required to supply power: Two-position jumper for the DC Input Module and/or on the DC Output Module. Ten-position jumper for the AC Output Module. Five-position jumper (10-position jumper cut in half) for a Relay Output Module.	 Refer to terminal block wiring diagrams for specific information.	

Step	Procedure	Comments	Reference
4	For each configured and labeled I/O Module, break off the "key-tabs" in the pattern that identifies each module type. (For a diagram of each key-tab pattern, use the I/O Modules and/or the diagram shown below.		

Step	Procedure	Comments	Reference
	NOTE: In the diagram below, the white cut-outs represent the cut-outs on the modules that accommodate tabs on the Terminal Block. That is, all key-tabs that line up with the white cut-outs on the diagram should be retained, and all other tabs should be removed. The orientation of the diagrams below corresponds to the picture of the terminal block, shown in the previous picture.		
	Diagrams for I/O Module Key-Tabs **120/240 Vac IN** **120/240 Vac OUT** **24Vdc OUT** **Relay OUT** **Contact IN** **24 Vdc IN** **Analog IN** **Analog OUT** 		

Step	Procedure	Comments	Reference
5	Using the following reference items: • Hybrid Control Designer data • Documentation Aids from Appendix A • Labels in I/O Terminal Block assemblies • Wiring diagrams given in this Section for each type of I/O module connect I/O wiring to the terminal blocks for each IO module. Route wires through the channel at left of the terminal block, to exit through the top or bottom of the block.	Barrier Terminal Block  Euro Terminal Block 	
6	Insert a wire-tie into the top and/or bottom end of the terminal block. Form a bend in each wire to provide strain relief, and secure the wire bundle with the tie.		

Step	Procedure	Comments	Reference
7	Connect wire shield to grounding bars on top and/or bottom of the Rack. (Refer to Signal Grounding, at the beginning of this section, for suggestions and recommendations.)		
8	Install I/O modules in racks.		
9	In each slot location not occupied by an I/O module, install a Filler Block cover, Part number 900TNF-0001.	**Note:** The Filler Block Cover looks much like an I/O Terminal Block assembly, except that it does not include the wire terminating block (screw terminals). The Filler Block mounts in the same manner as a Terminal Block (with captured screws at top and bottom). Blank labels are provided for mounting in the hinged door.	

I/O Terminal Block Wiring Diagrams

Universal Analog Input Module Wiring

The Universal Analog Input Module has eight inputs, which can include any combination of the following input types: RTD, TC, Ohms, Millivolt, Volt, or Milliamp. Figure 31 shows wiring examples of each of the analog input types. An example of wiring for eight TC inputs is given in Figure 33.

Specifications for this module and for other modules are given in the Specifications section of this manual.

Isolation

This module has eight inputs, which are isolated except for RTD current sources.

RTD Inputs

RTD inputs share current sources (two RTD inputs per source), as shown in Figure 30, in Figure 31, and in Figure 32.

For example, the current source for the RTD input at channel one (terminals 1 and 2) is terminal 3 (I_{RTD} 1 & 2). This same current source (I_{RTD} 1 & 2) is also used for an RTD input at channel two (terminals 4 and 5).

Figure 32 and Figure 35 show examples of RTD input wiring (2-wire and 3-wire RTDs). Four-wire RTD inputs are not available).

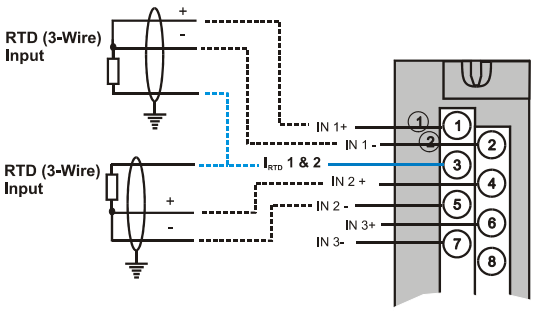


Figure 30 - RTD Inputs

OHMs Inputs

Ohms inputs are wired similar to 2-wire RTD inputs. That is, they require a current source, and thus must use one of the I_{RTD} current sources. Also, two terminals are jumpered together as they are for two-wire RTD inputs.

Analog channels wired for Ohms inputs differ from RTD inputs in these aspects:

- Ohms inputs connect to variable resistance devices other than RTDs, and
- Ohms inputs are configured in Hybrid Control Designer as Ohms inputs, rather than as RTD inputs.

Examples of wiring for resistance inputs are given in Figure 34.

Shield Grounding

Shields must be grounded as described under Shield Grounding at the beginning of this section.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

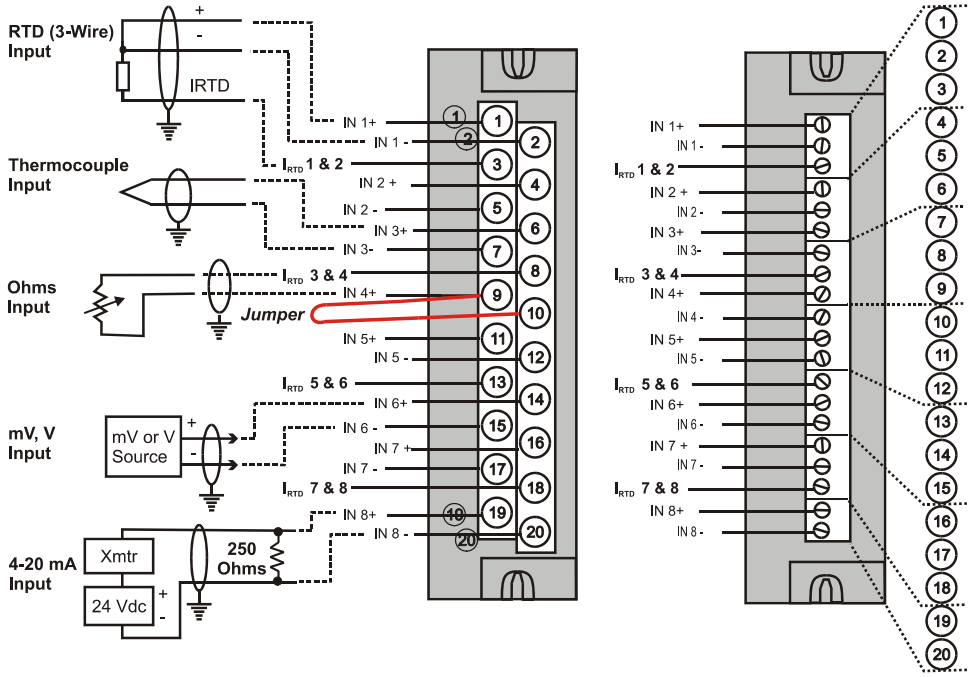


Figure 31 - Universal Analog Input Wiring Diagram

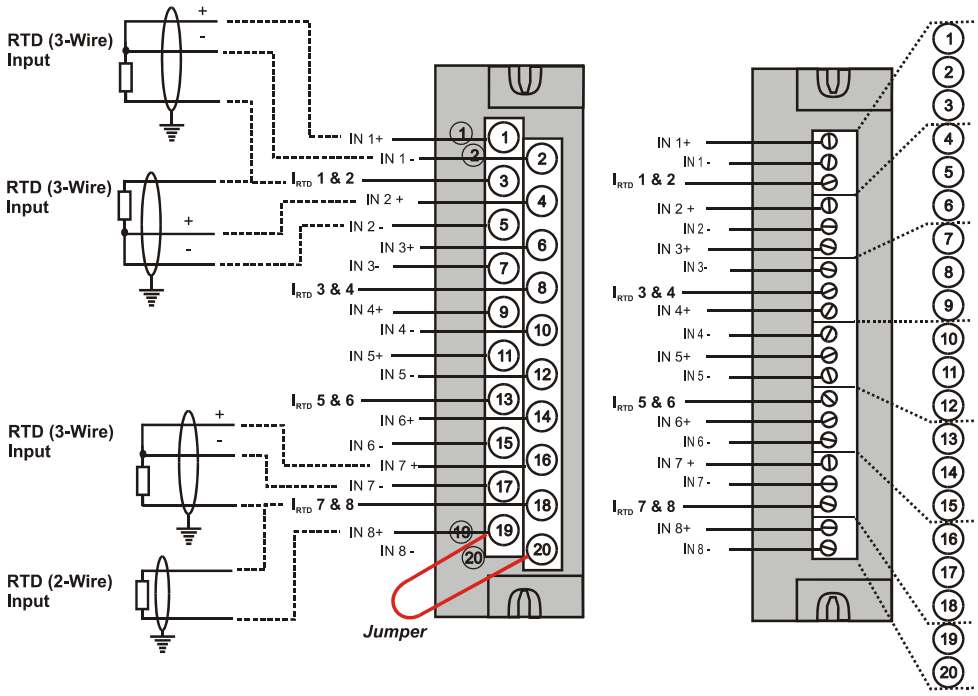


Figure 32 - Examples of RTD Input Wiring

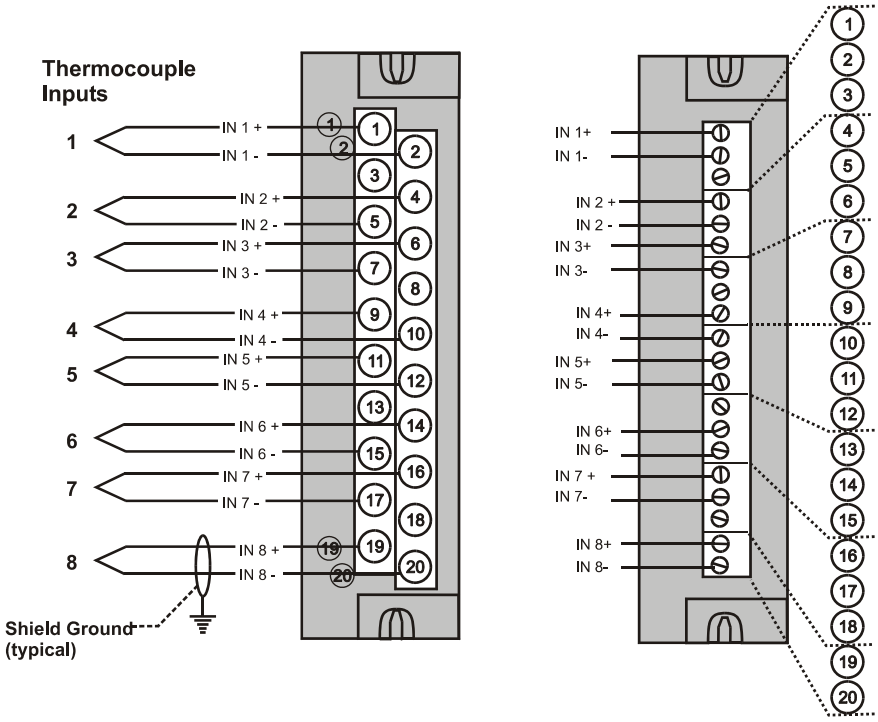


Figure 33 - Analog Input Wiring - Eight TCs

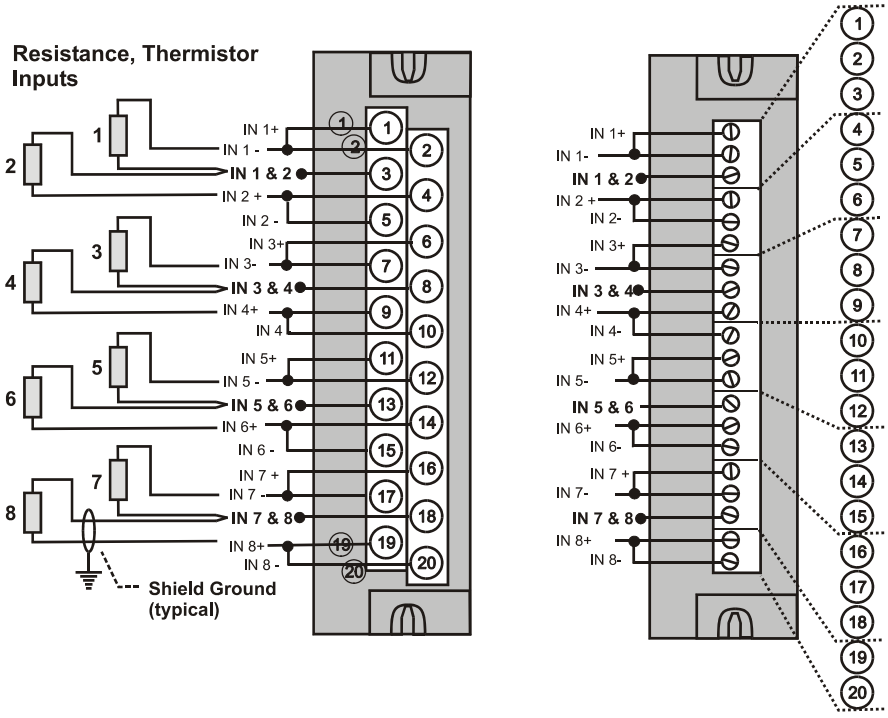


Figure 34 - Analog Input Wiring - Eight Resistance Inputs

Resistance Temperature Device Inputs

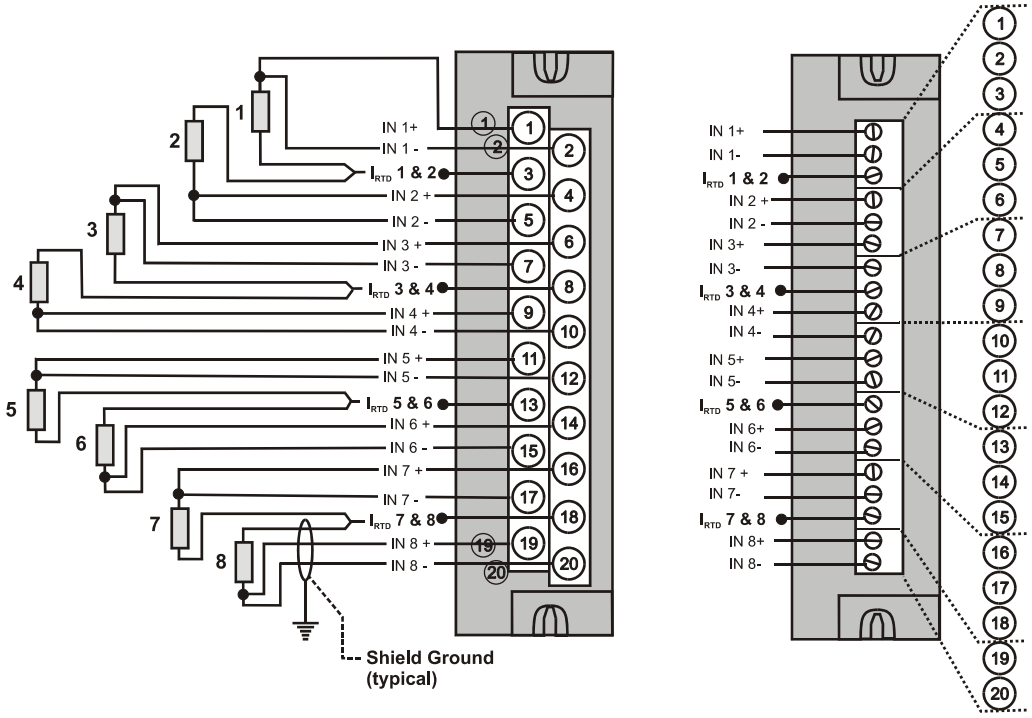


Figure 35 - Analog Input Wiring - Eight RTDs

Slidewires

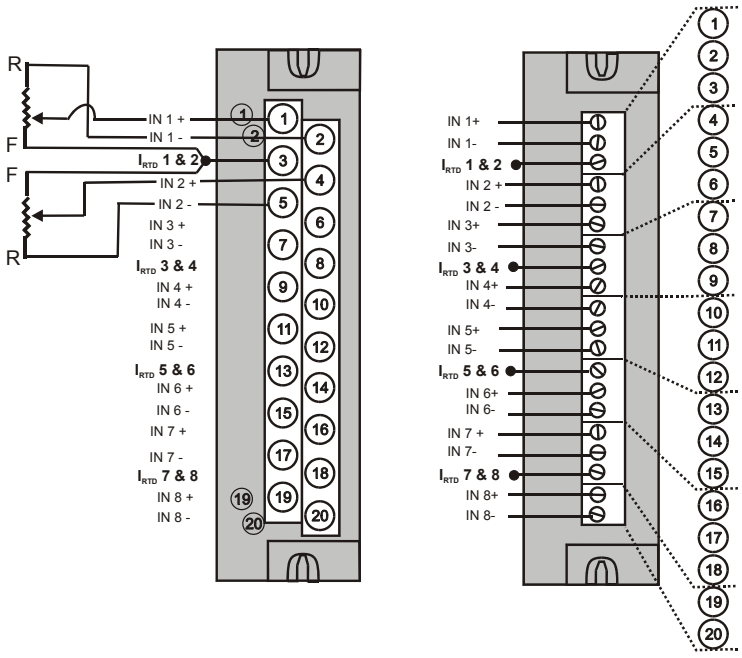


Figure 36 Analog Input Wiring – Slidewire (Position Proportion Block)

Analog Output Module Wiring

An example of Analog Output Module wiring is shown in Figure 37. Specifications for this module and for other modules are given in the Specifications section of this manual.

Isolation

The four outputs are isolated from each other.

Shield Grounding

Shields must be grounded as described under Shield Grounding at the beginning of this section.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring form power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

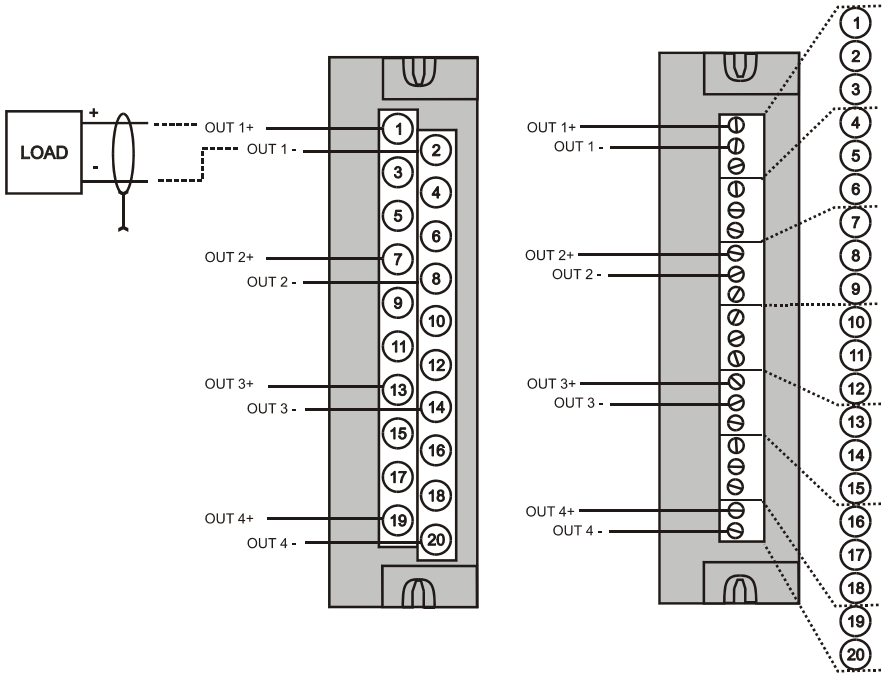


Figure 37 - Analog Output Wiring Diagram

DC Input Module Wiring

The DC Input Module has sixteen inputs, in two groups of eight inputs per group. The groups are isolated from each other; inputs are non-isolated within each group. An example of Digital Input Module wiring is shown in Figure 38. Specifications for this module and for other modules are given in the Specifications section of this manual.

Shield Grounding

Shields must be grounded as described under Shield Grounding at the beginning of this section.

Common Terminals

Two common terminals are provided for each group of eight inputs. Terminals 9 and 10 are connected in the input module, and terminals 11 and 12 are connected in the module.

Jumper Comb

A two-position jumper comb is available (as an option, for barrier-style terminal blocks only) for connecting digital common wiring (at terminals 9 and 11 ***or*** 10 and 12). See Figure 39.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

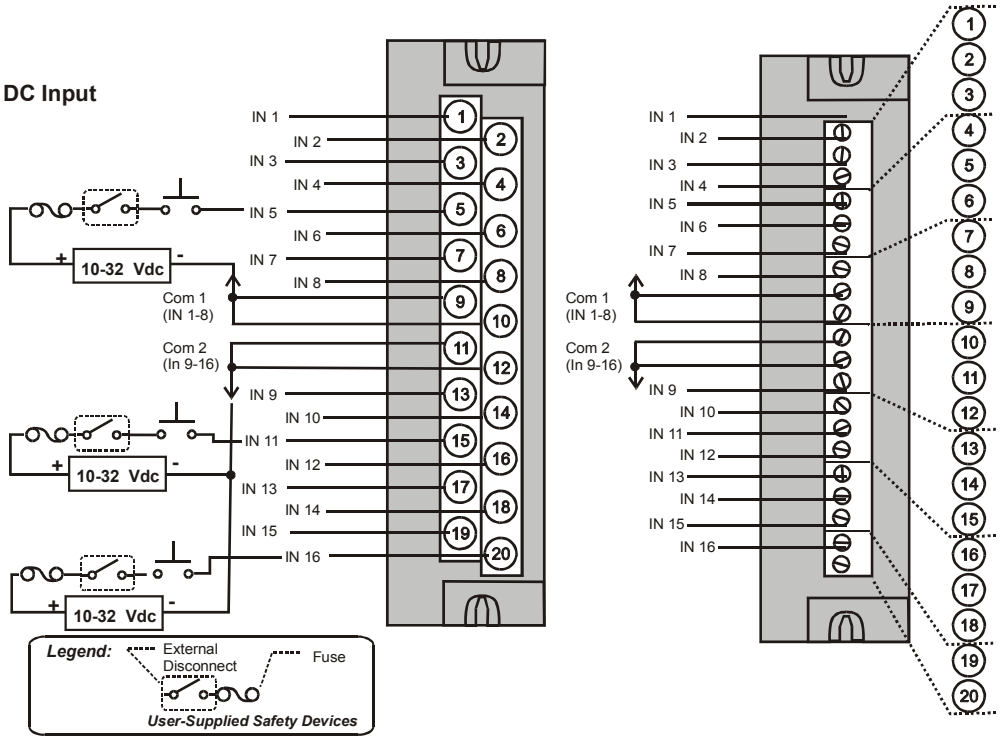


Figure 38 - DC Input Module Wiring Diagram

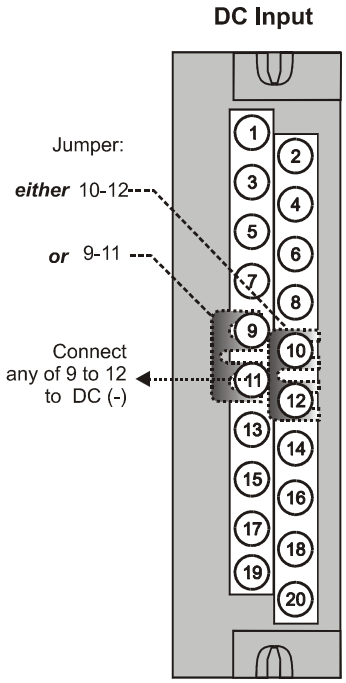


Figure 39 - DC Input Module Jumper

AC Input Module Wiring

The AC Input Module has sixteen inputs. An example of AC Input Module wiring is shown in Figure 40. Specifications for this module and for other modules are given in the Specifications section of this manual.

Common Terminals

Two common terminals are provided for each group of eight inputs. Terminals 9 and 10 are connected in the input module, and terminals 11 and 12 are connected in the module.

Jumper Comb

An optional two-position jumper comb is available as an option (for barrier style terminal blocks only) for connecting digital common wiring at terminals 9 and 11 ***or*** terminals 10 and 12. See Figure 41.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

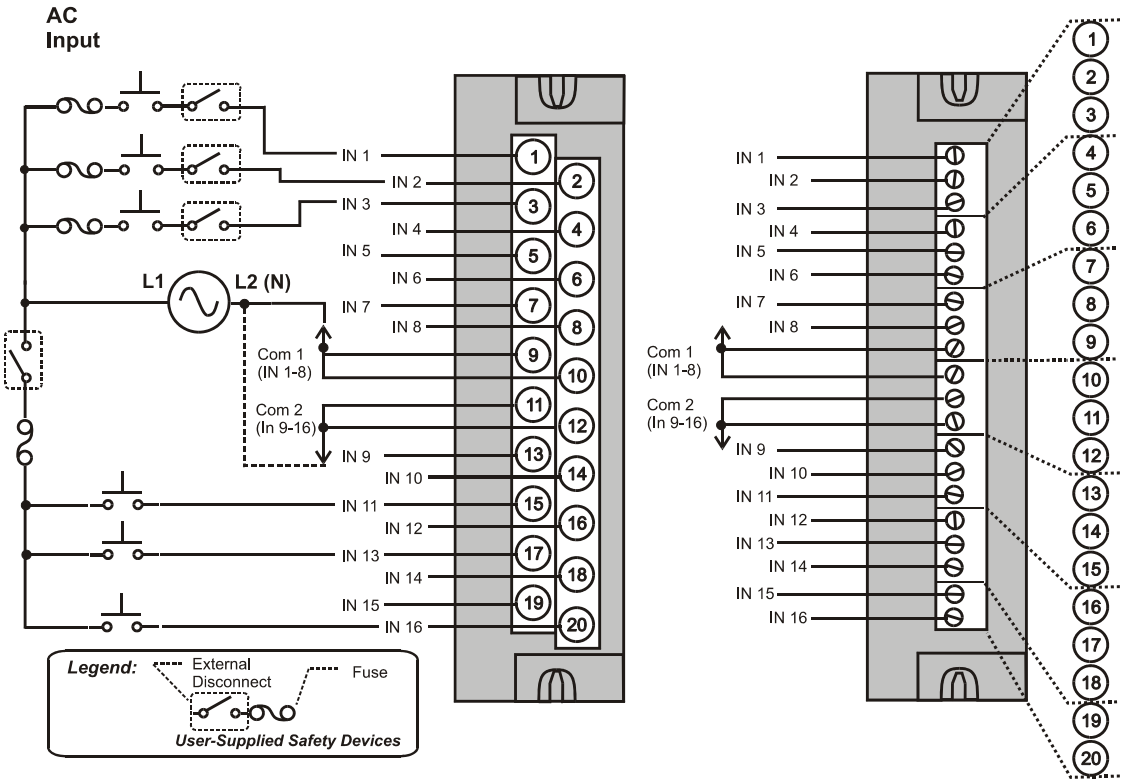


Figure 40 - AC Input Module Wiring Diagram

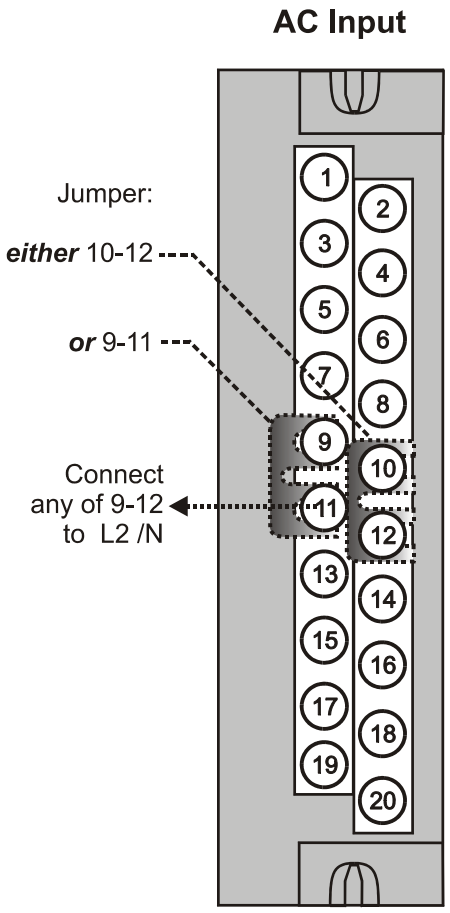


Figure 41 - AC Input Module Jumper

Contact Input Module Wiring

The Contact Input Module has sixteen inputs in one group. An example of Contact Input wiring is shown in Figure 42

Specifications for the Contact Input Module and other modules are given in the Specifications section of this manual.

Internally Powered Input Channels

The Contact Input Module provides voltage to the field contacts.

CAUTION

Do not apply any external power to the field device or to the input terminals. Doing so could damage the module.

Common terminals

Four common terminals are provided for the 16 inputs. Terminals 9, 10, 11, and 12 are connected in the Contact Input module.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

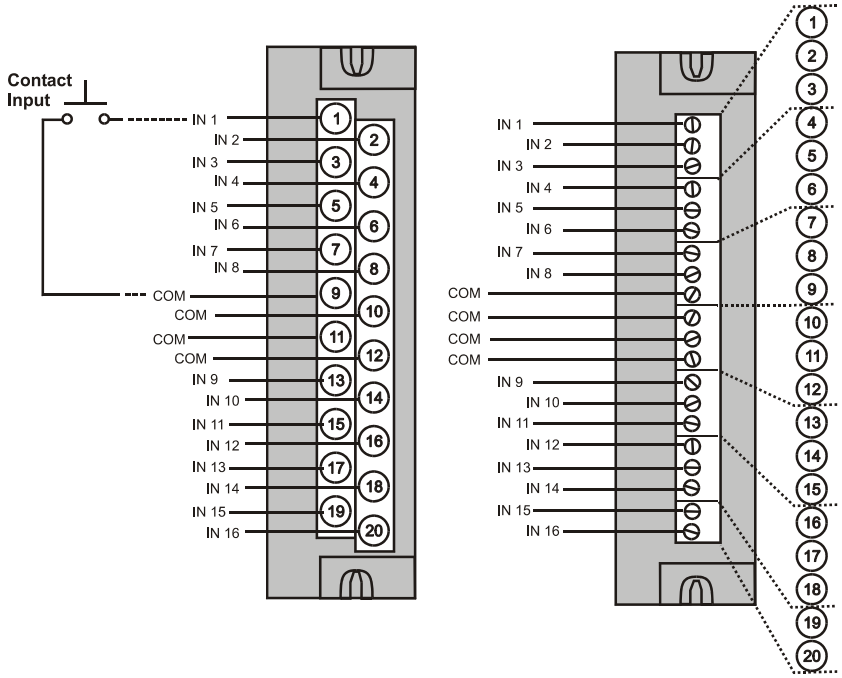


Figure 42 - Contact Input Wiring Diagram

DC Output Module Wiring

The DC Output Module provides 16 current-sinking outputs in two groups of eight points per group. The two groups are isolated from each other; outputs are non-isolated within each group. Current sinking means that a positive voltage potential is continuously applied to one side of each DC output load, and the negative side of the load is switched internally in the module.

Specifications for this module and for other modules are given in the Specifications section of this manual. Examples of DC Output wiring are shown in Figure 43 - DC Output Module Wiring Diagram

Over-Current Protection

Electronic high-current and high-temperature limiting provides overload protection; resets after cycling power. Conventional external fuses may be used if desired.

Reverse-Polarity Protection

A potential of ± 34 Volts will cause no damage to the module; a reverse polarity power supply connection allows continuous current flow to the loads that are not controlled by the On/Off state of the output circuits.

Jumper Comb

Two-position jumper combs are available (as an option for barrier style terminal blocks only) for connecting digital common wiring between terminals 10 and 12, and for connecting +24Vdc between terminals 9 and 11. See Figure 44.

+V Terminals

The +V1 (terminal 9) and +V2 (terminal 11) are the positive power supply input to power the output circuits for the two groups of eight inputs per group. The +V supply must provide minimum 24 Vdc at 65 mA (min) per group.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

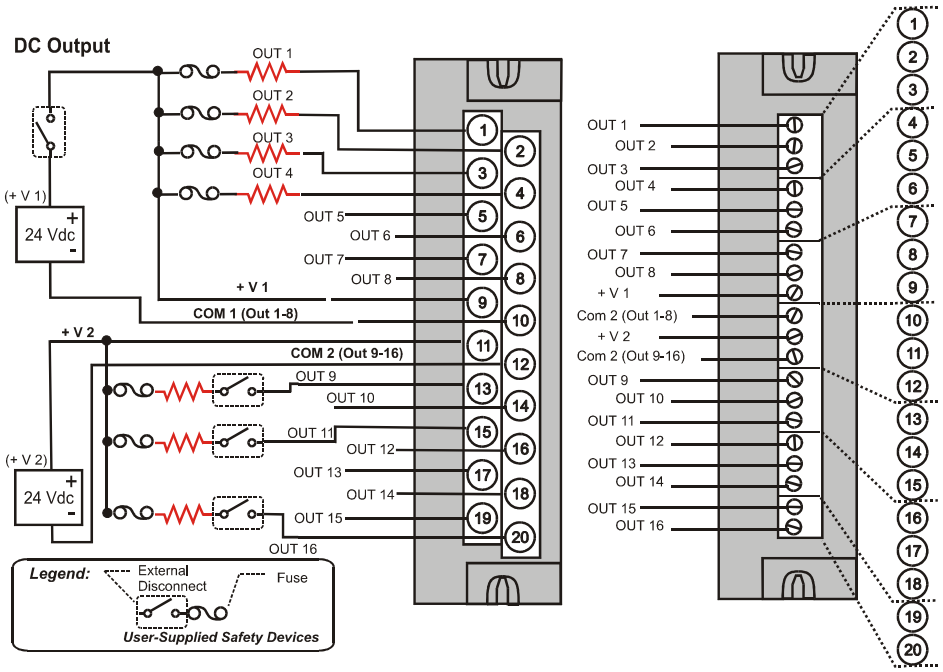


Figure 43 - DC Output Module Wiring Diagram

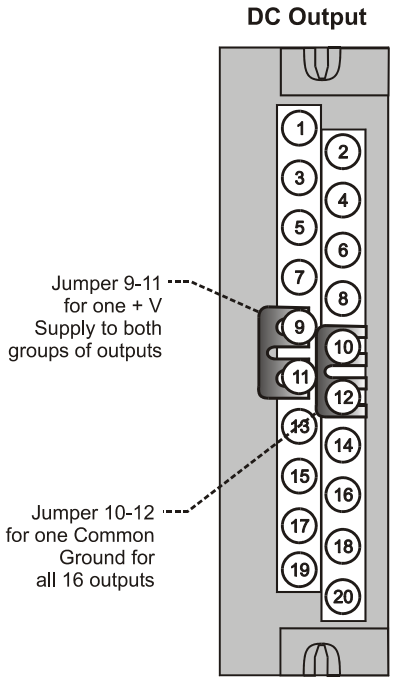


Figure 44 - DC Output Jumpers

AC Output Module Wiring

The AC Output Module provides eight output circuits. Each output is isolated from the other outputs. An example of AC output wiring is shown in Figure 45. Specifications for this module and for other modules are given in the Specifications section of this manual.

Output Loading

Voltage: 85 to 240 Vac

Maximum per output: 2.0A resistive load

Maximum per module: 8.0A

NOTE

When exceeding 1.0 A per output, it is recommended (but not required) to connect the high-current loads to every other output - for example, outputs 1, 3, 5, 7 or 2, 4, 6, 8. This distributes heat more evenly across the heat sink.

Jumper Comb

A ten-position jumper comb is available for inter-connecting all L1 (Hot) terminals (1, 3, 5, 7, 9, 11, 13, 15, 17, 19). See Figure 46.

Replaceable Fuses

Each output circuit on the AC Output Module includes a (plug-in) replaceable fuse.

Replacement fuse is from Wickmann, part #3741315041. This is a 3.15 Amp time lag fuse with UL/CSA approval for 250 VAC.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

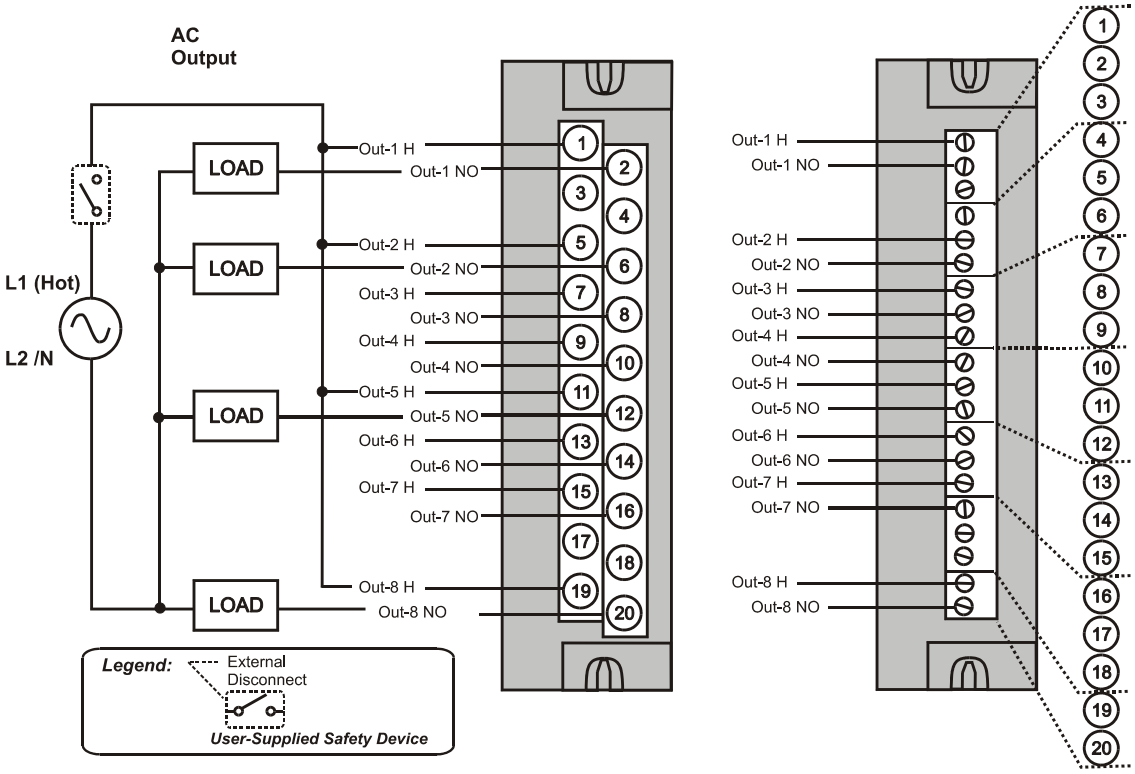


Figure 45 - AC Output Module Wiring Diagram

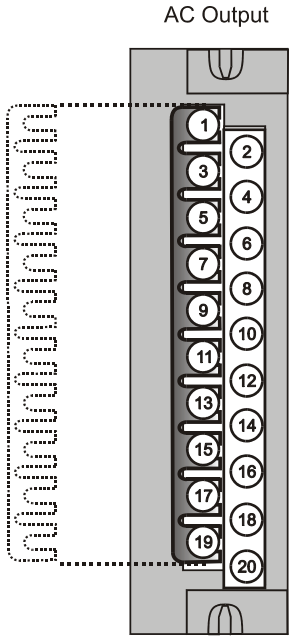


Figure 46 - AC Output Module Jumper

Relay Output Module Wiring

The Relay Output Module provides eight individually isolated, electromechanical relay outputs. Four of the outputs are Form-C, and the other four are Form-A. A schematic showing the relationship of individual Form-A relays and Form-C relays to external (user) connections is given in Figure 47.

Examples of Relay Output wiring as they relate to connections on the Terminal Block are shown in Figure 48.

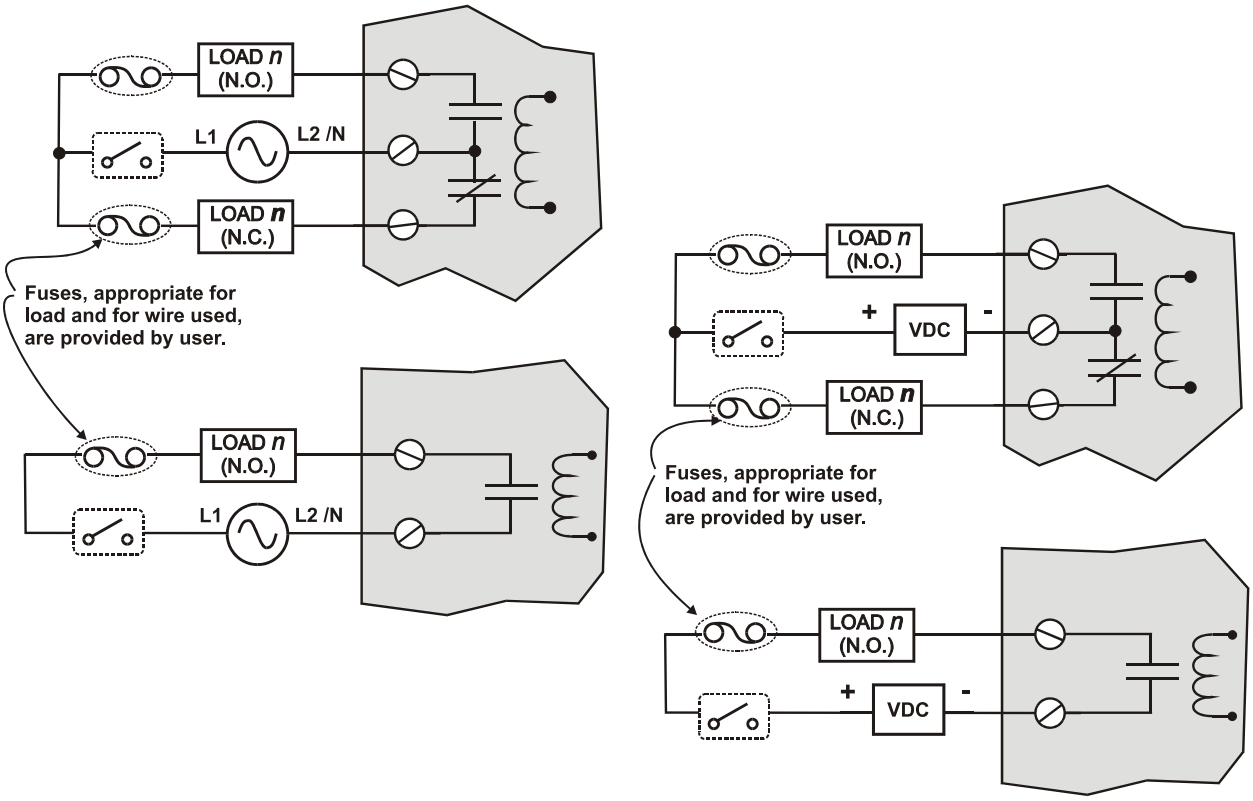


Figure 47 - Schematic Example: Relay Output and External Wiring

Contact Rating

Maximum current/output: 4A at 250Vac/30Vdc with resistive load

Maximum current per module: No de-rating per module, but ensure compliance with maximum ratings for each output.

Required Output Fusing

Outputs are not fused in the Relay module. Install a fuse for each output at the field device that is appropriate for the load and the wire used.

Jumper Comb

A ten-position jumper comb, available for the AC Output Module, can be cut in half and used as shown in Figure 49 to reduce the number of wires required to connect the Relay Output Module to AC Neutral or to DC Common.

⚠ WARNING

Hazardous voltages exist at terminal blocks.

- Using switches at field devices, disconnect the field wiring from power sources before servicing.

Failure to comply with these instructions could result in death or serious injury.

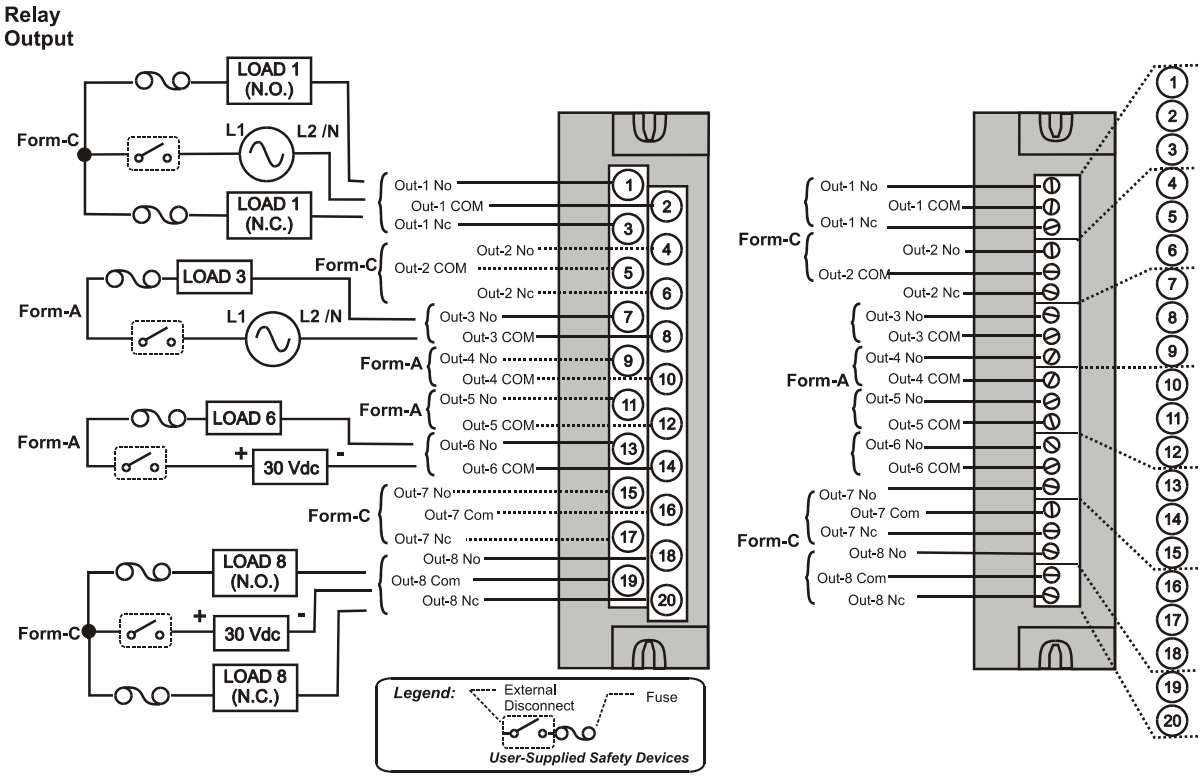


Figure 48 - Relay Output Module Wiring Diagram

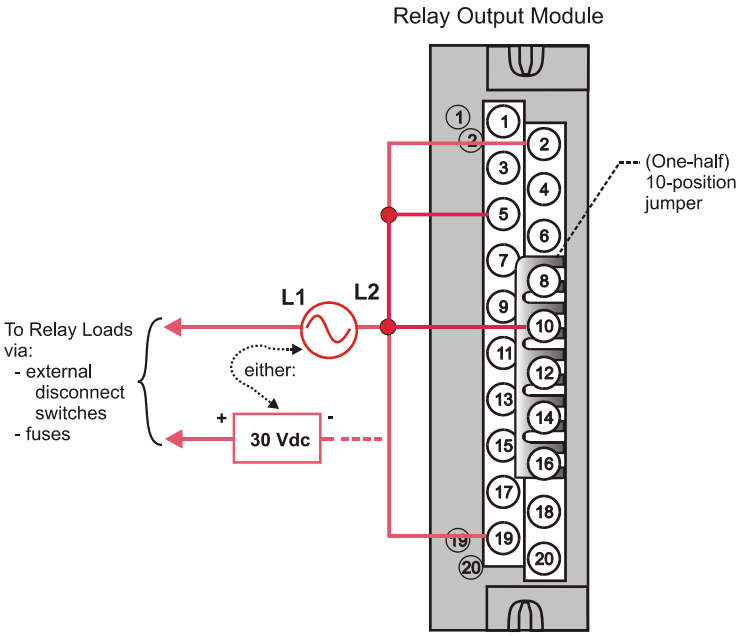


Figure 49 - Relay Output Module Jumpers

Communications Installation

Overview

This section contains descriptions of and procedures and recommendations for installing communications systems and components.

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Table 15 - Connect Communications Wiring and Cabling

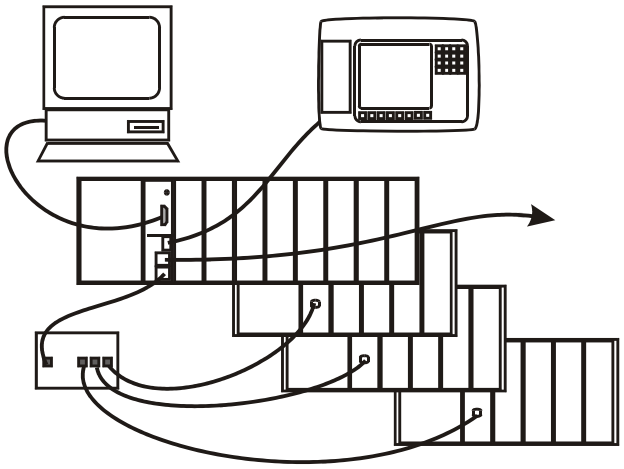
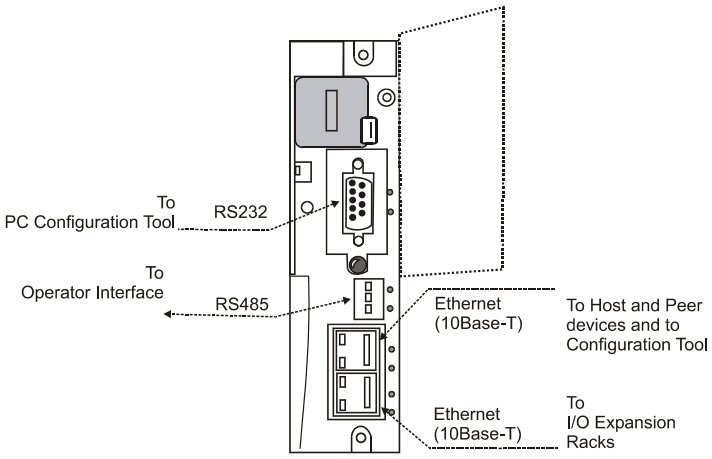
Step	Procedure	Comments	Reference
1	Determine requirements for communications links by referring to the site diagrams. (Refer to Appendix A.) (Expansion I/O C50 CPU only)		
2	Refer to the diagram of the controller at right, and to Table 16 - Links to Controller Communication Ports for connection details. Connect communications cabling as indicated by the site cabling diagram. (The Ethernet port for the expansion rack is only present for Model C50) For Modbus connections, see page 105.		

Table 16 - Links to Controller Communication Ports

Controller Port /Connector Type	Link Type: Controller to	Cable Type	To Device/Port	Reference Data
RS-232 (9-pin "D" connector)	Desktop or Laptop PC	RS-232 Null Modem cable, up to 50' Or RS-232 PC modem cable, up to 50'	Serial port of PC (w/ Null Modem cable) or Modem. Refer to RS-232 Remote Connection to PC Configuration Tool on page 91.	For Wiring details of Null Modem cable, 9-pin Male/Female connector, see Figure 50 - Null Modem Cable Construction.
RS-232 (9-pin "D" connector)	Modbus master (controller is single slave)	RS-232 Null Modem cable, up to 50' Or RS-232 PC modem cable, up to 50' RS232 to RS485 converter	Refer to device's port instructions	Page 20 Figure 16 & Figure 17 #2, 7, 9
RS-232 (9-pin "D" connector)	Modbus master (controller is one of multiple slaves)	RS232 to RS485 converter	Refer to device's port instructions	Page 20 Figure 16 & Figure 17 #6
RS-232 (9-pin "D" connector)	Modbus slave network (controller is master)	RS232 to RS485 converter	Refer to device's port instructions	Page 20 Figure 16 & Figure 17 #4, 5, 8
RS-485 3-pin Phoenix 1840379 (or equivalent)	Operator interface	Belden #9271 (or equivalent)	Terminal connector of operator interface. (Refer to Table 18.)	Page 20 Figure 16 & Figure 17 #1, 2, 4, 5, 6, 11
RS-485 3-pin Phoenix 1840379 (or equivalent)	Modbus master (controller is slave)	Belden #9271 (or equivalent)	Refer to device's port instructions	Page 20 Figure 16 & Figure 17 #3, 8, 9
RS-485 3-pin Phoenix 1840379 (or equivalent)	Modbus slave network (controller is master)	Belden #9271 (or equivalent)	Refer to device's port instructions	Page 20 Figure 16 & Figure 17 #7, 10
10Base-T RJ45	Host, Peer, and Internet Devices	Shielded CAT5E cable, up to 100 meters. A crossover cable is required for PC to Controller connection; otherwise, straight cable.)	RJ45 connector on Host, Peer, or Internet Device	

Controller Port /Connector Type	Link Type: Controller to	Cable Type	To Device/Port	Reference Data
10Base-T RJ45	I/O expansion link(C50 CPU only)	Shielded CAT5E crossover cable, up to 100 meters between Controller and hub, and hub-to-hub. Shielded CAT5E straight cable between controller and expansion rack and hub to expansion racks.	Either: RJ45 Connector Scanner module of Rack #2 (no other racks on I/O Expander Link) Or: RJ45 connector on Hub	??

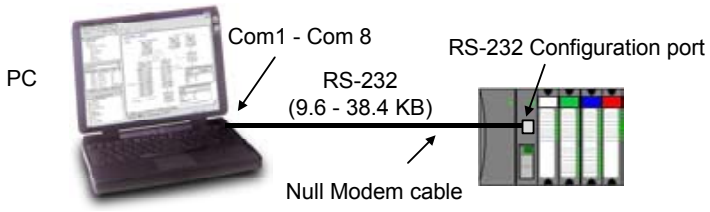
Connecting the HC900 Controller to a PC with the Hybrid Control Designer Software

To establish communications between the HC900 controller and the Hybrid Control (HC) Designer configuration software use any of the following methods:

- A. Direct Serial RS-232 connection
- B. Modem connection
- C. Direct Ethernet connection
- D. Networked Ethernet connection

These methods are described below.

A. Direct Serial RS-232 Connection



Step	Procedure
1	Prepare a null modem cable. Refer to RS-232 Direct Link to PC Configuration Tool (page 90) for specific instructions on the null modem cable.
2	Connect one end of the null modem cable to the HC900 controller's RS-232 configuration port.
3	Connect the other end to an available serial port (COM1 through COM8) on your PC. Refer to RS-232 Direct Link to PC Configuration Tool (page 90) for specific instructions on the null modem cable.
4	If a configuration is not available, start a new configuration in HC Designer by selecting File, New. After selecting controller type and revision, select OK.
5	From the Utilities Worksheet (Utilities tab in the main window) in the HC Designer software, set up the PC's serial port attributes for use with the controller. Make sure that the same baud rate is set up for the PC port and the controller. In general, the faster the baud rate the better the performance, however, your PC may not communicate reliably at the faster baud rates. You may choose 9600 Baud (controller default), 19.2KB, or 38.4 KB. (Refer to the HC900 Hybrid Control Designer User's Guide or its respective on-line help, **Setting Up PC Com Ports and Connections - PC Serial Com Port Setup** and **Utilities Worksheet** - **Set Controller Serial Port,** for details on this step). 
6	On the PC, use the Utilities Worksheet in the HC Designer software to select the Com port as the current port.

RS-232 Direct Link to PC Configuration Tool

The Controller can be connected directly to the PC, in which case a Null Modem Cable is required. The Null Modem cable is available from Honeywell (Part # 51404755-501) or from third-party suppliers, or can be fabricated by the user. The Null Modem construction is shown in Figure 50 - Null Modem Cable Construction. Cable Pinouts are shown in Table 17 - PC Cable Pinouts.

Table 17 - PC Cable Pinouts

Configuration Connector Pinouts (For Null Modem Cable)	
Signal Name	***Terminal No.***
DCD	1
RXD	2
TXD	3
DTR	4
GND	5
DSR	6
RTS	7
CTS	8
RI	9

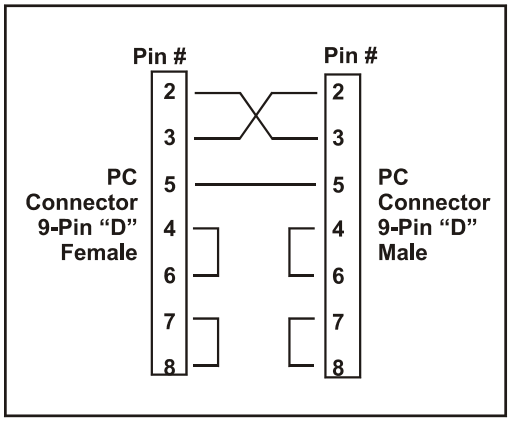


Figure 50 - Null Modem Cable Construction

RS-232 Remote Connection to PC Configuration Tool

The Controller can also be connected remotely by a set of modems, which are available from third-party suppliers. In this case, PC Modem Cable is used between the Controller and the modem at one end, and between the PC and the internal or external modem at the other end, as shown in Figure 51.

Remote controller access via dial-up modem is available via the communication setup in the PC configuration tool. All functions of the Hybrid Control Designer configuration tool can be performed over this link. Remote access functions include on-line monitoring, configuration upload and download, and firmware upgrade.

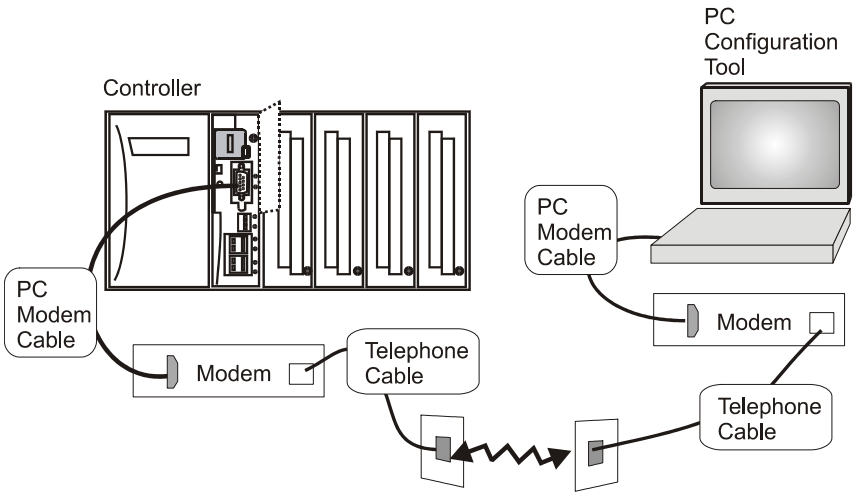
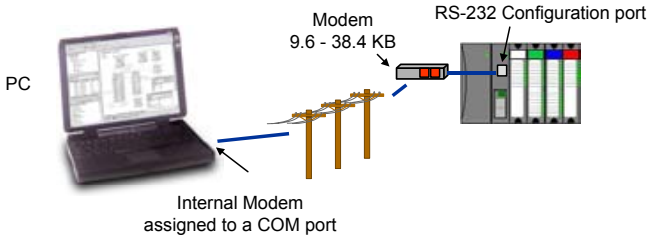
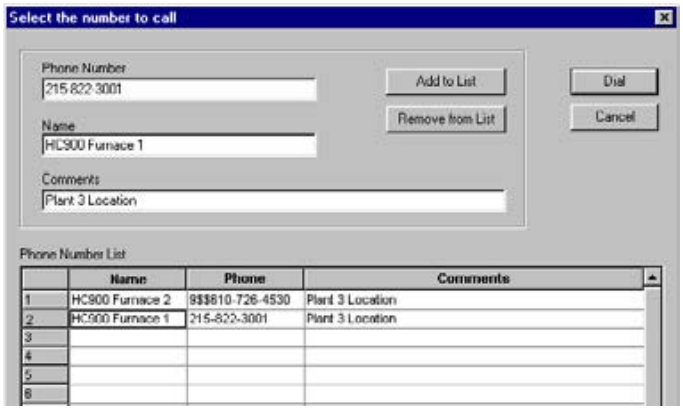


Figure 51 - RS-232 Remote Access via Modems

B. Modem Connection



Step	Procedure
1	Connect a modem to the HC900 controller's RS-232 configuration port. Refer to Modem configuration examples (page 95) for a list of approved modems, their settings, and the connection specifics.
2	On the PC, check on the Utilities Worksheet in the HC Designer software to see if the PC modem is properly installed. A modem icon on the associated COM port button indicates the PC modem is properly installed (internal or external). If the modem icon is not visible on the associated COM port button, use the modem supplier's instructions to properly install the modem and verify the installation using the Windows' Control Panel Modem property page to confirm proper installation.
3	Set up the phone book in the HC Designer software. This list includes the phone numbers for each of the HC900 controllers that can be connected using a modem. The phone book can be accessed from the Main Menu (View | Phone Book) or from the Utilities Worksheet by selecting the modem port as the current port. (Refer to the HC900 Hybrid Control Designer User's Guide or its respective on-line help, **Setting Up PC Com Ports and Connections** - **PC Serial Com Port Setup** and **Remote Access**, for details on this step.) 
4	On the PC, use the Utilities Worksheet in the HC Designer software to select the modem as the current port. A button will appear to allow you to dial a selected controller. 

Modem requirements

Most commercially available modems can be used with the HC900 Controller. The modem must have the following capabilities:

- RS-232 interface
- Auto answer
- Can operate at 9600 or 19200 or 38400 baud, 8 data bits, 1 stop bit, and no parity
- Hardware handshaking can be disabled
- Software handshaking can be disabled
- Data Terminal Ready (DTR) input can be disabled
- Result codes can be suppressed
- Echo can be disabled
- Must be equipped with non-volatile memory (NVRAM) so that settings that are configured using command strings can be retained during a power-outage
- Must be able to load the NVRAM settings automatically on power-up

Cable requirements

You will need an interface cable to connect the modem to the DB-9 female on the controller. If your modem has a 25-pin connector, be sure to use a DB-25 to DB-9 modem cable.

TIP

The Null Modem cable used to directly connect a PC running Hybrid Control Designer software to the controller may typically not be used to connect the PC to the modem or to connect the modem to the controller.

If your modem requires command string configuration, you will need an interface cable to connect the modem to your PC. Refer to your modem and computer documentation to determine this cable's requirements.

Modem configuration

Before connecting a modem to the controller's RS-232 port (marked "CONFIGURATION"), the modem must be configured with the following settings:

- Baud Rate = 9600, 19200, or 38400 (Must match Baud Rate configured in HC900 Controller)
- Parity = None
- 1 stop bit
- 8 data bits
- No handshaking
- Ignore DTR
- Suppress result codes
- Suppress echo
- Auto answer
- Disable command recognition (only necessary if the modem has this capability)

Some of these settings may be settable via switches. Others may require command strings to be written to the modem using a PC terminal program such as Hyperterminal. You will need to refer to your modem's documentation to make this determination. Those settings that are configured using command strings must be saved to the modem's non-volatile RAM (NVRAM), and the NVRAM must be configured as the profile that gets loaded when the modem is powered up.

Most modems are equipped with auto-recognition to set the baud rate, parity, stop bits, and data bits. If your modem has no means of setting these using switches, then most likely it is equipped with auto-recognition. To configure the port settings of a modem with auto recognition, do the following:

Step	Action
1	Connect the modem to a PC.
2	Power up the modem.
3	Start up a PC terminal program such as Hyperterminal.
4	Configure the PC COM Port for 9600, 19200, or 38400 baud (must match baud rate configured in the HC900 Controller), no parity, 1 stop bit, and 8 data bits.
5	Establish communications with the modem. *A common way of doing this is simply entering the AT E1 Q0 command and seeing if the modem responds with OK.* Once you establish communication to the modem, its port settings are configured.
6	Save the port settings to the profile that gets loaded on power-up.

Modem configuration examples

Below are procedures for setting up the following commercially available modems:

- 3Com US Robotics 56K Data/Fax External Modem
- Zoom 56K Dualmode External Modem
- Best Data 56SX Data Fax External Modem
- SixNet VT-MODEM Industrial External Modem

3Com US Robotics 56K Data/Fax External Modem

Step	Action

1 Ensure that the switches are set to the factory settings:

Switch	*Setting*	*Position*	*Function*
1	OFF	UP	Normal DTR operations
2	OFF	UP	Verbal (word) results
3	ON	DOWN	Enable result codes
4	OFF	UP	Displays keyboard commands
5	ON	DOWN	Disables auto answer
6	OFF	UP	Modem sends CD signal when it connects with another modem
7	OFF	UP	Loads Y0-Y4 configuration from user-defined nonvolatile memory (NVRAM)
8	ON	DOWN	Enables recognition (smart mode)

2 Connect the modem to a PC. If your computer's RS-232 port has a 25-pin connector, use a DB-25 male to DB-25 female **RS-232** cable. If your computer's RS-232 port has a 9-pin connector, use a DB-25 male to DB-9 female **modem** cable.

3 Power-up the modem.

4 Run a serial communication port program such as Hyperterminal.

5 Within the communication program, select the port to which the modem is connected.

6 Configure the port to these settings:

baud rate = 9600, 19200, 38400, 57600 (Must match Baud Rate configured in HC900 Controller)
data bits = 8
parity = none
stop bits = 1
flow control = none

7 In the program's terminal window, restore factory defaults by keying-in the following command string:

```
AT &F0
```

Then, press the **ENTER** key.

The modem should respond with OK.

Step	Action
8	Key in the following command string: AT Y0 Then, press the **ENTER** key. The modem should respond with OK.
9	Key in the following command string: AT &B1 Then, press the **ENTER** key. The modem should respond with OK.
10	Key-in the following command string: `AT E0 Q1 &W0` The Modem will not respond.
11	Power down the modem and disconnect it from the PC.
12	Set the modem switches to the following:

Switch	*Setting*	*Position*	*Function*
1	ON	DOWN	Modem ignores DTR (Override)
2	OFF	UP	Verbal (word) results
3	OFF	UP	Suppresses result codes
4	ON	DOWN	Suppresses echo
5	OFF	UP	Modem answers on first ring
6	ON	DOWN	CD always ON (Override)
7	OFF	UP	Loads Y0-Y4 configuration from user-defined nonvolatile memory (NVRAM)
8	OFF	UP	Disables command recognition (dumb mode)

13	Connect the modem to the RS-232 port of the HC900 using a DB-25 male to DB-9 male RS-232 cable.
14	Connect the modem to a telephone jack.
15	Power up the modem and the HC900 Controller.
16	On a remote computer, run Hybrid Control Designer software.
17	Set up Hybrid Control Designer software to dial the HC900 Controller.
18	Verify that communications is established with the remote HC900 Controller.

Zoom 56K Dualmode External Modem

Step	Action
1	Connect the modem to a PC. If your PC's RS-232 port has a 25-pin connector, use a DB-25 male to DB-25 female RS-232 cable. If your PC's RS232 port has a 9-pin connector, use a DB-25 male to DB-9 female modem cable.
2	Connect power to the modem.
3	Power up the modem.
4	Run a serial communication port program such as Hyperterminal.
5	Within the communication program, select the port to which the modem is connected.
6	Configure the port to these settings: baud rate = 9600, 19200, or 38400, 57600 (Must match Baud Rate configured in HC900 Controller) data bits = 8 parity = none stop bits = 1 flow control = none
7	In the program's terminal window, restore factory defaults by keying-in the following command string: `AT &F0` Then, press the **ENTER** key.
8	In the program's terminal window, key-in the following command string: `AT E1 Q0` Then, press the **ENTER** key. The Modem should respond with `OK`.
9	Key-in the following command string: `AT &Y0 &C0 &D0 &R1 &S0 &K0 S0=1` Then, press the **ENTER** key. The Modem should respond with `OK`.
10	Key-in the following command string: `AT E0 Q1 &W0` Then, press the **ENTER** key. The Modem will not respond.
11	Power down the modem and disconnect it from the PC.
12	Connect the modem to the RS-232 port of the HC900 Controller using a DB-25 male to DB-9 male RS-232 cable.
13	Connect the modem to a telephone jack.
14	Power up the modem and the HC900 Controller.
15	On a remote computer, run Hybrid Control Designer software.
16	Set up the PC software to dial the HC900 Controller.
17	Use the PC software "Loop-back" feature to verify that communications are established with the remote HC900 Controller.

Best Data 56SX Data Fax External Modem

Step	Action
1	Connect the modem to a PC. If your PC's RS-232 port has a 2- pin connector, use a DB-9 male to DB-25 female modem cable. If your PC's RS-232 port has a 9-pin connector, use a DB-9 male to DB-9 female RS-232 cable.
2	Connect power to the modem.
3	Power-up the modem.
4	Run a serial communication port program such as Hyperterminal.
5	Within the communication program, select the port to which the modem is connected.
6	Configure the port to these settings: baud rate = 9600, 19200, 38400, 57600 (Must match Baud Rate configured in HC900 Controller) data bits = 8 parity = none stop bits = 1 flow control = none
7	In the program's terminal window, restore factory defaults by keying-in the following command string: `AT &F0` Then, press the **ENTER** key.
8	In the program's terminal window, key-in in the following command string: `AT E1 Q0` Then, press the **ENTER** key. The modem should give an `OK` response.
9	Key-in the following command string: `AT &C0 &D0 &K0 &R1 &S0 &Y0 S0=1` The Modem should respond with `OK`.
10	Key-in the following command string: `AT E0 Q1 &W0` The Modem will not respond.
11	Power down the modem and disconnect it from the PC.
12	Connect the modem's serial cable to the RS-232 port of the HC900 using a DB-9 male to DB-9 male RS-232 cable.
13	Connect the modem to a telephone jack.
14	Power up the modem and the HC900 Controller.
15	On a remote computer, run Hybrid Control Designer software.
16	Set up the PC software to dial the HC900 Controller.
17	Use the PC software "Loop-back" feature to verify that communications are established with the remote HC900 Controller.

SixNet VT-MODEM Industrial External Modem

Step	Action
1	Connect the modem to a PC. If your PC's RS-232 port has a 25 pin connector, use a DB-9 male to DB-25 female modem cable. If your PC's RS-232 port has a 9 pin connector, use a DB-9 male to DB-9 female RS-232 cable.
2	Connect power to the modem. You will need to supply an external power supply with a DC voltage between 10 and 30 VDC.
3	Power-up the modem.
4	Run a serial communication port program such as Hyperterminal.
5	Within the communication program, select the port to which the modem is connected.
6	Configure the port to these settings: baud rate = 9600, 19200, 38400, 57600 (must match baud rate configured in HC900 controller data bits = 8 parity = none stop bits = 1 flow control = none
7	In the program's terminal window, restore factory defaults by keying-in the following command string: `AT &F0` Then, press the **ENTER** key.
8	In the program's terminal window, key-in the following command string: `AT E1 Q0` Then, press the **ENTER** key. The modem should give an `OK` response.
9	Key-in the following command string: `AT &Y0 &C0 &D0 &R1 &S0 &K0 S0=1` `The` Modem should respond with `OK`.
10	Key-in the following command string: `AT E0 Q1 &W0` The Modem will not respond.
11	Power down the modem and disconnect it from the PC.
12	Connect the modem to the RS-232 port of the HC900 Controller using a DB-9 male to DB-9 male modem cable.
13	Connect the modem to a telephone jack.
14	Power-up the modem and the HC900 Controller.
15	On a remote computer, run Hybrid Control Designer software.
16	Set up the PC software to dial the HC900 Controller.
17	Use the PC software "Loop-back" feature to verify that communications are established with the remote HC900 Controller.

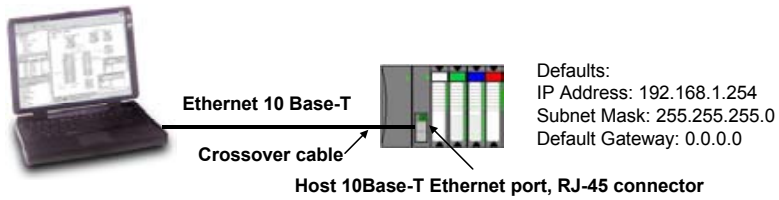
RS-485 Link to Operator Interface

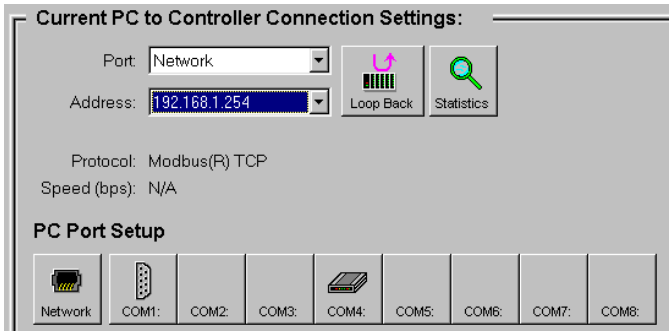
The RS-485 port is located below the hinged plastic cover on the top part of the Controller Module. Typically, the cable that interconnects this port to the Operator Interface must be fabricated during installation, because it will probably be necessary to run the cable through conduit.

Table 18 - Parts needed for RS-485 Cabling

Part #	Quantity	Description
Belden #9271 (or equivalent), with 120 ohm resistors (2,000 feet Maximum) Or Belden #9182 (or equivalent), with 150 ohm resistors (4, 000 feet maximum)	Variable	Commercially available communication cable
	1	10-terminal connector (Supplied with the operator interface)
Phoenix #1840379 (or equivalent)	1	connector (3-pin) (Supplied with the controller CPU module)
047260	1	Ferrite cable clamps (Supplied with the operator interface)
089037	2	Nylon cable ties

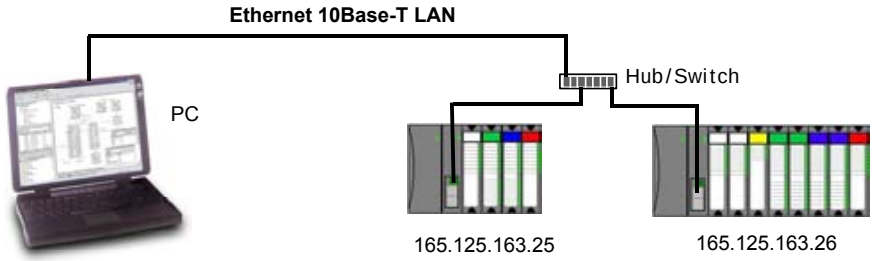
C. Direct Ethernet Connection to one HC900 controller



Step	Procedure
1	Make sure the PC has an Ethernet NIC (Network Interface Card) installed and enabled.
2	Connect an Ethernet 10Base-T crossover cable to the HC900 controller's Open Ethernet RJ-45 port (top RJ-45 port).
3	Connect the other end of the Ethernet 10Base-T crossover cable to the PC's network port.
4	On the PC, use the Utilities Worksheet in the HC Designer software to connect to the controller over Ethernet. Every HC900 controller is shipped with the default IP address of 192.168.1.254 and Subnet Mask of 255.255.255.0. You can use these network parameters initially for testing or configuration use. In the Current PC to Controller Connection Settings area of the dialog box, click on the Network button to bring up the Network Port Properties dialog box and Add the default IP address. Be sure the Ethernet Network Interface Card in the PC has a fixed IP address on the same subnet as the controller (192.168.1.x, where x= 2 to 253).
5	In the Current PC to Controller Connection Settings area of the dialog box, select Network for the Port to be used and the default IP address for the Address. Click on Loopback to assure communications between the PC and the controller. You may now use the Ethernet port for configuration interface. 
6	Consult your IT systems administrator for allocating IP addresses if this controller will require a unique IP address within a plant network. Be also sure that the PC Network Interface Card has an IP address that allows access to the controller on the subnet after changing the controller's network parameters.
7	You may change the controller's IP address and related network parameters from its default using the Utilities Worksheet in the HC Designer software. This may be done using either the RS-232 serial port (typically used) via a null modem cable connection or the Ethernet connection from the PC to the controller. If the RS-232 connection is desired, make sure the proper PC serial Com port to be used has been set up (See Direct Serial RS-232 Connection above).

Step	Procedure
8	Select the Set Controller's Network Parameters button. Using the wizard (bottom radio button), select the PC port to be used, then set the controller's new network parameters including IP address, Subnet Mask (if other than the default), and Default Gateway IP address (if required, otherwise use default). Refer to the HC900 Hybrid Control Designer User's Guide or its respective on-line help, Utilities Worksheet - Set Controller's Network Parameters, for further details on this step. Note: This step will require the controller to be placed temporarily in the Program mode. After the new network parameters have been downloaded, the controller will conduct a Cold Start in its transition to RUN. This will cause an initialization if there is a current configuration in the controller.

D. Network Access to one or more controllers



Step	Procedure
1	Make sure the PC has an Ethernet NIC (Network Interface Card) installed and enabled. Be sure the NIC has an IP address (fixed or DHCP served) that allows access to controllers with IP addresses on the same or other subnet. Consult your IT department or network administrator for allocating IP addresses to the controllers if required.
2	You will need to set each controller's IP address prior to network connection since every HC900 controller is shipped with the default IP address of 192.168.1.254. Placing multiple controllers on the same network before they have been given unique IP addresses will cause problems.
3	On the PC, use the Utilities Worksheet in the HC Designer software to set up the serial RS-232 connection to the controller at the desired baud rate (see Direct Serial RS-232 Connection above). This will require a null modem cable.
4	Select the Set Controller's Network Parameters button. Using the wizard (bottom radio button), select the PC COM port to be used, then set the controller's new network parameters including IP address, Subnet Mask, and Default Gateway (if required). See your IT network administrator for proper entries. (Refer to the on-line help provided with the HC Designer software, Utilities Worksheet, Set Controller's Network Parameters, for further details on this step). Note: This step will require the controller to be placed temporarily in the Program mode. After the new network parameters have been downloaded, the controller will conduct a Cold Start in its transition to RUN. This will cause an initialization if there is a current configuration in the controller.
5	Repeat step 4 for each controller on the same network.
6	Select the Network button at the bottom of the dialog box and Add any or all of controller IP addresses configured to the list. This will allow selection of any of these Addresses for downloading or uploading configurations.
7	You may now connect the controllers to your network for access by the Hybrid Control Designer software. For the Networking Example shown, connect one end of the Ethernet 10Base-T cable to the PC's network port. Connect the other end of the Ethernet 10Base-T cable to the Ethernet hub/switch.
8	Connect an Ethernet 10Base-T cable to each HC900 controller's Open Ethernet RJ-45 port (top RJ-45 port). Connect the other end of each Ethernet 10Base-T cable to the Ethernet hub/switch.
9	You may now access any controller on the network for configuration access by assigning Network as the Port and the respective IP Address as the Address of the controller. **ATTENTION: When multiple controllers are on the network, be careful to check for the correct IP address of the destination controller prior to download of a new configuration or when downloading edits to a configuration while in RUN mode. Otherwise, you may inadvertently download a configuration to the wrong controller.**

Setting Up the Controller Network Parameters

See the HC900 Hybrid Control Designer Users Guide, Doc. # 51-52-25-110 or respective HC Designer Help Files for setting up following network parameters:

- IP Address, Subnet Mask (optional), Default Gateway IP Address (optional)
- Network Name (optionally used in Peer Data Exchange)
- Local Name (optional, user identifier for controller)
- E-mail Server IP Address (required if e-mail alarms are configured)

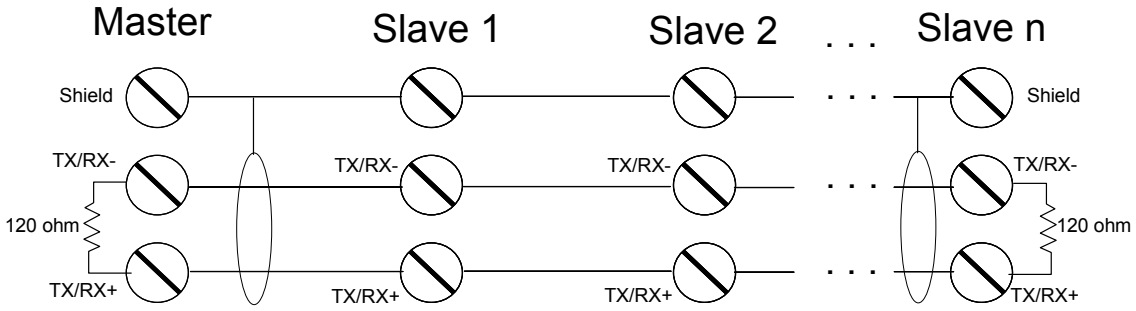
ATTENTION

This setup will require the controller to be placed temporarily in the Program mode. After the new network parameters have been downloaded, the controller will conduct a Cold Start in its transition to RUN. This will cause an initialization if there is a current configuration in the controller.

Connecting the HC900 Controller to Modbus device(s)

RS-485 Modbus connections

Using the master and slave(s) RS-485 ports of the controller and other device(s), connect as shown.



120 ohm termination resistors required at master and last slave on the link.

Use HC Designer software to configure the controller's RS-485 port as a master or slave.

RS-232 Modbus Connections

Connect to the RX, TX, and ground pins of the controller's 9-pin RS-232 port. Table 17 (page 90) identifies the pins. For connections on other device, refer to its product manual.

For multiple devices on RS-232, use an approved RS232-to-RS485 converter.

Use HC Designer software to configure the controller's RS-232 port as a master or slave.

Operating Characteristics

Introduction

This section provides insights into system functioning that are useful in configuration, in installation /commissioning tasks, and also in normal and abnormal operation. For related information regarding diagnostic indications, how they should be interpreted, and determining appropriate actions, refer to the Diagnostics section in this user manual.

Overview

The HC900 Controller components begin operation as soon as power is applied, and continue until power is removed. The operation of the system varies according to the following interacting factors:

- **Power transitions**: **Power DOWN** / **Power UP**
  Power DOWN transitions are usually planned and controlled, but in some cases such as power outages, are unintended. To ensure proper operation in either case, the HC900 Controller includes software that controls operation at power restoration. The controller handles a Power-UP transition as one of two types: **Cold Start** or **Warm Start**
- **Operating Modes**: **Program (Locked), Program, Offline, Run, and Run (Locked)**
  Operating Modes are selected:
  - by positioning the (Operating) Mode switch on the Controller Module, and,
  - by selecting parameters on displays (operator interface, Hybrid Control Designer).

  In some cases, mode transitions also restart (Cold Start or Warm Start) controller operation.
- **Results of diagnostics:** in case of system hardware or software fault, the controller automatically alters operation as appropriate for the diagnosed conditions.

Power Down / Power Up

The HC900 Controller is designed to facilitate restoration of process operation after a power outage. The active control configuration is maintained in battery-backed RAM, and the last configuration update performed in the program mode is also stored in Flash memory on the Controller Module. When power is restored, the system automatically enters a diagnostic procedure that checks the integrity of hardware, software, and the control database. Depending on the results of the diagnostic, the controller will execute either a Warm Start or a Cold Start.

Warm Start

A Warm Start is a restart of the control strategy using dynamic data that is stored in battery backed RAM to allow control action to resume exactly as it was before the restart. In the Warm Start procedure (flowcharted in the main flow of Figure 52), diagnostic testing proves the integrity of the hardware, software, and configuration database resulting in an automatic Warm Start of process control. Control action is resumed exactly as it was before the outage.

This flowchart also indicates actions that would be taken by the controller in case of fault. Notice that if primary diagnostic testing determines that RAM or firmware is faulty, all process control functions cease, and the Status LED (red color) strobes one blink, periodically. If RAM and firmware tests pass, but the database in RAM is faulty, the controller initiates the Cold Start operation.

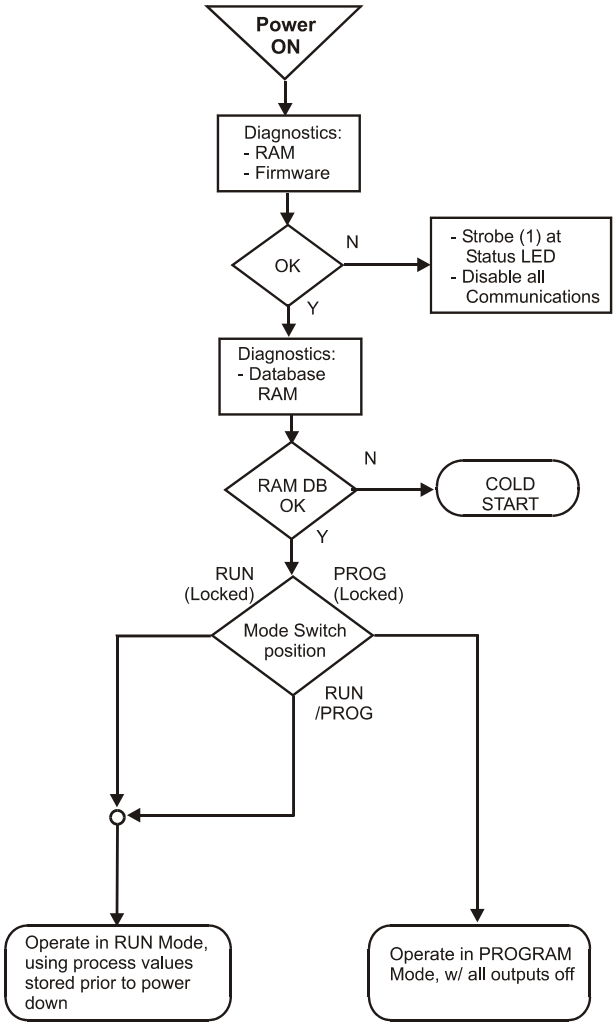


Figure 52 - Warm Start Operation

Cold Start

A Cold Start clears the data in battery backed RAM, turns all outputs off, transfers the configuration file from flash memory to RAM and reinitializes all dynamic data.

The Cold Start procedure is flowcharted in

Figure 53. The controller initiates the Cold Start procedure:

- After a power outage, when diagnostics indicate that the controller hardware and software program are intact, but the content of the RAM database is incorrect. (See Figure 52.)
- On a Mode transition from PROGRAM to RUN. (This Mode transition can be initiated by operating the Mode switch on the controller, or by exiting the Program mode at an operator interface.)
- When initiated by the user (after download with Cold Start selected, or any transition from PROGAM Mode to RUN Mode.)

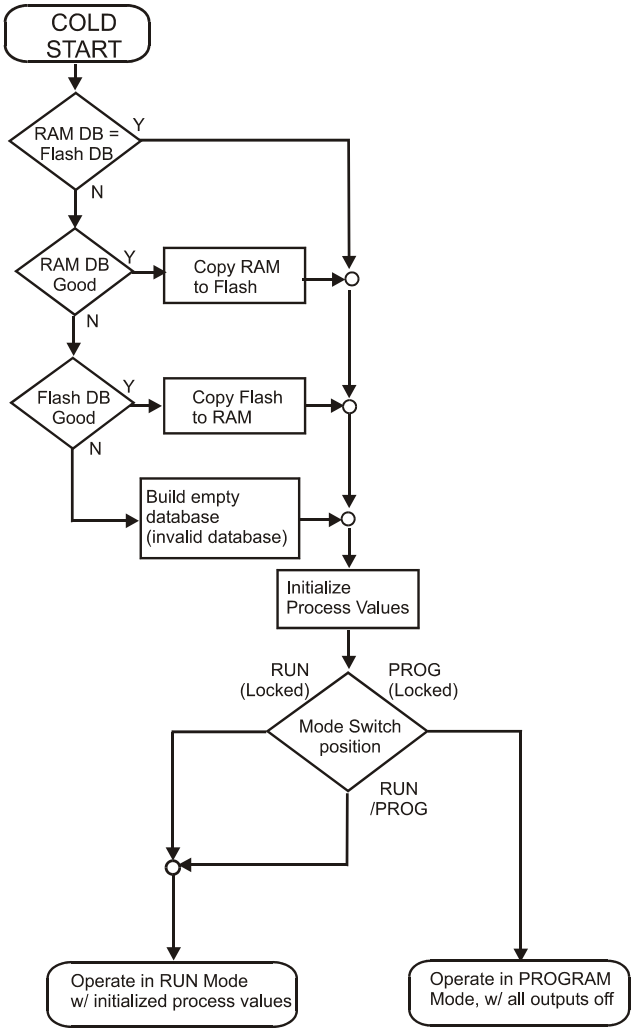


Figure 53 - Cold Start Operation

Controller Modes

The HC900 Controller includes three operating modes. The purpose of each mode is described immediately below, and salient characteristics of each are described in Table 19. The functions of the Mode Switch are described in Table 20, and the procedures that the controller performs in transitions between modes are described in Table 21.

PROGRAM Mode

In the PROGRAM Mode, active control processing is suspended. This mode is used for safe execution of utility functions such as configuration download and calibration of analog inputs and outputs.

All outputs are Off.

RUN Mode

The Run Mode is used for normal operation of the controller; that is, for running the control configuration that was previously downloaded. Configuration download and other utility functions can be performed in this mode. See the Hybrid Control Designer User Guide for precautions, restrictions, and procedures.

OFFLINE Mode

The OFFLINE Mode can be entered only from the RUN Mode, and is intended primarily for performing AI calibration.

⚠ CAUTION

Because Function Blocks are not processed and outputs are Frozen in this mode, inputs (that is, process values) can vary from the values that existed when the OFFLINE Mode was entered.

Before entering the OFFLINE Mode:

- KNOW all potential consequences of suspending control action..
- PLAN for all operator actions required to preclude adverse consequences while processing is suspended, and when resuming control processing.
- EXECUTE prudent control actions (such as placing all control loop in the Manual Mode).

Failure to comply with these instructions may result in product damage.

Table 19 - Controller Operating Modes

Mode Name	Functions in selected mode
RUN	I/O scanning (Controller and Expander Racks) Function block execution; outputs are set according to function block algorithms. Monitoring of Diagnostics (controller rack and I/O expander racks) Detection of I/O Modules Other functions permitted: • Downloading of configurations • Indications of Forces at Status LEDs on I/O modules Other functions NOT permitted: • AI calibration • AO calibration
PROGRAM	I/O scanning (Controller and expansion Racks[C50 CPU only]) is performed, but function blocks are not executed, and all outputs (digital and analog) are set to OFF. (See Note 1.) Monitoring of Diagnostics (Controller and Expander Racks) Detection of I/O Modules Other functions permitted: • AI calibration • AO calibration • Downloading of configurations Other functions NOT permitted: • Indications of Forces at Status LEDs at I/O modules
OFFLINE	IO scanning (Controller and Expander Racks) is performed, but function blocks are not executed, and all outputs (digital and analog) are Frozen (see Note 2) at the states they were in when the OFFLINE mode was selected. Monitoring of Diagnostics (local and expanded racks) Detection of I/O Modules Other functions permitted: • AI calibration • Indications of Force at Status LEDs of I/O modules Other function NOT permitted: AO calibration

Note 1: The Off state of the module outputs are defined as:

- Digital output - low state
- Time proportional Output (TPO) : 0% duty cycle
- TPSC Outputs: Both Fwd and Rev are Off.
- Analog output: 0.0 mA

Note 2: The Frozen states of module outputs are defined as:

- Digital output: same state as previous (last active state)
- Time Proportional Output (TPO): Same duty cycle as in last active state
- TPSC Outputs: digital outputs are Off to freeze the motor position.
- Analog output: same current as previous (last active current level)

Controller Mode Transitions

Mode changes are controlled primarily by positioning of the MODE switch on the controller module, and secondarily by selection of mode names on operator interface displays. That is, the Mode switch takes precedence. In the RUN (Locked) position or in the PROG (Locked) position, selecting a mode name at the operator interface has no effect on the operational mode. In the RUN/PROG position, the mode may be changed from any mode to any other mode.

The effects of the Mode switch operator interface selections are described in Table 20. The effects on controller operation for each mode transition are described in Table 21.

Table 20 - Mode Switch Functions

Mode Name	Position of Mode Switch	Mode Selections at Operator Interface	Switch Function
RUN (Locked)	Left	None (locked in RUN)	In this position, the Controller is locked in the RUN mode of operation. Run mode configuration changes are disabled and mode can not be changed at any operator interface.
RUN/PROG	Middle	PROGRAM RUN OFFLINE	In this position, the mode can be changed at any operator interface using screen selections PROGRAM, RUN, or OFFLINE.
PROG (Locked)	Right	None (locked in Program)	In this position, the Controller is locked in the PROGRAM mode of operation. Mode can not be changed at any operator interface.

Table 21 - Controller Behavior in Mode Transition

Initial Mode	New Mode	Controller Behavior
PROGRAM	RUN	Validate configuration database. Reset all I/O scanners. Upon startup, initiate Cold Start sequence. Diagnostic: Identify and configure all I/O racks and modules. (All output modules are configured with Failsafe values. Any modules not included in the configuration are configured with default values, which causes outputs to be Off.) While in transition, all output modules are Off; when transition procedures are completed, Function Block processing begins, and output values are set to Function Block output values. Any calibration process that was in progress is immediately aborted, and the results are discarded.
PROGRAM	OFFLINE	Same as PROGRAM to RUN transition, except that Function Blocks are not processed, and outputs remain Off. Any calibration process that was in progress is immediately aborted, and the results are discarded.
RUN	PROGRAM	Set all channels of all output modules to Off. Set all output module Failsafe values to the Off state. Turn off the LED indications on all output modules.
OFFLINE	PROGRAM	Same as RUN to PROGRAM transition. Any calibration process that was in progress is immediately aborted, and the results are discarded.
RUN	OFFLINE	Freeze output module channels. Freeze Force LED indications on all output modules.
OFFLINE	RUN	Function Block execution starts immediately. Any calibration process that was in progress is immediately aborted, and the results are discarded.

Software Download/Upload Functions

The following is a general description of software file transfers between the controller and computer devices external to the controller.

⚠ CAUTION

Performing download procedures incorrectly could cause loss of control in an operating process or loss of data and program files in a controller.

Refer to the appropriate User's Manuals for download/upload procedures.

Failure to comply with these instructions may result in product damage.

Two types of software files can be downloaded to the controller:

- Configuration files
- Firmware.

Configuration files can also be uploaded from the controller for archiving. Firmware can only be downloaded to the controller. Pathways for file transactions between the controller and computer devices external to the controller are shown in Figure 54.

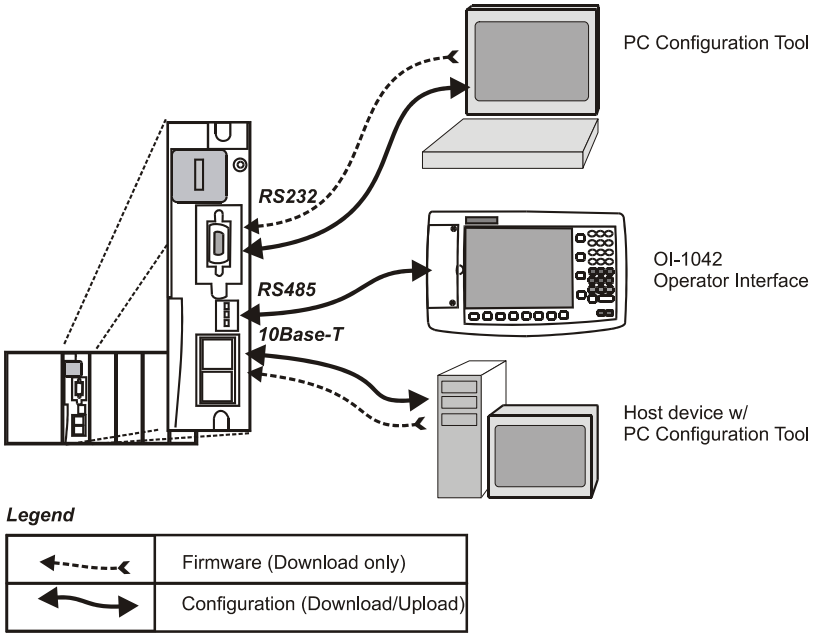


Figure 54 - Pathways for Upload/Download Transactions

Configuration Download

Configuration files include the items indicated in Table 22. Downloading of some items is mode dependent. That is, downloading of some file types is not permitted in the Run mode or in the Offline mode.

Table 22 - Configuration file downloading

Downloading of Configuration items:	Permitted When Controller is in . . .		
	PROGRAM Mode	RUN Mode	OFFLINE Mode
Controller Configuration Files	Yes	Yes/No (Note 1)	No
Setpoint Profiles / Setpoint Schedule	Yes	Yes	Yes
Recipe Files	Yes	Yes	Yes
Data Storage Configuration Files	Yes	Yes	Yes
Data Storage Non-volatile parameters	Yes	Yes	Yes

Note 1 - Controller files can be downloaded with the controller in Run Mode with the Mode switch set to Run/Program, but not with the switch set to Run/Lock.

The download from the host processor is directed to an area of controller memory separate from that used for running the controller, and hence has no effect on the active process.

The host signals the controller when the download is complete, and requests a configuration validation test and report from the controller. The controller then checks the new database and compares it to the current (running) database. Using the test report as a basis, the host then presents the operator (user) with a dialog box containing a set of choices: begin using the new database with no cold start, use it with a re-start, or abort the download.

For downloading procedures, refer to the Operator Interface User Manual.

Configuration Upload

Controller configuration files, setpoint profiles, and recipe files can be uploaded for storage and archiving in a PC and/or to a disk in the Operator Interface. Using the PC, the Upload function is accessed from the Hybrid Control Designer.

For details of uploading configuration items, refer to Hybrid Control Designer and Operator Interface manuals.

Diagnostics and Troubleshooting

Overview

The HC900 system incorporates a comprehensive set of diagnostic tools that test hardware and software operation. Diagnostic software elements are contained in each system component. The diagnostic elements that are executed at any given time depend on operating conditions such as current operating mode and the current status of hardware and software. As long as power is applied, each major component of the controller will execute one or more diagnostic elements.

Diagnostics have two functions; they:

- Automatically alter system operation to react appropriately to operating conditions (particularly in the event of a system fault).
- Provide external indications that enable operating and maintenance personnel to react appropriately when external actions are required.

External Indications of Diagnostic Information

Two sets of diagnostic indicators are provided as standard:

- Light Emitting Diodes (LEDs) included in controller hardware. Locations of LEDs are shown in Figure 55; descriptions are given in Table 23 , Table 24, Table 25, and Table 26.
- Screen items on:
  - The Operator Interface connected to the RS485 port
  - A PC with Hybrid Control Designer connected to the controller module via the RS-232 port or the Ethernet 10Base-T Open Connectivity port.

The LEDs are useful when personnel are performing troubleshooting activities solely at the controller. Also, they are useful for verifying indications viewed as screens items.

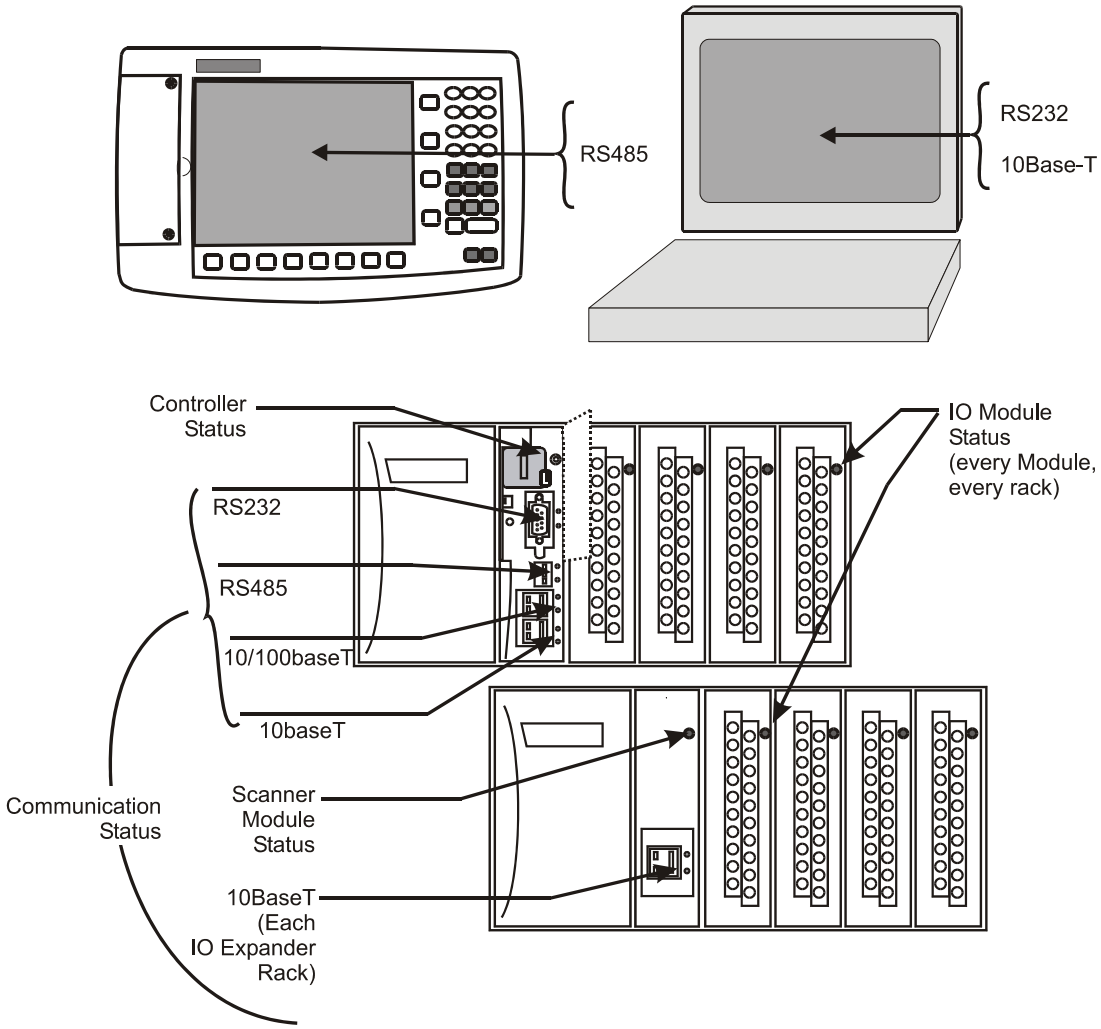


Figure 55 - LED Indicators

Table 23 - LED Indications on Main CPU

LED	LED State/Color	Indicates Condition:
Controller Status	Off	No power.
	Solid Red	Failed
	Blinking Red	(Diagnostic Code; refer to Table 27.)
	Solid Green	PROGRAM Mode
	Blinking Green	RUN Mode
	Solid Yellow	OFFLINE Mode
RS232 port: PC Config'n tool:		
XMT (upper LED)	Green (On/Off)	On when first byte is sent, Off when the last byte is sent.
RCV (lower LED)	Green On/Off	On when first byte is received, Off when the last byte is received or failure is detected.
RS485 port (Operator Interface)		
XMT (upper LED)	Green (On/Off)	On when first byte is sent, Off when the last byte is sent.
RCV (lower LED)	Green (On/Off)	On when first byte is received, Off when the last byte is received or failure is detected.
10Base-T port (LAN/Internet)		
XMT (upper LED)	Green (On/Off)	On while message is being sent from the Main CPU; otherwise Off.
LINK (lower LED)	Green (On/Off)	On while the Main CPU is receiving a message. Remains On as long as host is present; Off when the host is removed from the link.
	NOTE: These LEDs indicate activity on the communication port, they are controlled by hardware (PHY chip), not by software.	
10Base-T port (I/O Expansion –C50 CPU only)		
LAN (upper LED)	Green (On/Off)	On when activity is present on the link.
LINK (lower LED)	Green (On/Off)	On when another 10Base-T PHY is present on the link
	NOTE: These LEDs indicate activity on the communication port, they are controlled by hardware (PHY chip), not by software.	

Table 24 - LED Indications on Scanner Module

LED	LED State/Color	Indicates Condition:
Scanner Status	Off	No power.
	Solid Red	Failed
	Blinking Red	(Diagnostic Code; refer to Table 30 - Scanner Diagnostics.)
	Solid Green	Startup Mode
	Blinking Green	Scan Mode
10Base-T port (I/O Expansion –C50 CPU only)		
XMT (upper LED)	Green (On/Off)	On while a message is being sent from the Main CPU; otherwise Off.
LINK (lower LED)	Green (On/Off)	On while the Main CPU is receiving a message. Remains On as long as host is present; Off when the host is removed from the link.
	NOTE: These LEDs indicate activity on the communication port, they are controlled by hardware (PHY chip), not by software.	

Table 25 - LED Indications on I/O Module

LED	LED State/Color	Indicates Condition:
Module Status	Off	No power.
	Solid Red	Hardware failure
	Blinking Red	Diagnostic Code; refer to Table 28 - Bad Module Diagnostics.
	Blinking Yellow	At least one output is Forced.
	Solid green	Cold start with passing diagnostics
	Blinking Green	Normal scanning
Channel LEDs (one per input or output)	Green (On/Off)	For Inputs, indicates On or Off status of the field input even if Forced to the opposite state. For Outputs, indicates On or Off status of the output including if Forced.

Table 26 - LED Indications on Ethernet Hub

LED	LED State/Color	Indicates Condition:
10Base-T port (I/O Expansion –C50 CPU only)		
XMT (upper LED)	Green (On/Off)	On while a message is being sent from the Main CPU; otherwise Off.
LINK (lower LED)	Green (On/Off)	On while the Main CPU is receiving a message. Remains On as long as host is present; Off when the host is removed from the link.
	NOTE: These LEDs indicate activity on the communication port, they are controlled by hardware (PHY chip), not by software.	

User Interface

Table 27 lists Controller Module diagnostic indications (Operator Interface messages, and Status LED) along with causes of the indications, automatic control file actions, and suggested user actions.

⚠ WARNING

Hazardous voltages exist in the equipment enclosure.

- Identify and avoid contact with voltage sources.
- Disconnect power before servicing. (More than one switch may be required to disconnect all power.)

Failure to comply with these instructions could result in death or serious injury.

Table 27 - Controller Module Diagnostics

Table 27 - Controller Module Diagnostics					
OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
N/A	N/A	1	RAM failed on power-up.	Executes an infinite loop that toggles the LED. Communications and control are disabled.	1. Cycle power 2. Replace CPU 3. Replace rack
N/A	N/A	1	ROM failed on power-up.	Executes an infinite loop that toggles the LED. Communications and control are disabled.	1. Cycle power 2. Replace CPU 3. Replace rack
SYSTEM	GOOD	N/A	N/A	N/A	N/A
	FORCED OUTPUT	2	A block has an output that is forced.	None	Remove force on block output.

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
	INVALID CONFIG.	2	A configuration that exceeds the loop capacity of the controller was downloaded or an invalid configuration exists.	An empty database is created.	Download a valid configuration.
	SWITCH FAULT	2	A failure is detected in the switch reading.	1. All control blocks stop running 2. All I/O scanning ceases. This forces the modules into failsafe.	Replace CPU.
SYSTEM	NO MASTER PORT	2	There are slave blocks in the configuration, and no communication port configured as a Modbus master.	1. MSTRFAIL pins on ASYS and FSYS blocks turn on. 2. All Modbus slave and Modbus read blocks freeze their output pins to the last value. 3. All slave blocks have their BAD COMM pin on. 4. All slave blocks have their NO SCAN pin on. 5. IN SCAN STATUS is set to NO for all slaves. 6. COMM STATUS is set to BAD for all slaves in the function block diagram. 7. Statistical counters for all slaves are 0.	1. Configure one of the ports as a master. 2. Download a configuration that has no slave blocks.
CPU	GOOD	N/A	N/A	N/A	N/A
	WATCHDOG	3	Watchdog reset resulting from software failure	1. Associated rack monitor block's RACK OK pin is turned off. 2. ASYS block's HW OK pin is turned off.	1. Force a cold start. 2. Upgrade control file software. 3. Replace CPU board. 4. Contact Honeywell Personnel.
	PREFETCH ABORT	3	CPU failed when attempting to fetch an instruction from the prefetch register.	1. Controller performs a restart 2. Associated rack monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off.	1. Force a cold start. 2. Isolate system from noise and force a cold start. 3. Replace CPU board.
	ADDRESS ERROR	3	The reserved exception occurred for an unknown reason.	*See PREFETCH ABORT.*	1. Force a cold start. 2. Isolate system from noise and force a cold start. 3. Replace CPU board.
	UNDEFINE ERROR	3	Bad Instruction Detected	*See PREFETCH ABORT*	*See PREFETCH Abort*

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
	DATA ABORT	3	CPU failed when attempting to access data.	*See PREFETCH ABORT.*	*See PREFETCH ABORT.*
	SOFTWARE INTERRUPT ERROR	3	Software Interrupt occurred which is not supported by the software.	*See PREFETCH ABORT.*	*See PREFETCH ABORT.*
	VECTOR ERROR	3	Corrupted interrupt vectors in RAM	Interrupt vectors were restored	*See WATCHDOG*
MEMORY	GOOD	N/A	N/A	N/A	N/A
	5 DAY LOW BATTERY WARNING	4	Estimated battery life is less than 5 days.	1. Associated rack monitor block's RACK OK pin is turned off. 2. ASYS block's HW OK pin is turned off.	Replace battery.
	LOW BATTERY	4	Battery voltage is low.	1. Associated rack monitor block's RACK OK pin is turned off. 2. ASYS block's LOW BATTERY pin is turned on. 3. ASYS block's HW OK pin is turned off.	Replace battery.
	FLASH ERROR	4	Flash failed to burn	1. Associated rack monitor block's RACK OK pin is turned off. 2. ASYS block's HW OK pin is turned off.	Force a cold start (Another Flash burn is attempted; if FLASH ERROR again, replace CPU board.
RTC	GOOD	N/A	N/A	N/A	N/A
	NOT PROGRAMMED	5	RTC not programmed	1. Time and date is set to 00:00:00, January 1, 1970. 2. Associated rack monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off.	Program RTC.
	BAD DATA	5	Bad date and time	*See NOT PROGRAMMED.*	1. Program RTC. 2. Cycle power. 3. Replace CPU. 4. Replace boards in rack. 5. Replace rack.
	PROGRAMMING FAILURE	5	RTC failed to program	*See NOT PROGRAMMED.*	*See Bad Data.*
	READ FAILURE	5	Unable to read RTC	*See NOT PROGRAMMED.*	*See Bad Data.*

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
COMPORT	GOOD	N/A	N/A	N/A	N/A
	FAILED	N/A	One of the Comm ports is reporting a physical or data link failure	*Refer to related Comm port diagnostic below.*	1. Check connections 2. Access the Comm port diagnostics screen 3. Replace CPU
IO	GOOD	N/A	N/A	N/A	N/A
	MODULE ERROR	6	One of the module diagnostics in the associated rack is set to WRONG MODULE, NO COM/MISSING MODULE (if the communications is failing due to the module not installed), BAD MODULE, or BAD CHANNEL.	*Refer to related Module diagnostic below.*	1. Access the I/O Module diagnostics screen. 2. Install proper module 3. Replace faulty module
	HI TEMP	6	One of the module diagnostics in the associated rack is set to HI CJ TEMPERATURE.	*Refer to HI CJ TEMPERATURE in Module diagnostics*	See module diagnostic actions for HI CJ TEMP
	RACK BACKPLANE FAIL	6	The Main CPU/Scanner is unable to successfully communicate to any modules that are in its SPI backplane.	All associated module diagnostics are set to MODULE NO COMM. Refer to MODULE NO COMM diagnostic for further details.	1. Remove modules and check for bent pins on connectors. 2. Reinsert modules one at a time and note which module the diagnostic reoccurs, and replace that module. 3. Cycle power to the rack. 4. Replace the power supply. 5. Replace the rack. 6. Replace the CPU board.

Table 27 - Controller Module Diagnostics					
OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
IO	RACK COMM FAIL	6	The Main CPU is unable to successfully communicate to an expansion rack(C50 CPU only) that is in its configuration.	*See RACK BACKPLANE FAIL.*	1. Verify that the expansion rack should be in the configuration 2. Verify that the jumpers on the scanner are set up for the correct rack address. 3. Check that expansion rack is on. 4. Check the expansion rack's status LED for diagnostic information. 5. Check that cable is connected to expansion rack. 6. If a hub is used, check that all cables are properly connected to the hub, proper crossover cables are used, and that hub is powered. 7. Cycle power to the rack. 8. Cycle power to the hub. 9. Replace the expansion rack's power supply. 10. Replace the expansion rack. 11. Replace the expansion rack's scanner board. 12. Replace the main CPU.
	RACK SW INCOMPATILITY	6	The Main CPU determined that its software is not compatible with the scanner module.	All associated module diagnostics are set to MODULE NO COMM. Refer to MODULE NO COMM diagnostic for further details.	1. Upgrade the scanner software either by replacing the module or doing a code-download. 2. Update Main CPU software either by replacing the module or doing a code download.

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
MODULE 1 through MODULE 16	GOOD	N/A	N/A	N/A	N/A
	HI CJ TEMPERATURE	6	Possible causes of this diagnostic are: 1. One of the two CJs on the module is indicating a temperature reading greater than 70 degrees C. 2. Both cold-junction sensors are failing to convert. 3. The CJs are converting properly, but their differential is greater than 10 degrees C.	1. Associated AI blocks that are configured as T/Cs set their fail pin on, their warn pin off, and their output pin to the failsafe value. 2. Associated AI blocks that are configured as T/Cs set their IO status to “CJ High Temperature” for reason 1 or “CJ Failure” for possible causes 2 and 3. 3. Associated rack monitor block’s module fail pin is turned on. 4. Associated rack monitor block’s RACK OK pin is turned off. 5. Associated rack monitor block’s HITEMP pin is turned on. 6. ASYS block’s HITEMP pin is turned on. 7. ASYS block’s HW OK pin is turned off.	1. Improve ventilation to rack 2. Replace AI module
	WRONG MODULE	6	The module does not agree with the module required for the control scenario.	1. Associated blocks set their fail pin on, their warn pin off, and their output pin to the failsafe value. 2. Associated blocks set their IO status to “Channel No Comm”. 3. Associated rack monitor block’s module fail pin is turned on. 4. Associated rack monitor block’s RACK OK pin is turned off. 5. ASYS block’s HW OK pin is turned off.	1. Verify configuration 2. Replace module with the correct one.

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
MODULE 1 through MODULE 16	MODULE NO COMM	6	Main CPU is unable to communicate to the module for one of the following reasons: • Module is not installed • Backplane problem is inhibiting the CPU to properly communicate with the module • Module is on an expansion rack(C50 CPU only) and the expansion rack communications is failing	*See WRONG MODULE.*	Action is based on the IODIAG indication. If IODIAG is not MODULE ERROR, then follow the prescribed action defined for that diagnostic. For MODULE ERROR, do the following: 1. Verify configuration 2. Install module.
	BAD CHANNEL	6	*See* Table 29 - Bad Channel Diagnostics.	Associated block sets its fail pin on, its warn pin off, and its output pin to the failsafe value. Associated block sets its IO status as denoted in Table 29 - Bad Channel Diagnostics. Associated rack monitor block's module fail pin is turned on. Associated rack monitor block's RACK OK pin is turned off. ASYS block's HW OK pin is turned off.	*See* Table 29 - Bad Channel Diagnostics.
	BAD MODULE	6	Module is reporting a diagnostic condition. *See* Table 28 - Bad Module Diagnostics.	*See WRONG MODULE.*	User should inspect the module's status LED to determine the nature of the problem. The information in Table 28 - Bad Module Diagnostics describes the user action for the various LED diagnostics.

Table 27 - Controller Module Diagnostics					
OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
XIO PORT	GOOD	N/A	N/A	N/A	N/A
	DLFAIL	6	The communications to a particular rack is resulting in a lot of DLL errors.	1. Related rack monitor block's RACK OK pin is turned off. 2. Depending on the nature of the DLL errors, the associated rack monitor block's module diagnostics, and pins could be affected. 3. Associated rack's COM Port is set to FAILED. 4. Rack 1 COM Port diagnostic is set to FAILED.	1. Use the OI or Hybrid Control Designer software to determine which rack is experiencing the DLL errors. Verify that the expansion rack(C50 CPU only) should be in the configuration 2. Verify that the jumpers on the scanner are setup for the correct rack address. 3. If a hub is used, check that all cables are properly connected to the hub, proper crossover cables are used, and that hub is powered. 4. Cycle power to the rack. 5. Cycle power to the hub. 6. Replace the expansion rack's power supply. 7. Replace the expansion rack. 8. Replace the expansion rack's scanner board. 9. Replace the main CPU.

Table 27 - Controller Module Diagnostics					
OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
XIO PORT	HWFAIL	6	The power-up test of the expansion rack(C50 CPU only) Ethernet controller failed.	1. All rack monitor block XIO PORT DIAG are set to HWFAIL, and COMPORT DIAG is set to FAIL. 2. All rack monitor block RACK OK pin are turned off. 3. All modules in the configuration have their diagnostic set to MOD_NOCOMM, their rack monitor module fail pin is turned on., and the rack monitor block's RACK OK pin is turned off. 4. ASYS block's HW OK pin is turned off. 5. The statuses for the AO, AI, DI, and DO channels that are affected are set to BAD_CHANNEL.	Replace main-CPU module

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
RS-232	GOOD	N/A	N/A	N/A	N/A
	DATA LINK FAILURE	8	A large number of messages are resulting in data link errors.	1. Rack 1 monitor block's COMPORT DIAG is set to FAILED. 2. Rack 1 monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off. 4. If configured as a Modbus master: 1. ASYS and FSYS blocks' Modbus Master Fail pins are turned on. 2. Slave and read blocks associated with the slaves experiencing the failure have their read pins frozen to the last value read. 3. Slave blocks associated with the slaves experiencing the failure have their BAD COMM and NO SCAN pins turned on. 4. IN SCAN STATUS is set to NO for all slaves experiencing the failure. 5. COMM STATUS is set to BAD for all slaves experiencing the failure. 6. The slaves with the data link errors have a non-zero data link error count. 7. The slaves experiencing the failure are moved to the background scan rate.	1. Check baud rate 2. Check connectors 3. Check cable polarity 4. Isolate cabling from electrical interference 5. If RS232 to RS485 converter is used, check its power, switch/jumper settings, and polarity. 6. If configured as a Modbus master, use the slave status screens to determine which slaves are experiencing the problem. For those slaves check: • power • connections • address • baud rate • parity • number of stop bits • for electrical interference • grounding • termination resistor (if at end of link) 7. The diagnostic is cleared by clearing the port's statistics.

Table 27 - Controller Module Diagnostics					
OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
RS-232	HW FAILURE	8	The DUART failed its power-up tests.	1. Rack 1 monitor block's COMPORT DIAG is set to FAILED. 2. Rack 1 monitor block's RACK OK pin is turned off. 3. ASYS and FSYS blocks' HW OK pins are turned off. 4. If configured as a Modbus master: 1. ASYS and FSYS blocks' Modbus Master Fail pins are turned on. 2. All Modbus slave and Modbus read blocks have their read pins frozen to the last value read. 3. All slave blocks have their BAD COMM and NO SCAN pins turned on. 4. IN SCAN STATUS is set to NO for all slaves. 5. COMM STATUS is set to BAD for all slaves in the function block diagram. 6. Statistical data for all slaves is frozen. 7. All slaves in the function block diagram are scanned at the background scan rate.	Replace CPU module
RS-485	GOOD	N/A	N/A	N/A	N/A
	See RS-232	9	*See RS-232*	*See RS-232*	*See RS-232*
NET PORT	GOOD	N/A	N/A	N/A	N/A
	NETWORK SETUP ERROR	10	Controller/network names determined on network are illegal	1. Rack 1 monitor block's COMPORT DIAG is set to FAILED. 2. Rack 1 monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off.	Correct the setup problem.
	NO IP ADDRESS	10	DHCP and IP address are not configured	*SEE NETWORK SETUP ERROR*	Enter an IP address.
	HARDWARE FAILURE	10	Ethernet port tests failed during power-up.		Replace CPU module.

Table 27 - Controller Module Diagnostics

OI Screen Item	OI Screen Item Value	Number of LED Strobes	Possible Cause	Control File Action	User Action
RACK 1 VIRTUAL CONNECT 1 – 5	GOOD	N/A	N/A	N/A	N/A
	APPLICATION ERROR	10	At least 1 response to a host resulted in an exception code	1. Rack 1 monitor block's COMPORT DIAG is set to WARNING. 2. Rack 1 monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off.	At host, determine which message is causing the exception code and fix.
PEER PORT	GOOD	N/A	N/A	N/A	N/A
	APPLICATION ERROR	10	One of the peer connection's application error count is non-zero	1. Rack 1 monitor block's COMPORT DIAG is set to WARNING. 2. Rack 1 monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off.	At host, determine which message is causing the exception code and fix.
	NETWORK SETUP ERROR	10	Controller/network names determined on network are illegal	1. Rack 1 monitor block's COMPORT DIAG is set to FAILED. 2. Rack 1 monitor block's RACK OK pin is turned off. 3. ASYS block's HW OK pin is turned off.	Correct the setup problem.
	NO IP ADDRESS	10	DHCP and IP address are not configured	*SEE NETWORK SETUP ERROR*	Enter an IP address.
	HARDWARE FAILURE	10	Ethernet port tests failed during power-up.	*SEE NETWORK SETUP ERROR*	Replace CPU module

I/O Module Diagnostics

To indicate the type of diagnostic failure, the module's status LED is flashed red with a number of quick strobes followed by a long off time. The table below outlines the potential module diagnostics.

Table 28 - Bad Module Diagnostics

Failure	Description	AI	AO	DI			DO			# of Strobes	User Action
				Con-tact	AC	DC	Re-lay	AC	DC		
FAIL SAFE	The module is in the failsafe state because it is not receiving message requests from the main CPU/Scanner at a rate equal to the value configured for its failsafe timeout.	√	√	√	√	√	√	√	√	1	1. If expansion rack(C50 CPU only), check communication link connection to main CPU 2. Remove the module and check for a bent pin, then reinsert the module. 3. Measure Power Supply voltage; if not within specifications, replace the power supply. 4. Replace the I/O Module. 5. Remove other modules and replace one at a time until the problem reoccurs. Most likely the last module inserted needs to be replaced. 6. Replace the rack.
EAROM	EA ROM Failed its checksum	√	√							2	Replace Module
RAM		√	√							3	Replace Module
ROM										4	
+24 V		√	√	√			√			5	1. Remove the module and check for a bent pin, then reinsert the module. 2. Replace module. 3. Measure 24V at test points on Power Supply. If below 21.6V, replace Power Supply. 4. Replace Rack.
FACTORY CAL	CRC failure of primary and backup factory calibration	√	√							6	Replace Module.
FIELD CAL	CRC failure of field calibration values	√	√							7	None; controller will switch card to Factory Cal.
HARDWARE	General Hardware Failure (AI=convertor not working)	√								8	Replace module.
HW/SW Key	The software residing on the module does not match the module type. This diagnostic should only result in the factory.			√	√	√	√	√	√	9	Replace module.
Shift Register	The loopback test of the shift register failed.			√	√	√	√	√	√	11	Replace module.

Bad I/O Channel Diagnostics

Below is a list of conditions that can cause a bad channel diagnostic. The associated function block's I/O status will indicate the nature of the diagnostic described in the failure column.

Table 29 - Bad Channel Diagnostics

Module Type	Failure	Description	User Action
AI	Burnout Failure	The sensor – T/C, RTD, or mV source -- is failing burnout checks.	1. Check terminal block connections 2. Replace source element 3. Replace card.
	Under range	The signal at the terminals is less than 10% below the range of the sensor.	1. Check the signal level being applied to the terminals. 2. Replace card.
	Over range	The signal at the terminals is more than 10% over the range of the sensor.	1. Check the signal level being applied to the terminals. 2. Replace card.
	Failing to convert	When attempting to take a reading, the ADC fails. This could result if the incoming signal is either too large or small. It also could result if the ADC circuit is failing. If the problem is the ADC circuit, most likely other channels will have the same failure.	1. Check the signal level being applied to the terminals. 2. Replace card.
AO	Channel Failure	The board indicates that the channel is failing to output the correct value.	1. Check terminal connections. 2. Replace module.

Scanner Diagnostic LED Indication

The scanner uses its LED to communicate diagnostic information. These diagnostics are a subset of the main CPU's and are listed below.

Table 30 - Scanner Diagnostics

Table 30 - Scanner Diagnostics				
Diagnostic Condition	Number of Strobes	Possible Cause	Scanner Action	User Action
Ram Failure	1	RAM failed on power-up.	Executes an infinite loop that toggles the LED. Communications and module scanning are disabled.	1. Cycle power 2. Replace scanner 3. Replace rack
Rom Failure	1	ROM failed on power-up.	Executes an infinite loop that toggles the LED. Communications and module scanning are disabled.	1. Cycle power 2. Replace scanner 3. Replace rack
Invalid configuration	2	The scanner has not been configured by the main CPU.	Does no scanning of modules. Modules remain in their failsafe state.	1. Verify that the jumpers on the scanner are setup for the correct rack address. 2. If a hub is used, check that all cables are properly connected to the hub, proper crossover cables are used, and that hub is powered. 3. Cycle power to the rack. 4. Cycle power to the hub. 5. Replace the expansion rack's(C50 CPU only) power supply. 6. Replace the expansion rack. 7. Replace the main CPU. 8. Replace the expansion rack's scanner board.

Table 30 - Scanner Diagnostics

Diagnostic Condition	Number of Strobes	Possible Cause	Scanner Action	User Action
Communication failure to main-CPU	2	The scanner is not receiving any messages from the main CPU.	Does no scanning of modules. Modules remain in their failsafe state.	1. Verify that the jumpers on the scanner are setup for the correct rack address. 2. Check that cable is connected to expansion rack(C50 CPU only). 3. If a hub is used, check that all cables are properly connected to the hub, proper crossover cables are used, and that hub is powered. 4. Cycle power to the rack. 5. Cycle power to the hub. 6. Replace the expansion rack's(C50 CPU only) power supply. 7. Replace the expansion rack. 8. Replace the expansion rack's scanner module. 9. Replace the main CPU.
Ethernet port data link failure	2	The communications to the main CPU is resulting in a lot of DLL errors.	Does no scanning of modules. Modules remain in their failsafe state.	1. Verify that the jumpers on the scanner are setup for the correct rack address. 2. If a hub is used, check that all cables are properly connected to the hub, proper crossover cables are used, and that hub is powered. 3. Cycle power to the rack. 4. Cycle power to the hub. 5. Replace the expansion rack's(C50 CPU only) power supply. 6. Replace the expansion rack. 7. Replace the expansion rack's scanner board. 8. Replace the main CPU.
Ethernet port hardware failure	2	The power-up test of the Ethernet controller failed.	Does no scanning of modules. Modules remain in their failsafe state.	Replace scanner module

Table 30 - Scanner Diagnostics

Diagnostic Condition	Number of Strobes	Possible Cause	Scanner Action	User Action
Watchdog Reset	3	Watchdog reset resulting from software failure	Scanner restarts and requests configuration from the main CPU.	1. Cycle power to the scanner 2. Upgrade scanner software 3. Replace scanner module 4. Contact Honeywell Personnel.
Prefetch abort CPU exception	3	CPU failed when attempting to fetch an instruction from the prefetch register.	See watchdog reset	1. Cycle power to the scanner 2. Isolate system from noise and cycle power to the scanner 3. Replace scanner module
Address error CPU exception	3	The reserved exception occurred for an unknown reason.	See watchdog reset	*See* Prefetch abort CPU exception
Undefine instruction CPU exception	3	Bad Instruction Detected	See watchdog reset	*See* Prefetch abort CPU exception
Data abort CPU exception	3	CPU failed when attempting to access data.	See watchdog reset	*See* Prefetch abort CPU exception
Software interrupt exception	3	Spurious Interrupt	See watchdog reset	*See* Prefetch abort CPU exception
Vector error	3	Interrupt vectors in RAM were corrupted	Interrupt vectors were restored	*See* Watchdog reset
Flash write error	4	Flash failed to burn properly.	The boot code is the only software running. This software waits for a request to burn the flash. It does no scanning of modules. Modules remain in their failsafe state.	Do a code download.
Rack backplane failure	6	The Scanner is unable to successfully communicate to any modules that are in its SPI backplane.	Does no scanning of modules. Modules remain in their failsafe state.	1. Remove modules and check for bent pins on connectors. 2. Reinsert modules one at a time and note which module the diagnostic reoccurs, and replace that module. 3. Cycle power to the rack. 4. Replace the power supply. 5. Replace the rack. 6. Replace the scanner module.

Table 30 - Scanner Diagnostics

Diagnostic Condition	Number of Strobes	Possible Cause	Scanner Action	User Action
High CJ temperature	6	Possible reasons for this diagnostic are: 1. One of the two CJs on the module is indicating a temperature reading greater than 70 degrees C. 2. Both cold-junction sensors are failing to convert. 3. The CJs are converting properly, but their differential is greater than 10 degrees C. (will be confirmed through experimentation).	No action is taken.	1. Improve ventilation to rack 2. Replace AI module
Wrong module	6	The module does not agree with the module required for the control scenario.	No action is taken.	1. Verify configuration 2. Replace module with the correct one.
No communication to the module.	6	The scanner is unable to communicate to the module for one of the following reasons: Module is not installed Backplane problem is inhibiting the scanner to properly communicate with the module	No action is taken.	1. Verify configuration 2. Install or replace module. 3. Check for bent pins on the module. 4. Replace the backplane.
Bad channel	6	*See* Table 29 - Bad Channel Diagnostics.	No action is taken	*See* Table 29 - Bad Channel Diagnostics.
Bad module	6	Module is reporting a diagnostic condition. *See* Table 28 - Bad Module Diagnostics.	No action is taken.	User should inspect the module's status LED to determine the nature of the problem. The table in Table 28 - Bad Module Diagnostics describes the user action for the various LED diagnostics.

Analog Calibration

Overview

All calibration data for Analog Input Modules and Analog Output Modules is stored in non-volatile memory in the I/O modules. Calibration data is stored for each channel of each AI or AO module. Calibration data for each channel can be either:

- Factory calibration, which is stored permanently in the module, and
- Field Calibration, which is entered from an HMI (OI- on the RS-485 Port, and/or a PC on the RS-232 Port and/or the Ethernet 10Base-T Port using Hybrid Control Designer software.

A field calibration procedure consists of two parts:

- Connecting a calibration device to each channel of an AI or AO module, and
- Using the Operator Interface to select actions and enter custom calibration data values calibration into the I/O module.

This section contains information and instructions for connecting calibration devices.

⚠ WARNING

Hazardous voltages exist at the Power Supply and at the terminal boards on I/O Modules

Only trained and authorized personnel should perform the procedures in this section.

Failure to comply could result in death or serious injury.

ATTENTION

For calibration procedures, refer to the Operator Interface manual or Hybrid Control Designer manual.

Analog Input Calibration

Analog input modules can accommodate five input types:

- RTD
- Thermocouple
- Ohms
- Volt and milliVolt
- 4-20 mA

Calibration values for each channel are stored in the module as numeric values paired with A/D conversion counts corresponding to those numeric values. The numeric values are those identified as 'REFERENCE' on the OI or HCD calibration displays; apply these values to the input terminals during the calibration procedure.

For AI channels configured as thermocouple inputs, the stored calibration values are compensated by the measured temperature of the terminals. Because of this observe the following rules:

- If you plan on calibrating the 2 cold junction compensation devices, perform this operation first before performing any thermocouple calibrations. However, because cold junction measurement inaccuracies will be compensated in each individual thermocouple calibration, cold junction calibration may be skipped.
- After connecting the thermocouple extension wire to the terminals, you must wait for the terminal temperature to stabilize.
- If using a compensated calibrator, input the equivalent simulated temperature values corresponding to the REFERENCE mV values. These will be the hi and low range values for the particular thermocouple configured.

Figure 56 is an adaptation of the wiring diagram given in the installation section of this manual. This figure indicates how an calibration device can be connected to the appropriate terminals of an analog input module. The calibration device(s) must have the following precision characteristics:

- TC, mVolts, Volts inputs: 1 microvolt resolution
- Ohms, RTD inputs: .01 ohm resolution
- 4-20mA inputs: 4 microamp resolution

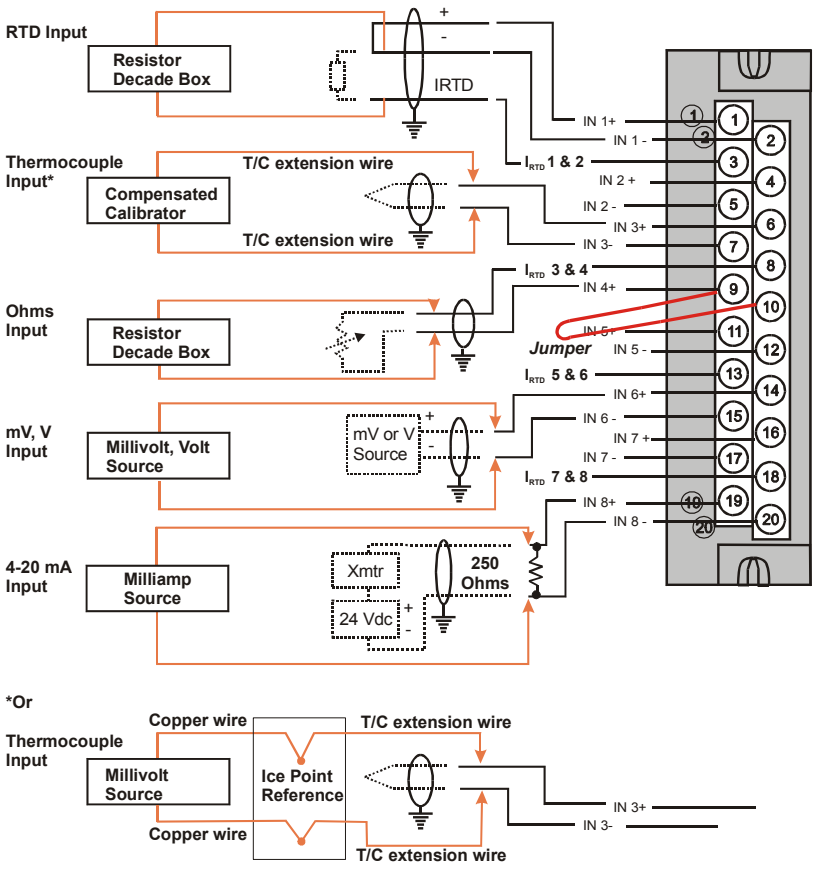


Figure 56 - Terminal Board Connections for AI Calibration

Analog Output Calibration

Analog output modules have essentially one output type.

A diagram of a precision ammeter connected to the terminals of an Analog Output module is given in Figure 57. The specifications of the meter must be consistent with calibration requirements.

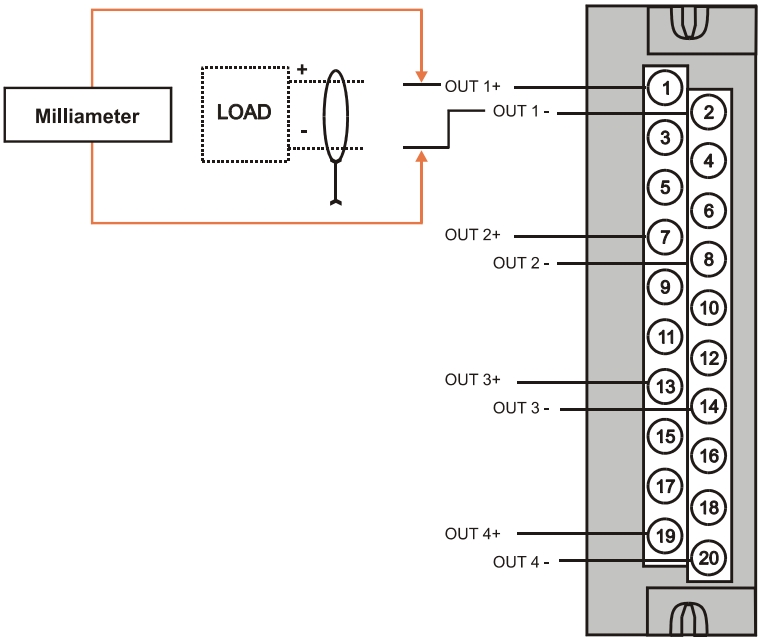


Figure 57 - Terminal board Connections for AO Calibration

Removal and Replacement Procedures

Overview

This section contains procedures for removing and replacing the active components of an HC900 Hybrid Controller. It also includes recommendations, suggestions, and hints as they apply to the circumstances under which the procedures are used.

Safety Considerations - PLAN AHEAD!

When using the procedures in this section, plan the sequence of procedural actions so as to ensure:

- The safety of personnel
- The protection of property
- The integrity of operating processes

The first consideration is safety of personnel. While there is always an inclination to preserve the materials and time invested in a running process, no action should ever be taken that would risk injury to personnel.

Protection of personnel property is an important consideration that always requires comprehensive knowledge of the entire control process: the control equipment, the process control strategy, and the conditions and circumstances that exist when the removal and replacement procedures are taken.

The procedures in this section include notices of potential hazard as they apply to various components in the controller. Because each control process and the set of conditions and circumstances at each user site are unique, it is the user's responsibility to know the potential consequences of each action as it relates to a running process.

It is recommended that the user becomes familiar with the significant aspects of each set of circumstances and has a plan for execution of the proper action sequence.

⚠ CAUTION

All of the input/output modules available for use in the HC900 Controller have a RIUP designation. That is, they can be Removed and Inserted Under Power, where "power" refers to DC power at the backplane of the rack. (It does ***not*** refer to power for field wiring at the terminal board associated with the I/O module, which ***must*** be disconnected (using a user-supplied switch) at the field device before removing or inserting the module.

For all other components of the controller, AC power to the controller must be removed before removal or replacement of the component.

⚠ WARNING

Hazardous voltages exist at the Power Supply and at the terminal boards on I/O Modules

- Only trained and authorized personnel should perform the procedures in this section.
- Disconnect all sources of power associated with these components before removal or insertion.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING **EXPLOSION HAZARD** Class 1, Division 2 Installations

- SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

⚠ WARNING **EXPLOSION HAZARD** Class 1, Division 2 Installations

- DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN NOT TO BE HAZARDOUS.

Replacing the Power Supply

The power supply for the HC900 Hybrid Controller is available in two models and is used in the local (controller) rack and in the remote (I/O expansion) racks(C50 CPU only), in 4-, 8-, and 12-module sizes. This reduces required inventories of spare parts, and also simplifies removal and replacement procedures.

Removing the power supply from a rack will remove all DC voltages from the rack that powers the Controller Module or Scanner Module, and from all I/O modules within the rack.

NOTE:
The power supply includes an internal fuse, rated at 5 amperes. This fuse is not replaceable in the field. If desired, the user can provide an external fuse that has a current rating lower than that of the internal fuse.

Table 31 - Power Supply Replacement

Step	Action
	If the power supply to be replaced is powering a rack that is currently controlling a running process, then: Either: - Ensure that powering the rack down will not have adverse consequences on any running process. Or: - Bring the process to a safe and orderly shutdown.
2.	Using an external, user-supplied switch, disconnect the power supply from the source of site AC power. Use a meter to ensure that power is off.
3.	Depending on the type of wire lugs used, loosen or remove the three screws on the terminal board, and remove the three wires from the terminal board. ***NOTE***: DO NOT remove the nut that secures the lug for the PE Ground wire (green) to the grounding stake at the bottom of the rack.
4.	At the top and bottom of the module, loosen the captured screws that secure the module in the rack, and remove the power supply from the rack.
6.	Place the new power supply in the rack.
7.	Secure the lugs for AC wiring to the terminals on the new power supply. • L1 (top terminal) - Black (USA) or Brown (Europe) • L2 /N (middle terminal - White (USA) or Blue (Europe).

Step	Action
8.	Ensure power can be applied safely, and use the external (user-supplied) switch to re-connect power to the power supply.
9.	Using a meter and the test points on the face of the power supply, ensure that voltages (measured on the backplane) are within specifications.

Replacing the Controller Module

Removing and replacing the Controller Module requires that that the source of AC power is removed from the rack. Removing power from the Controller rack has the following consequences:

- All control action stops
- All power to all I/O modules in the rack is lost; hence all control outputs to the process are lost. Because external power connected to terminal boards (from or to field devices) will still be present, it is essential that field devices are maintained in a safe condition during replacement procedures.
- Control to all I/O expansion racks(C50 CPU only) is lost. If power is available to the expansion racks, outputs go to configured Failsafe values.

Before replacement:

- (If possible), upload and SAVE a copy of the configuration, or ensure that a previously SAVEd copy of the current configuration is available.
- (If possible), bring the process to a safe and orderly shutdown.

Table 32 - Controller Module Replacement

Step	Action
1.	If a process is currently in operation, bring it to a safe and orderly shutdown.
2.	Using an external (user-supplied) switch, disconnect the power supply in the Controller rack from the site AC power source.
3.	Observe where communications cables are plugged into the Controller Module, and if necessary, tag them to identify their functions. Unplug all communications cables.
3.	At the top and bottom of the module, loosen the captured screws that secure the module in the rack, and remove the Controller Module from the rack.
4.	Ensure that the new Controller Module is properly aligned with the slot guides, insert the new Controller Module in the rack, and secure it in place with the captured screws at top and bottom of the module.
5.	Re-install communications cables.
6.	Using the (user-supplied) switch, re-connect site AC power to the rack.
	If using the Ethernet port for configuration, use the Hybrid Control Designer software to set the proper network address.
7.	Download the configuration.
8.	Set the Real-Time Clock.
9.	If all status indications are green, power may be restored to the I/O modules per the application's procedures.

Replacing the Scanner Module

Removing and replacing the Scanner Module from an I/O expansion rack(C50 CPU only) requires that the source of AC power is removed from the rack. Removing power from the Expansion rack has the following consequences:

- All power to all I/O modules in the rack will be lost; hence all control outputs from the rack to the process are lost.

Table 33 - Scanner Module Replacement

Step	Action
1.	If a process is currently in operation, then: Either: - Ensure that powering-down the expansion rack will not have adverse consequences on any running process. Or: - Bring the process to a safe and orderly shutdown.
2.	Using an external (user-supplied) switch, disconnect the power supply in the expansion rack from the site AC power source.
3.	Unplug the 10Base-T cable from the scanner.
4.	At the top and bottom of the Scanner Module, loosen the captured screws that secure the module in the rack, and remove the module from the rack.
5.	Configure the scanner address jumpers on the replacement module to match those of the removed module.
6.	Ensure that the new Scanner Module is properly aligned with the slot guides, insert the new Scanner Module in the rack, and secure it in place with the captured screws at top and bottom of the module.
7.	Re-install the 10Base-T cable.
8.	Using the external (user-supplied) switch, connect the power supply in the expansion rack to the site AC power source. The Scanner Module should resume communications with I/O modules in the rack and with the Controller Module with which it is connected.
9.	Check status indications at the Scanner Module, at the Controller Module, and at the OI.

Replacing an I/O Module

⚠ CAUTION

Read and understand all of the following information regarding RIUP before attempting to remove and/or replace any I/O module, particularly in a system that is actively controlling a process.

All of the I/O Module types in the HC900 Controller System include the Removal and Insertion Under Power (RIUP) feature. That is, while the rack is powered, any of the I/O Modules can be removed or inserted:

- With no physical damage to the module, to the rack, or to other modules in the rack
- Without disturbing the functions of ***other I/O modules*** in the rack or in the system.

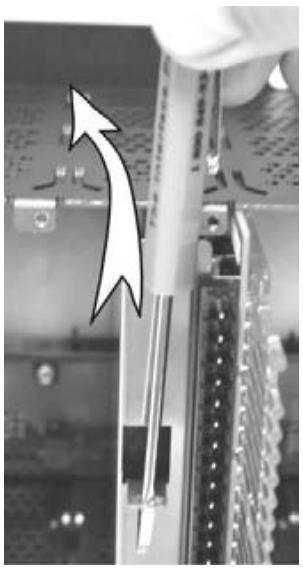
Under carefully controlled circumstances, this feature enables the user to remove and insert an I/O module without completely shutting down a running system. However, it must be recognized that removing or inserting an I/O module under power is potentially hazardous to property and to personnel.

Circumstances that dictate prudent actions depend on conditions and specific process applications at each user facility. It is the responsibility of site personnel to know all potential consequences of RIUP, and to take actions to prevent all adverse consequences before removing or inserting an I/O module under power. Table 34 provides some general guidelines for establishing appropriate procedures at a given installation.

Table 34 - RIUP: Potential Hazards and Recommended Actions

Hazard	Source	Preventive Action(s)
⚠ CAUTION Loss of control or view of a running process can cause damage to equipment and/or to process product.	Each signal at each of the terminals for an I/O module has a specific function. Any or all of the signals may be vital for safely controlling a process.	Either: Using trained personnel and appropriate control mechanisms, transfer to manual control of each signal that is necessary to maintain safe process control. Or: Bring the process to a safe stop before initiating the removal or insertion procedure.
⚠ WARNING Human contact with high voltage sources will result in death or serious injury.	Potentially lethal voltages on Terminal Blocks.	**Disconnect all signals at terminal blocks from sources of power before removing the terminal block from the I/O module.** Ensure that the Protective Earth (PE) ground is properly connected and properly functioning.

Table 35 - I/O Module Replacement

Step	Action
	⚠ CAUTION Removal or Insertion Under Power of an I/O module is an option, but if operating circumstances permit, disconnecting power from the rack is the preferred option. Plan and develop an action sequence before beginning the replacement procedure. Primary considerations include: **When replacing I/O module, the voltages to the modules must be disconnected at the field device before removing the terminal block from the module.** ***Loss of control/monitoring in a running process*** - Each signal at each of the terminals for an I/O module has a specific function. Any or all of the signals may be vital for safely controlling a process. Determine the functions of all signals to the modules and know the potential consequences of losing each. If possible, transfer control to alternate mechanisms; otherwise, bring the process to a safe and controlled shutdown.
1.	**⚠ WARNING** Disconnect all signals from power sources, using (user-supplied) switches at field devices. Use a meter to ensure that all voltages are disconnected. If a power-down replacement procedure is opted, also disconnect power from the rack, using the (user-supplied) switch in the site AC power source.
2.	Loosen the captive screws at top and bottom of the module; loosening the screws will cause the terminal block to be partly extracted from the module connector. Remove the terminal block from the module.
3.	Using the extractor loop on the cover on the module, pull the module from the slot as shown in the illustration at right. As shown in the illustration, a long flat-tip screwdriver is used as an extraction lever. Insert the screwdriver tip into the extraction tab on the front of the module cover, and rotate the screwdriver handle toward the back, using the top edge of the rack as a fulcrum. 
4.	Verify that the replacement module is of the proper type. Then, carefully insert it into the slot in the rack so as to make proper contact with the connector in the backplane.
5.	Replace the terminal block on the module.
6.	If the rack was powered-down for the procedure, restore power to the rack.
7.	Re-connect signals to field devices.

Battery Installation/Replacement

Advisory Regarding Battery Installation

Memory for the CPU in the Controller Module includes:

- Volatile memory and
- Non-volatile memory (Flash)

Only volatile RAM requires battery backup.

When power is applied to the Controller Module, the CPU is initialized automatically. If the battery is installed after initialization, and if site power is maintained, the current draw from the battery is very low - approximately 4 microamps. If site power is disconnected with the battery in place and with the CPU in the initialized state, the current draw on the battery is approximately 800 microamps. However, if the battery is installed before power is applied (and the CPU initializes), the SDRAM will draw approximately 40 milliamps.

At the 4 microamp level, the battery will retain energy over an extended period.

At the 800 microamp level, the battery will retain sufficient energy to maintain the content of SDRAM for 50 weekends (approximately 100 days) of backup service.

At the 40 milliamp level, battery life is severely reduced. The battery could be rendered useless in less than 60 hours.

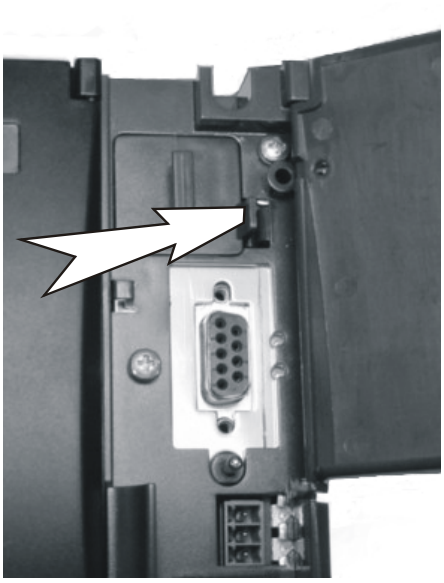
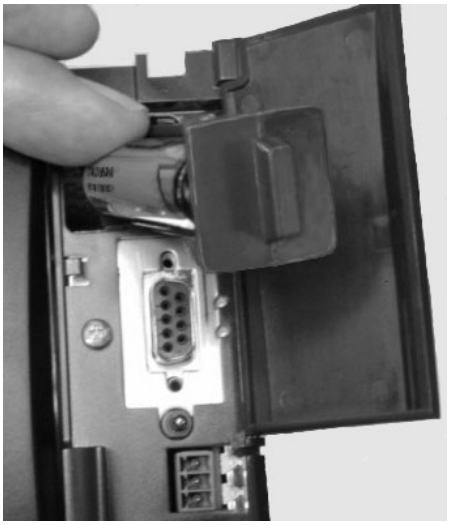
CAUTION

Installing the backup battery when the CPU is not initialized will cause undue battery drain.

Do not install or replace the backup battery until after site power is applied.

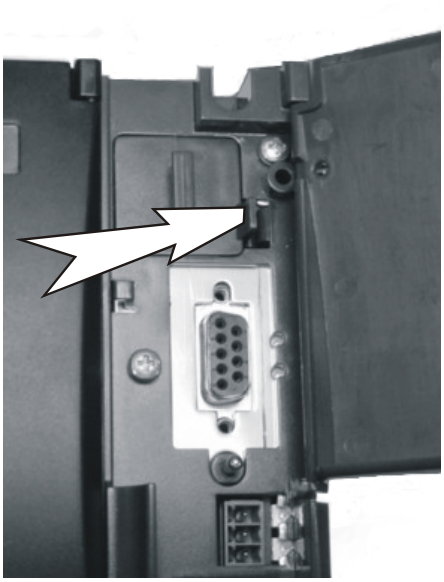
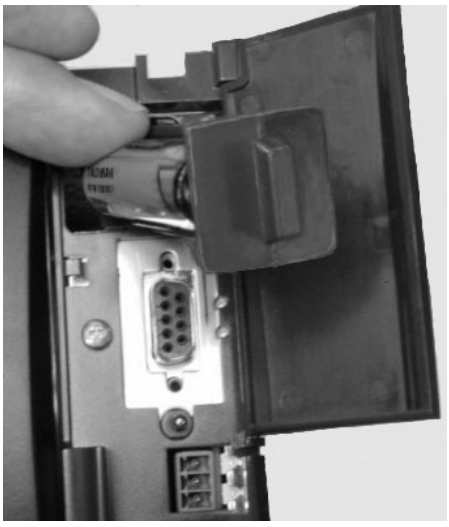
Battery Installation Procedures

Table 36 - Installing Backup Battery (CPU not initialized)

Step	Action	
1.	⚠ CAUTION Improper application of site power can cause damage to equipment. Ensure that the controller rack is ready and safe for application of AC power.	
2.	Apply site AC power to the Power Supply that is associated with the controller Module..	
3.	Open the plastic door at the top of the Controller Module. Press the latch on the battery cover to the right to release the battery holder, and use the molded-in extension on the battery holder to extract the holder. Note the orientation of the battery-holder assembly (battery toward the left).	
4.	The battery is retained in the holder by spring tension of the plastic holder itself. Insert the negative end of the battery into the back end of the holder, and press on the battery so that it snaps into the holder. To ensure that the battery is seated properly, rotate it in the holder, using finger or thumb pressure toward the positive (front) end of the battery.	
5.	While maintaining proper orientation (battery toward the left), slide the battery holder into the slot in the Controller Module until it snaps into place.	

Battery Replacement Procedures

Table 37 - Replacing a Backup Battery (CPU Powered))

Step	Action	
1.	⚠ **CAUTION** If the battery is removed from the Controller Module when AC power is not applied, the content of SDRAM will be lost. Before beginning this procedure, upload and SAVE a copy of the configuration, or ensure that a previously SAVEd copy of the current configuration is available.	
2.	Apply site AC power to the Power Supply that is associated with the controller Module..	
3.	Open the plastic door at the top of the Controller Module. Press the latch on the battery cover to the right to release the battery holder, and use the molded-in extension on the battery holder to extract the holder. Note the orientation of the battery-holder assembly (battery toward the left).	
4.	The battery is retained in the holder by spring tension of the plastic holder itself. Extract the battery from the holder by using your thumb to apply pressure to the front end of the battery, and rotating it to the left. Insert the negative end of the new battery into the back end of the holder, and press on the battery so that it snaps into the holder. To ensure that the battery is seated properly, rotate it in the holder, using finger or thumb pressure toward the positive (front) end of the battery.	
5.	While maintaining proper orientation (battery toward the left), slide the battery holder into the slot in the Controller Module until it snaps into place.	

Controller Components and modules

RACKS	NUMBER
4 I/O Slot Rack	900R04 - 0001
8 I/O Slot Rack	900R08 - 0001
12 I/O Slot Rack	900R12 - 0001

Power Supplies	
120/240VAC, 60W	900P01 -0001
120/240VAC, 28W	900P02 -0001

CPU Assemblies	
Controller C50 CPU Config.SW & Docs	900C51 - 0001
Controller C50 CPU	900C52 - 0001
Controller C30 CPU Config. SW & Docs	900C31 - 0001
Controller C30 CPU	900C32 - 0001
I/O Scanner (for remote rack)	900C53 - 0001

I/O Card Selections	
Analog Input (8 channel)	900A01 - 0001
Analog Output, 0 to 20mA, (4 channel)	900B01 -0001
Digital Input, Contact type, (16 channel)	900G01 - 0001
Digital Input, 24VDC (16 channel)	900G02 - 0001
Digital Input, 120/240 VAC, (16 channel)	900G03 - 0001
Digital Output, Relays (8 channel)	900H01 - 0001
Digital Output, 24VDC (16 channel)	900H02 - 0001
Digital Output, 120/240 VAC (8 channel)	900H03 - 0001

Terminal Boards	
Low VoltageTerminal Block (Euro style)	900TEK - 0001
Low VoltageTerminal Block (Barrier Style)	900TBK -0001
High VoltageTerminal Block (Euro style)	900TER - 0001
High Voltage Terminal Block (Barrier Style)	900TBR - 0001
Filler Block Terminal Cover	900TNF - 0001
Shield Terminal Strip (package of 2)	900TSS - 0001
Terminal board jumpers (10, two pos jumpers)	900J02 - 0001
Terminal board jumpers (10, ten pos.jumpers)	900J10 - 0001

Manuals	
Full Document set on CD	900ME1-0001
Full document set, hard copy - Engish	900ME2-0001

Software	
HC Designer Config. Software CD	900W01 - 0001

Specifications

HC900 Hybrid Controller Design

Controller Module Feature	Description
CE Conformity (Europe)	This product is in conformity with the protection requirements of the following European Council Directives: 73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed. EN61326: Electrical Equipment For Measurement, Control and Laboratory use. EMC requirements.
Installation Category (Over-voltage Category)	Category II: Energy-consuming equipment supplied from the fixed installation (Multi-loop Process Controller). Local level appliances, and Industrial Control Equipment. (EN 61010-1)
Pollution Degree	Pollution Degree 2: Normally non-conductive pollution with occasional conductivity caused by condensation. (ref. IEC 664-1)
EMC Classification	Group 1, Class A, ISM Equipment
Product Classification	Class I: Fixed, Permanently Connected, Industrial Process Control Equipment with protective earthing (grounding). (EN 61010-1)
Power, per rack **Controller Rack**	Voltage: Universal power, 90 to 264 Vac, 47 to 63Hz Rating: 130VA @ 264VAC, typical 110VA @ 115VAC In-rush current: 7 amps peak-to-peak for 150 ms at 240 Vac Variable; depends on I/O Module complement.

Controller Module Design

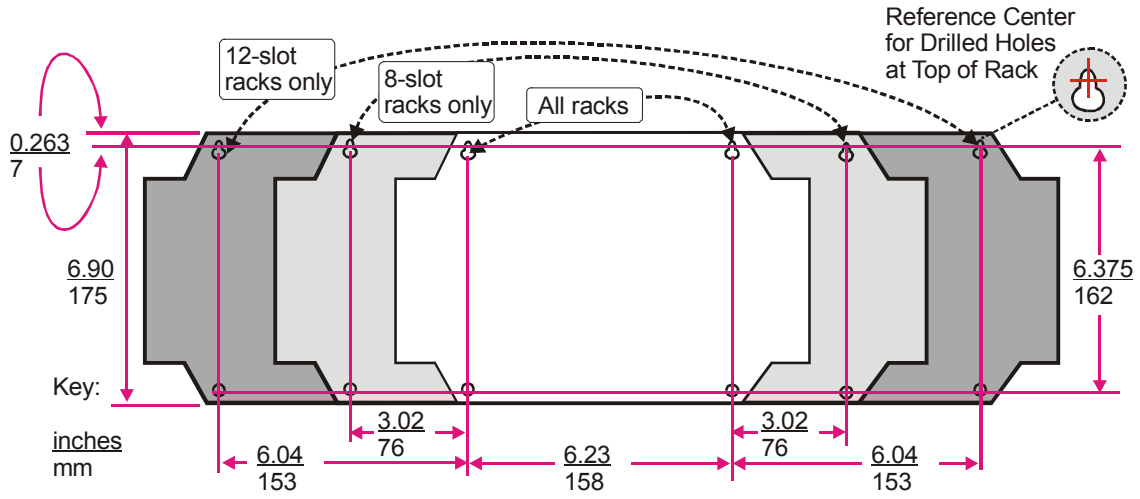
Controller Module Feature	Description
Module design	Plug-in module: CPU, memory (RAM and Flash PROM), DUART for RS-232 and RS-485, communications connectors, backplane connector, Real-Time Clock, and support components on a single wiring board.
CPU	NetArm-40; 33 MHz RISC-based processor Includes: embedded MAC for Ethernet support; 6 DMA channels (including 2 dedicated for MAC support)
BUS	**Model C30** -16-bit Address and Data Bus (PROM and RAM) **Model C50** -32-bit Address and Data Bus (PROM and RAM)
Memory	**Model C30:** RAM: 8 megs SDRAM Flash (PROM): 2 megs Dual Backed **Model C30:** RAM: 16 megs SDRAM Flash (PROM): 4 megs Dual Backed
Real-Time Clock	On-board RTC; output is distributed in system
Battery-Backup	Lithium AA-cell, 3.6 Volt TADIRAN® or equivalent; protects RAM for 100 days.
Input/Output	I/O Backplane connector: 40-pin Samtec connector - - Receives power (5 Vdc and 24 Vdc) from power supply - Serial Peripheral Interface (SPI) for I/O Modules in Local Rack - diagnostic sensing for I/O slots in this rack
Status Indicators	Controller Status: Bi-Colored LED Communications status: two indicators per communications port
Communications	RS-232 Port: 1/2 DUART; 9-pin "D" connector - • connects to PC configuration tool via Null-Modem cable (up to 50'), or via straight cable to modems and telephone connections. Baud: 9600, 19.3k, or 38.4k (configured from operator interface) • connects to any Modbus slave or master device RS-422/485 Port: 1/2 DUART; 3-pin connector (Phoenix 1840379 or equivalent) - • connects to the Operator Interface (up to 2000 feet, using Belden 9271 or equivalent) • connects to any Modbus slave or master device Ethernet 10Base-T Port: to Open connectivity network. RJ45 connector on CAT 5 cable; Connects to PC (HMI) via crossover cable (up to 100 meters), or to a third-party networking device using straight cable (up to 100 meters). Ethernet 10Base-T Port to I/O expansion network (C50 CPU only). RJ45 connector on CAT 5 cable; connects I/O on Controller Module to: - Scanner Module on one I/O expansion rack, or to - third-party networking device, which can connect to up to four I/O expansion racks. Networking device enables use of 100 meters of additional cable; a second in-line networking device enables additional 100 meters of cable, for 300 meters (984 feet) maximum distance between controller and I/O expansion rack.

Scanner Module Design

Controller Module Feature	Description
Module design	Plug-in module: CPU, memory (RAM and Flash PROM), communications connector, backplane connector, and support components on a single wiring board.
CPU	33 MHz RISC-Based Processor Includes: embedded MAC for Ethernet support; 6 DMA channels (including 2 dedicated for MAC support)
Memory	RAM: 8 Megs SDRAM Flash (PROM): 2 Megs Dual Backed Flash Memory
Bus	16-Bit Address and Data Bus (PROM and RAM)
Communications	Ethernet 10Base-T Port: RJ45 connector on CAT 5 cable; connects I/O on Scanner Module to: - Controller Module, or to - third-party Hub
Status Indicators	Scanner Status: Bi-Colored LED
Input/Output	Backplane: 40-pin Samtec connector - - Receives power (5 Vdc and 24 Vdc) from power supply - Serial Peripheral Interface (SPI) for I/O Modules in Local Rack - diagnostic sensing for I/O slots in this rack

Rack Design

Rack Features	Description
Remote I/O configuration	Enables placement of I/O Modules near field devices.
Variable capacity	Available in three sizes (I/O module capacity): 4-slot, 8-slot, and 12-slot.
Multi-purpose applicability	Racks are made in one basic design, and any 4-slot, 8-slot, or 12-slot rack can be used either as a Controller (local) rack or as an I/O expansion (remote) Rack(C50 CPU only)
Power Supplies	Power Supplies (shipped separately) are identical for controller and I/O expansion racks(C50 CPU only), and are located identically at left of rack.
Input/Output	Backplane connectors - - 20-pin connectors for each I/O module - 40-pin connectors for Controller Module or Scanner Module
Mounting; dimensions	Mounting holes are in standardized patterns, as shown in the diagram below.



Input Output System: Common Features

I/O Feature	Description
Slot locations	Any I/O slot in any rack (Controller or I/O expansion) can accommodate any module type available for use in the HC900 system. Also, racks can accommodate any mix of modules within constraints regarding power availability.
Rack Complement	Power supplies are identical for all racks. Scanner modules are identical for IO Expander racks(C50 CPU only).
I/O Module Pin Output (to terminal block)	Every module has the same 20-pin (inline) connector on the printed wiring board, that mates with either style of wiring terminal board available for the HC900.
Terminal Block Types	Two types are available: 20-connector barrier strip or 20-connector "Euro" style. Both styles fit any type of I/O module available for the HC900 System. Blocks have color code: red block, with tin plating on terminals for higher voltages, and black with gold plating for lower voltages. Coding system applies to both block types.
Hardware keying	Key matches module to connector, ensuring correct board replacement
Color-coded Label	Every terminal board assembly includes a hinged door that accommodates a color-coded, pre-printed label. Eight label types are available (label type per I/O module type).
Intelligent Module	All I/O modules include microcontrollers for handling communications with the Controller Module, and for performing and reporting diagnostics
Light Pipes	All I/O modules include an integrated set of light pipes on the back of the circuit board that convey: - Status of the module (Tri-color) - for digital modules, activity status of each channel (in green)
Metal cover w/extractor	All modules include a metal cover that protects the front of the board. The metal cover includes a formed-in loop at front for module extraction.
Remove and Insert Under Power (RIUP)	Standard. Modules are automatically sensed and configured on insertion. Field power shall be disconnected before removing terminal blocks.

Analog Input, Analog Output Modules: Common Features

Feature	Description
Micro Controller	Motorola 68HC11 micro controller 12k One-time programmable PROM built-in diagnostics

Analog Input Module

Feature	Description
Input types	RTD, T/C, Ohms, mV, Volt, mA. See Table 38 for PV Input types and ranges.
Input Impedance	10 megohms for T/C and mV inputs; > 1 megohm for volts and 250 ohms for mA inputs
Number of inputs	8 per module
Input Device	Photo-MOSFET Relay
Isolation	400 Vdc point-to-point, solid state switching; 1k Vdc to logic RTDs are isolated in pairs (I_{RTD} is common to two inputs.)
Noise Rejection	Series mode > 60dB Common mode > 130 dB at 120 Vac
Burnout	T/C, mV, V (except for following ranges) are configurable for Upscale, Downscale, Defined Value, or None: *Volt:* -500 mV to 500 mV; -1 V to 1 V; -2 V to 2 V; -5 V to 5 V; 0 V to 10 V; -10 V to 10 V; inherent to zero volt *RTD:* Inherent Upscale *MA*: Inherent Downscale
T/C Break Detection	Via current pulse
Faulty thermocouple detection	If greater than 100 ohms, a warning status is provided as an output for the AI block
Accuracy	Factory configured accuracy - ± 0.1% of range Cold Junction accuracy = ± 0.5% of range Field calibration accuracy = ± 0.05% of range *Reference conditions:* Temperature = 25 °C ± 3 °C (77 °F ± 5 °F) Humidity = 45% to 55% RH non-condensing Line voltage = Nominal ± 1 % Source resistance = ohm Series mode and common mode = 0 V Frequency = Nominal ± 1 %
Temp. effect on Accuracy	±0.01% of full scale/°C
A/D converter	One per card

Feature	Description
A/D resolution	15 bits
Reference Junction Sensing	Via 2 RTDs at top/bottom of module
Update rate	500 ms (Analog to digital converter per module)
Long Term stability	0.1% per year
Channel Configuration Data	Stored in non-volatile memory.
Calibration Data	Data is stored in non-volatile memory Redundant Factory Calibration Individual Channel Field Calibration
Diagnostics	Monitoring of Factory Calibration, Field Calibration, 24 Vdc supply, and configuration.
Channel Configuration Data	Stored in non-volatile memory.

Analog Output Modules

Feature	Description
Number of outputs	4 isolated outputs per module
Isolation	500 Vdc Channel-Channel 600 Vdc from logic
Output device	MOSFET
Load resistance	0 to 750 ohms
Accuracy	0.1% of full scale at reference conditions
D/A Resolution	12 bits
Output Current	0 to 21.8mA into 0 to 750 Ohms, range selectable
Minimum current sensing	> 3.5 mA per output
Calibration Data	Data is stored in non-volatile memory. Redundant Factory Calibration, with automatic rejection of Bad version Individual Channel Field Calibration
Failsafe Outputs	Timeout causes outputs to be forced to configured values.
Diagnostics	Monitoring of Factory Calibration, Field Calibration, Configuration, and +24 Vdc power supply.
Output Verification	Feedback to CPU that indicates output current flowing.

Digital Input Modules; Common Features

Feature	Description
Micro controller	Atmel 8515 RISC architecture 8k Flash PROM
Hardware/software keying	Key matches module to terminal block connector, ensuring correct board replacement
Status indicator	Tri-color LED: Green - Good Yellow - at least one input is Forced Red - Fault
LED status indicators	Via light pipes at front of card for each digital I/O point - green indicates On, logic side
Filtering	Hardware and software filtering on inputs
Number of Inputs	16

Contact Input Module

Feature	Description
Input group	16 inputs, in one group (single-ended)
Power	230 mA max for 5V; 40 mA for 24V
Open contact voltage	17.85 V max; 15 V nominal (supplied by Power Supply in rack))
Input impedance	5360 Ohms nominal
Input Current	2.0 mA min.,
Contact Resistance	ON: 1000 Ohms, Max OFF: 150 K ohms, Min
Response Time	OFF to ON: 4ms max; 2ms nominal ON to OFF: 6ms max; 5ms nominal
Switching Current	2.6 mA

DC Input Module

Feature	Description
Inputs	16 (sinking)
Input Voltage Range	10 Vdc to 32 Vdc
Peak Voltage	32 Vdc
Isolation	2 groups of 8 inputs/group; dielectric strength between groups: 42.4 Vdc (30 Vac)
ON voltage level	9.5 Vdc minimum
OFF voltage level	3.5 Vdc maximum
Input impedance	2.6k ohms nominal
Input current	2.3 mA @ 12 Vdc 6.9 mA @ 24Vdc nominal
Minimum On current	3.5 mA
Minimum Off current	1.5 mA
Base Power Required	230 mA maximum for 5 Vdc; (no 24 Vdc power)
Response Time	OFF to ON: 4 ms maximum; 2 ms nominal ON to OFF: 4 ms maximum; 2 ms nominal

AC Input Module

Feature	Description
Inputs	2 isolated groups of 8 inputs each
Input voltage range	80 to 240 Vac
Peak voltage	264 Vac
AC frequency	47 to 63 Hz
Isolation	2 groups of 8 inputs/group; dielectric strength between groups: 500 Vdc (350 Vac)
ON voltage level	75 Vac minimum
OFF voltage level	20 Vac maximum
Input Impedance	48 K ohms
Input current	1 mA @ 120 Vac, 60 Hz; 2 mA @ 230Vac, 50 Hz
Minimum On current	5 mA
Maximum Off current	2 mA
Base power required	230 mA maximum for 5VDC (no 24VDC power)
Response Time	OFF to ON: 34 ms maximum ON to OFF: 50 ms maximum
Software filtering	Specific to 50/60 Hz line frequency

Features Common to all Output Modules

Feature	Description
Micro Controller	Atmel 8515 RISC processor 8k Flash PROM
Hardware/software keying	Key matches module to terminal block connector, ensuring correct board replacement
Output Diagnostic	Checks output driver ICs
Status indicator	Tri-color LED: Green - Good Yellow - at least one output is Forced Red - Fault
LED status indicators	Via light pipes at front of card for each digital output point green indicates On, logic side

DC Output Module

Feature	Description
Outputs	16 (current sinking, low side)
Isolation	2 groups of 8 outputs/group
Operating Voltage	6.5 to 32 Vdc (5.0 to 6.5 V @ < 0.5 A per channel)
Output type	Intelligent Power Switch (IPS)
Peak Voltage	34Vdc
On-State Voltage drop	0.3 Vdc @ 1 A load
Overload Protection	Electronic high-current and high temperature limiting, resets after cycling field power
Maximum Load Current	1 A per point, 8 A max. per card, resistive load
Maximum Leakage Current	0.15 mA @ 32 Vdc
Maximum In-rush Current	4 A for 10 ms
Minimum Load	0.0 mA
Base Power Required	426 mA @ 5 V
Response Time	Off to On: 10 ms On to Off: 5 ms
Fuses	Electronic limiting

AC Output Module

Feature	Description
Outputs	8
Isolation	Per output; Jumper comb is available for connecting "L1" terminals
Operating Voltage	85 Vac to 240 Vac
Output type	Triac
Peak Voltage	250 Vac
AC Frequency	47 to 63 Hz
Transient Over-voltage Protection	MOV
ON-Voltage drop	< 1.5 Vac (> 0.1 A) < 3.0 Vac (< 01. A)
Maximum Load Current	2 A per point, 8 A max. per module, resistive load
Maximum Leakage Current	4 mA (240 Vac, 60 Hz) 1.2 mA (100 Vac, 60 Hz) 0.9 mA (100 Vac, 50 Hz)
Maximum In-rush Current	60 A for 10 ms
Minimum Load	50 mA
Base Power Required	218 mA @ 5V
Response Time	Off to On: 2 ms + 1/2 cycle On to Off: 2 ms + 1/2 cycle
Fuses	Replaceable; Wickmann part #3741315041. 3.15 Amp time lag fuse with UL/CSA approval for 250 VAC

Relay Output Module

Feature	Description
Relays per Module	Form-A: 4 Form-C: 4
Output Device	Electro-mechanical relay
Voltage	120/250 Vac, 30 Vdc
Contact Current Rating	4 A @ 250 Vac, 30 Vdc resistive load
Max. Leakage Current	1 mA @ 350 Vdc
Minimum Load	0 mA
Base Power Required	140 mA @ 5 V 100 mA @ 24 V

Environmental and Operating Conditions

Parameter	Reference	Rated	Extreme	Transportation and Storage
Ambient Temp. **°F** **°C**	 77 ± 5 25 ± 3	 32 to 131 0 to 55	 32 to 140 0 to 60	 –40 to 151 –40 to 66
Ambient Relative Humidity *	10 % to 55 % RH non-condensing	10 % to 90 % RH non-condensing	5 % to 90 % RH non-condensing	5 % to 95 % RH non-condensing
Mechanical **Acceleration** **Duration**	 0 g 0 ms	 1 g 30 ms	 5 g 30 ms	 20 g 30 ms
Vibration **Power**	10 Hz to 60 Hz—amplitude 0.07 mm (peak-to-peak) 60 Hz to 150 Hz—acceleration 1 g Voltage Frequency Power Consumption	0 Hz to 14 Hz—amplitude 2.5 mm (peak-to-peak) 14 Hz to 250 Hz—acceleration 1 g 100 V to 240 V (24 V optional) 50/60 Hz 110 VA typical 115VAC		

*Relative Humidity is de-rated above 40 °C.

Module "T" Rating for Class 1, Div. 2, groups A, B, C, D

Analog Input Module – 8 channel	T6
Digital Input, Contact type, 16 channel	T5
Digital Input, 24Vdc type, 16 channel	T4
Digital Input, 120/240 Vac, 16 channel	T3C @ Ta=60°C T4 @ Ta=40°C
Analog Output, 4 channel	T5
Digital Output, Relay type, 8 channel	T5
Digital Output, 24Vdc, 16 channel	T4
Digital Output, 120/240Vac, 8 channel	T4

HC900 Analog Input Ranges vs. UMC800 Analog Input ranges

Users of UMC800 Controllers from Honeywell will find the analog range selections of the HC900 Controller differ slightly from those available in the UMC800. These differences are indicated in Table 38 in the column identified "(Reference): Corresponding UMC800 Input type and range". The number to the right of the range data indicates the range number reference for the UMC800 range table.

When using the Hybrid Control Designer configuration software to convert UMC800 configuration files to HC900 configuration files, the HC900 range to the left of the UMC800 data will be used by the conversion program. There may also be UMC800 ranges that are not supported by the HC900 Controller. For these ranges the conversion process will default the range data to a null, not-programmed, range.

Table 38 - HC900 PV Input Types and Ranges

Type	Range Low	Range High	EU	(Reference): Corresponding UMC800 Input type and range
None				n/a
B	-18	1815	C	B 40 1820 C 58
B	0	3300	F	B 104 3308 F 59
E	-270	1000	C	n/a
E	-454	1832	F	n/a
E	-129	593	C	n/a
E	-200	1100	F	n/a
J	-18	871	C	J –200 870 C 4
J	0	1600	F	J –328 1598 F 5
J	-7	410	C	J 0 400 C 2
J	20	770	F	J 32 752 F 3
K	-18	1316	C	K 0 1200 C 16
K	0	2400	F	K 32 2192 F 17
K	-18	982	C	K 0 800 C 14
K	0	1800	F	K 32 1472 F 15
K	-29	538	C	K 0 400 C 12
K	20	1000	F	K 32 752 F 13
Ni-NiMo	0	1371	C	NiMo 0 1400 C 50
Ni-NiMo	32	2500	F	NiMo 32 2552 F 51
Ni-NiMo	0	682	C	n/a
Ni-NiMo	32	1260	F	n/a
NiMo-NiCo	0	1371	C	MoCo 0 1400 C 110
NiMo-NiCo	32	2500	F	MoCo 32 2552 F 111
NiMo-NiCo	0	682	C	n/a
NiMo-NiCo	32	1260	F	n/a
NiCroSil-NiSil	-18	1300	C	N 0 1200 C 24
NiCroSil-NiSil	0	2372	F	N 32 2192 F 25
NiCroSil-NiSil	-18	800	C	N 0 800 C 22
NiCroSil-NiSil	0	1472	F	N 32 1472 F 23

Type	Range Low	Range High	EU	(Reference): Corresponding UMC800 Input type and range
R	-18	1704	C	R -20 1760 C 28
R	0	3100	F	R -4 3200 F 29
S	-18	1704	C	S 0 1600 C 30
S	0	3100	F	S 32 2912 F 31
T	-184	371	C	T –200 400 C 40
T	-300	700	F	T –328 752 F 41
T	-129	260	C	T -50 150 C 34
T	-200	500	F	T -58 302 F 35
W_W26	-20	2320	C	W_W26 -20 2320 C 52
W_W26	-4	4200	F	W_W26 -4 4208 F 53
W5W26	-18	2316	C	W5W26 -20 2320 C 54
W5W26	0	4200	F	W5W26 -4 4208 F 55
W5W26	-18	1227	C	n/a
W5W26	0	2240	F	n/a
Platinel	0	1380	C	PLTNL 0 1380 C 118
Platinel	32	2516	F	PLTNL 32 2516 F 119
Platinel	0	750	C	PLTNL -70 750 C 116
Platinel	32	1382	F	PLTNL -94 1382 F 117
Pt100	-184	816	C	Pt100 –200 800 C 68
Pt100	-300	1500	F	Pt100 –328 1472 F 69
Pt100	-184	649	C	n/a
Pt100	-300	1200	F	n/a
Pt100	-184	316	C	Pt100 -50 150 C 60
Pt100	-300	600	F	Pt100 -58 302 F 61
Pt500	-184	649	C	n/a
Pt500	-300	1200	F	n/a
Pt1000	-40	260	C	Pt1000 –50 400 C 120
Pt1000	-40	500	F	Pt1000 –50 752 F 121
JIS100	-200	500	C	JIS -200 500 C 78
JIS100	-328	932	F	JIS -328 932 F 79
JIS100	-200	260	C	JIS 0 100 C 72
JIS100	-328	500	F	JIS 32 212 F 73
Cu10	-20	250	C	Cu10 -20 250 C 84
Cu10	-4	482	F	Cu10 -4 482 F 85
YSI405	10	37.8		n/a
YSI405	50	100		n/a
Ohms	0	200		Ohms 0 200 86
Ohms	0	500		n/a
Ohms	0	1000		n/a
Ohms	0	2000		Ohms 0 2000 87
Ohms	0	4000		n/a

Type	Range Low	Range High	EU	(Reference): Corresponding UMC800 Input type and range
MA	4	20		mA 4 20 100
MA	0	20		mA 0 20 99
MV	0	10		mV 0 10 88
MV	0	50		mV 0 50 92
MV	0	100		mV 0 100 95
MV	-10	10		mV -10 10 89
MV	-50	50		mV -50 50 93
MV	-100	100		mV –100 100 96
MV	-500	500		mV –500 500 98
V	0	1		V 0 1 101
V	0	2		V 0 2 103
V	0	5		V 0 5 105
V	0	10		V 0 10 108
V	1	5		V 1 5 107
V	-1	1		V -1 1 102
V	-2	2		V -2 2 104
V	-5	5		V -5 5 106
V	-10	10		V -10 10 109
Carbon	0	1250	mV	n/a
Oxygen	-30	510	mV	n/a

System Sizing Summary

Alarms	240
Alternator Blocks	6 max.
Analog Inputs	Model C30 - 96 points max Model C50 - 128 points max.
Analog Outputs	Model C30 - 48 points max Model C50 - 64 points max.
Block Config. Parameters	18,000
Block Dynamic Parameters	16,000
Block Inputs	8,000
Digital I/O	Model C30 - 192 points max Model C50 - 512 points max.
Events	64
Function blocks	Model C30 – 400 max Model C50 – 2000 max.
Loops	Model C30 – 8 max Model C50 – 32 max.
Numeric Constants	500
Peer connections	8
Peer Data registers	1024/controller
Recipes	50 max.
Segments per Profile	50
Sequencers	4 max.
Sequences	20 max.
Set point Profiles	99
Setpoint Programmers	8 max.
Setpoint Schedulers	2 max.
Setpoint Schedules	20
Signals	2000
Softwire bytes	Model C30 – 34,000 Model C50 – 168,000
Steps per Schedule	50
Steps per Sequence	64 max.
Tag Descriptors	1500
Text bytes	44,000
Total I/O	Model C30 – 192 points Model C50 – 512 points
Variables	600
Variables per Recipe	240

Appendix A
Site Planning Documentation Aids

Overview

This appendix contains aids for installation planning; these include:

- An example of a set of site diagrams that suggest methods of showing:
  - Placement of enclosures for controller components relative to process equipment, and placement of enclosures ("closets") for networking components
  - Network diagrams that show methods, routes, components, and configuration details
- A set of templates that are intended to collect and to organize data required for both hardware and software configuration.

Site Map and Network Diagram

Each Site Map is unique; it shows the specific physical placement of process equipment and process control equipment in a given facilities environment. Hence, it isn't practical to provide a template in this manual, and a custom Site Map drawing must be generated for the user's facility.

As a suggestion for content and style of a Site Map, an example is provided in Figure 58. This example is based on the multiple-controller configuration illustrated in Figure 3 of this manual, and includes the networking components shown in Figure 59, below in this Appendix.

Each Network Map is unique; it shows the connections and relationships between network components included in the hierarchy of networks at the user's site. A Network Map should be generated by the IT/MIS personnel who plan and install the system of networks, and should be updated and maintained to reflect any changes to the networking system. This is particularly important when more than one networking service agency is employed.

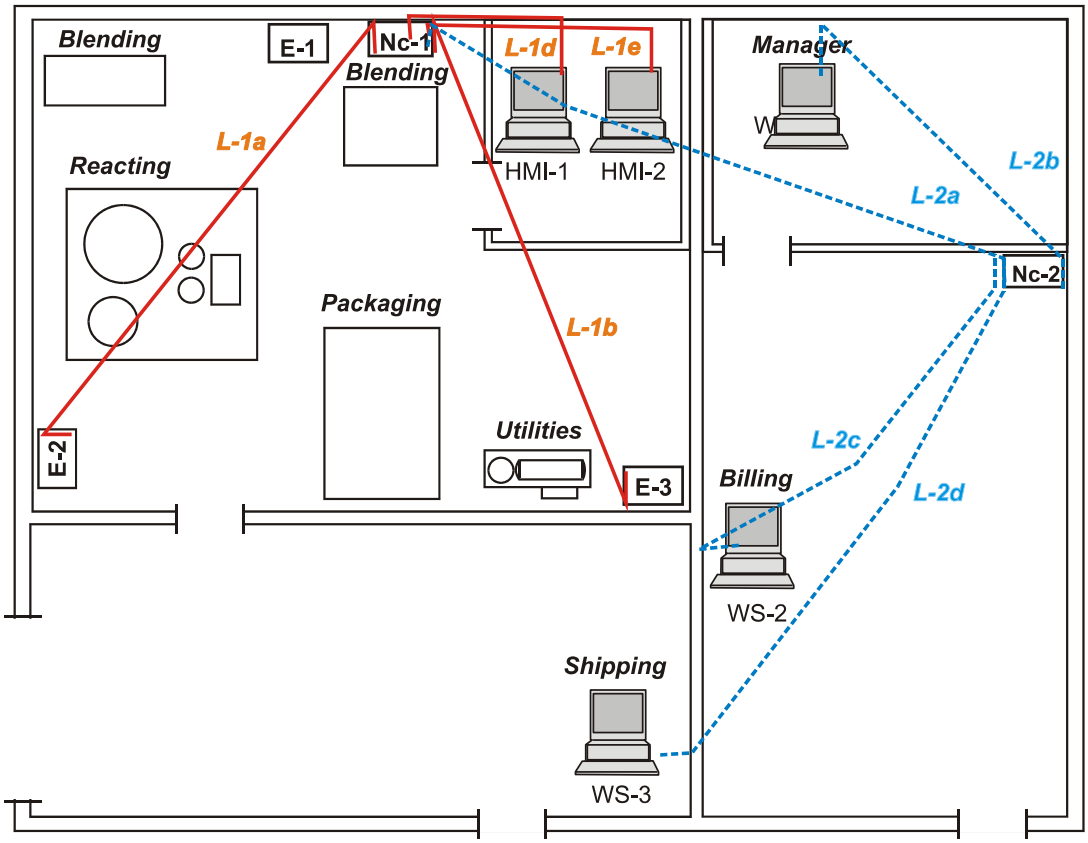
As a suggestion for content and style of a Network Map, an example is provided in Figure 59. This example is based on the same multiple-controller configuration illustrated in Figure 3 of this manual, and corresponds to the Site Map shown in Figure 58 in this Appendix.

Configurator Templates

Configurator templates are provided (following Figure 59) for convenience in collecting and organizing configuration data. These templates include:

- HC900 Controller Configurator
- I/O Module Configurator
- I/O Module Channel Assignment Configurator
- Peer Network Configurator

It is recommended that these configurator sheets be copied and completed for each controller, for each rack and each I/O module in each controller, and for each peer network to be installed at the user's site. The data collected on these sheets will be very useful in performing and coordinating installation and software configuration tasks.



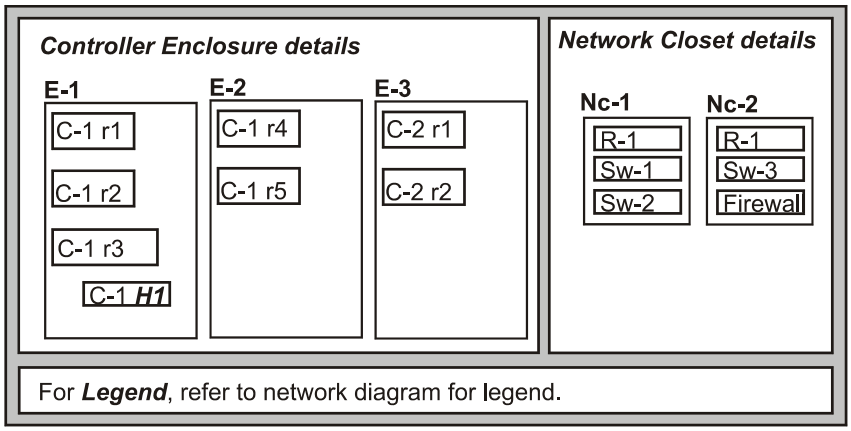
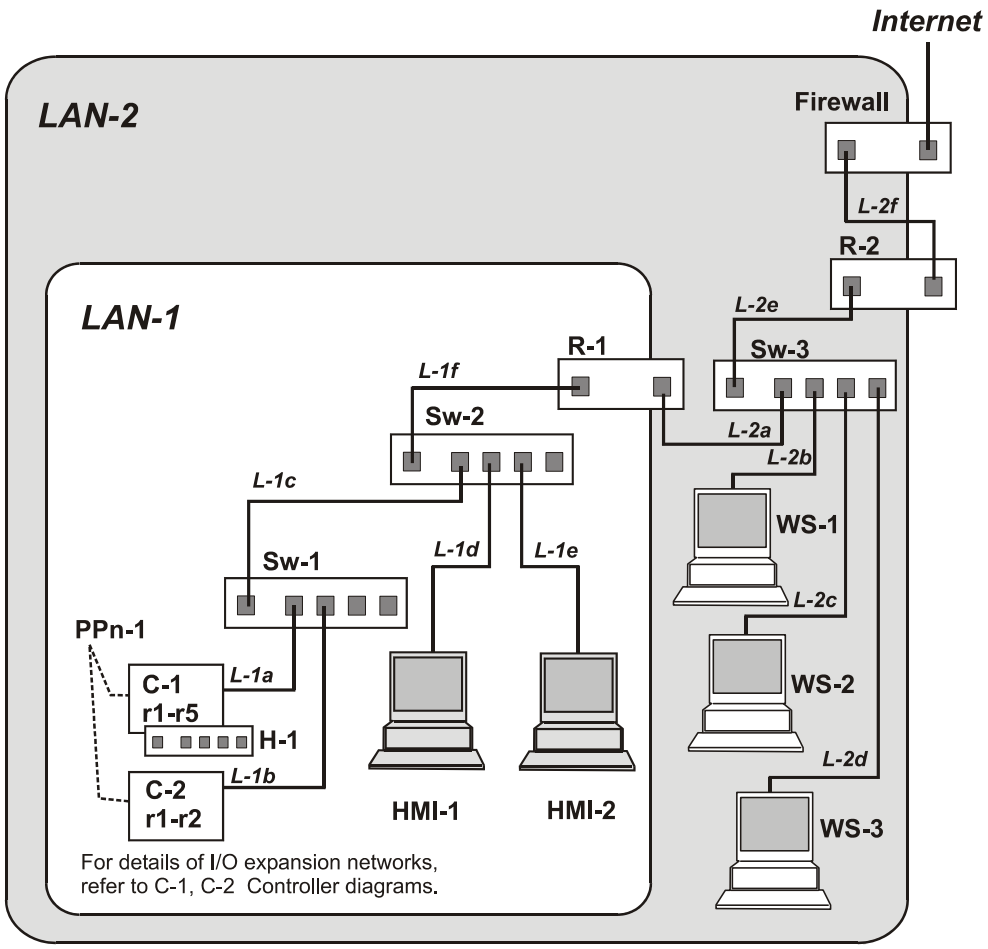


Figure 58 - Example Site Map - Equipment Placement

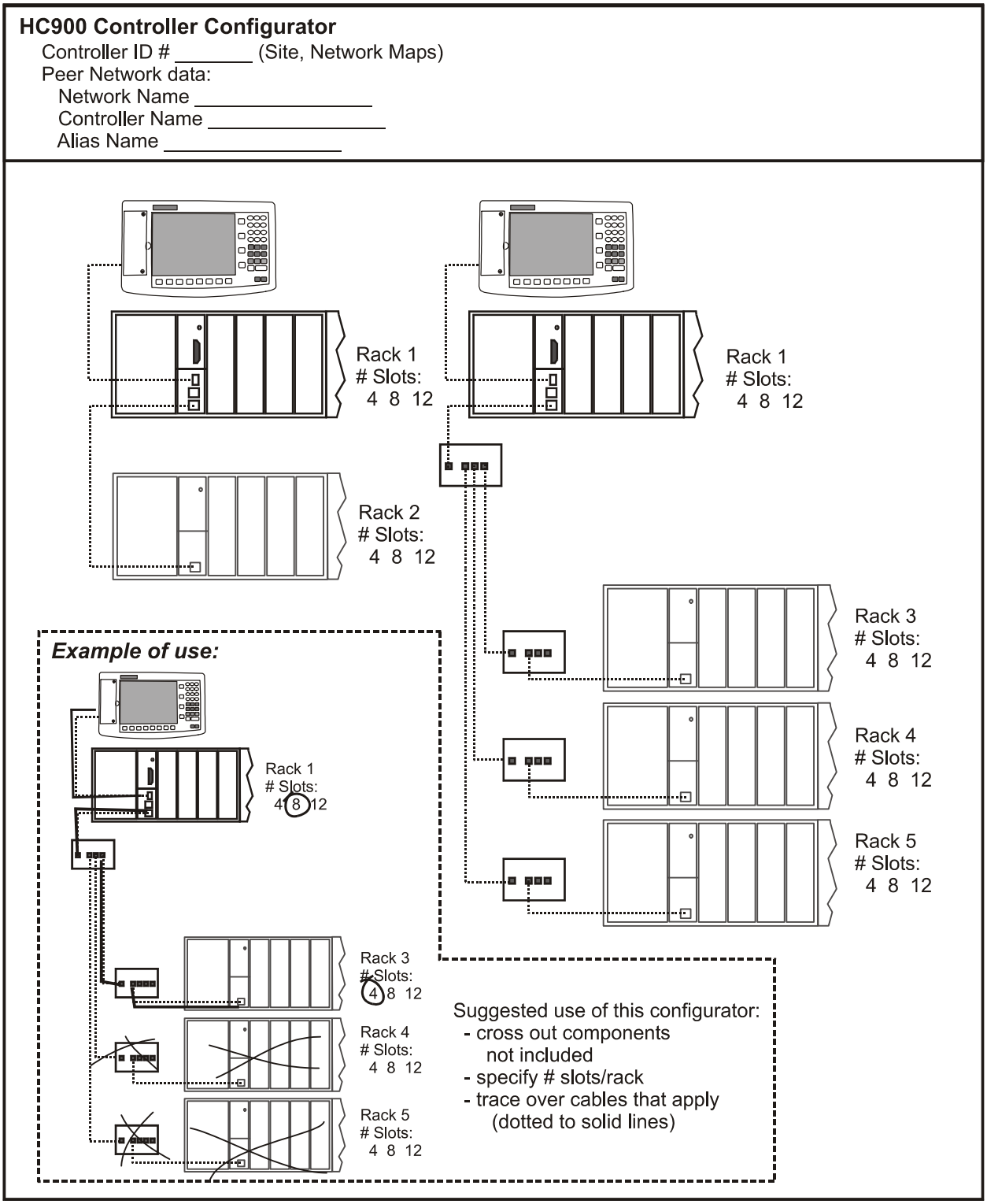


Legend:

C-n = Controller ID number
rn = rack ID number
Sw-n = Switch ID number
Rn = Router ID number
HMI-n = Human-Machine Interface ID number
WS-n = Work Station ID number
L-nx = LAN ID number, cable segment number
H-n = Hub ID number

Figure 59 - Example Network System Diagram

HC900 Controller Configurator



I/O Module Configurator

Controller # _____ [1]**; Process Area _____** [2]

IP Address |_|_|_| . |_|_|_| . |_|_|_|. |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_|
Peer Network Name |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| (up to 16 ASCII char's)
Peer Network Controller Name |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| (up to 16 ASCII char's)
Alias Name |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| (up to 16 ASCII char's)

Rack # 1 Enclosure ID: _____ [3]

Module # [4]	1	2	3	4	5	6	7	8	9	10	11	12
Module Type [5]												
Jumper comb [6]												

Rack # 2 Enclosure ID: _____ [3]

Module # [4]	1	2	3	4	5	6	7	8	9	10	11	12
Module Type [5]												
Jumper comb [6]												

Rack # 3 Enclosure ID: _____ [3]

Module # [4]	1	2	3	4	5	6	7	8	9	10	11	12
Module Type [5]												
Jumper comb [6]												

Rack # 4 Enclosure ID: _____ [3]

Module # [4]	1	2	3	4	5	6	7	8	9	10	11	12
Module Type [5]												
Jumper comb [6]												

Rack # 5 Enclosure ID: _____ [3]

Module # [4]	1	2	3	4	5	6	7	8	9	10	11	12
Module Type [5]												
Jumper comb [6]												

[1] Optional; assigned per user's convenience. (Refer to user-generated Site and Network Maps.)

[2] Optional; assigned per user's convenience. (Refer to user-generated Site Map.)

[3] Optional; assigned per user's convenience. (Refer to user-generated Site Map.)

[4] Module # = Slot number in rack.

[5] Module Type: **AI** = Analog Input; **AO** = Analog Output; **DCI** = DC Digital Input; **ACI** = AC Digital Input **CI** = Contact Input; **DCO** = DC Digital Output; **ACO** = DC Digital Output; **RO** = Relay Output.

[6] Jumper Comb: specify: none (-), 2-position (2), or 10-position (10)

I/O Module Channel Assignment Configurator

1. **Network # |____|** [1]
2. **Network Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| [2]
2. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| [3]

Rack # 1 2 3 4 5 [4]

Slot # 1 5 9[5]	**Slot # 2 6 10**[5]	**Slot # 3 7 11**[5]	**Slot # 4 8 12**[5]
Module Type ____[6]	**Module Type ____**[6]	**Module Type ____**[6]	**Module Type ____**[6]

Ch. #	Tagname[7]	Ch. #	Tagname[7]	Ch. #	Tagname[7]	Ch. #	Tagname[7]
1		1		1		1	
2		2		2		2	
3		3		3		3	
4		4		4		4	
5		5		5		5	
6		6		6		6	
7		7		7		7	
8		8		8		8	
9		9		9		9	
10		10		10		10	
11		11		11		11	
12		12		12		12	
13		13		13		13	
14		14		14		14	
15		15		15		15	
16		16		16		16	

[1] Optional; assigned per user's convenience.

[2] Assigned in Peer Network configuration.

[3] Assigned in Peer Network configuration.

[4] To specify rack, encircle appropriate number.

[5] This configurator is intended for four contiguous slots; specify by encircling appropriate numbers (e.g., 1, 2, 3, 4 *or* 5, 6, 7, 8 *or* 9, 10, 11, 12).

[6] Specify Module Type: **AI** = Analog Input; **AO** = Analog Output; **DCI** = DC Digital Input; **ACI** = AC Digital Input **CI** = Contact Input; **DCO** = DC Digital Output; **ACO** = DC Digital Output; **RO** = Relay Output
(Ensure that Module Type specified here agrees with that entered in the **I/O Module Configurator**.)

[7] To specify rack, encircle appropriate number.

Peer Network Configurator

Network # _____; Network Name |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| (up to 16 ASCII char's)

1. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

2. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

3. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

4. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

5. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

6. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

7. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

8. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

9. **Controller Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| **Alias Name** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
   IP Address |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|; **Subnet Mask** |_|_|_| . |_|_|_| . |_|_|_| . |_|_|_|

Appendix B Installation of Remote Termination Panels (RTPs)

Overview

The Remote Termination Panel (RTP) provides an easy way to connect the HC900 controller to the field wiring. The RTP integrates some of the typical externally connected components, reducing wiring and setup time. It also minimizes the need for multiple wires under a single screw connection by expanding the connectivity of the shared terminals of the I/O modules.

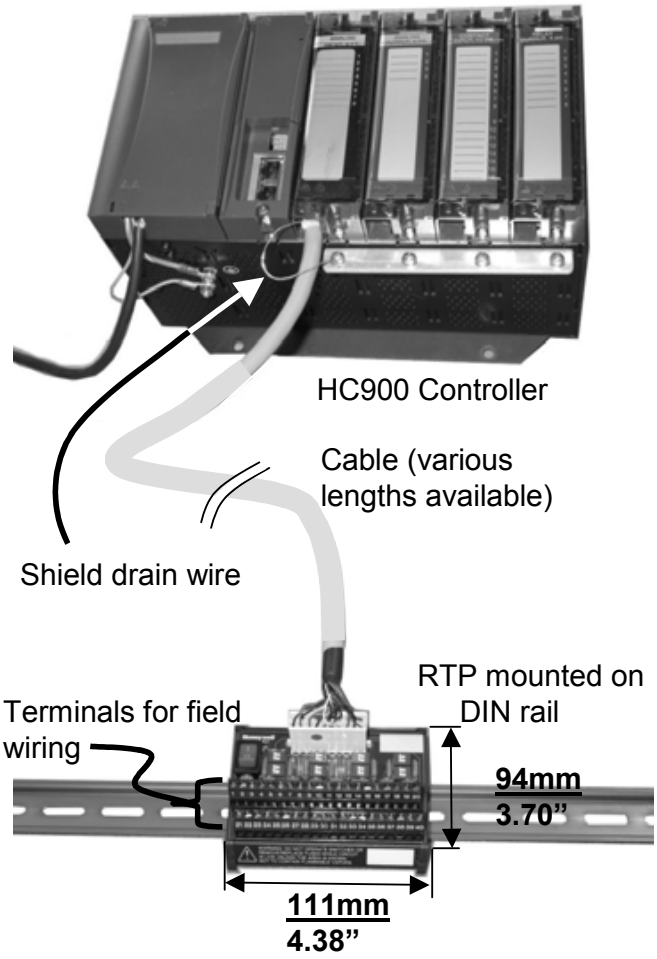
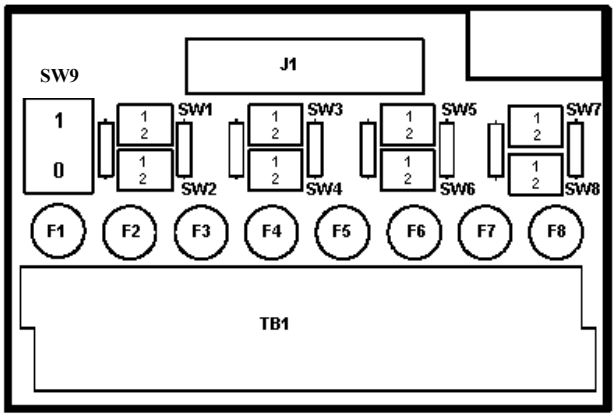
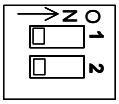
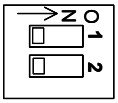
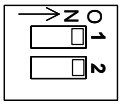
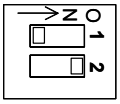
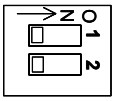


Figure 60 Example installation (all RTPs are dimensions shown)

Analog Input

8 Point Analog Input	
Step	**Action**
1	**ATTENTION: RTP is not for use with thermocouples.** **ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to AI module at controller. Choose from: 900RTC-L010 Remote Terminal Low Voltage Cable Assembly, 1.0 meters long 900RTC-L025 Remote Terminal Low Voltage Cable Assembly, 2.5 meters long. 900RTC-L050 Remote Terminal Low Voltage Cable Assembly, 5.0 meters long • Install AI module label onto the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP.

8 Point Analog Input	
Step	**Action**
3	**Set DIP switch positions SW1 through SW8.** Set each input's DIP switch positions according to the input type. Refer to Figure 61 (Step 4) to determine which switch corresponds to which input. If an input is not used, set its DIP switch positions to OFF.  Fuses: 80mA Time lag Wickmann part #3740080041 UL/CSA approved **Volt, millivolt:**  **Ohms:**  **Transmitter:**  **Milliamp:**  **RTD:**  SW9 is the red power switch for 24 volt supply. Module RIUP is not affected by using the RTP. See page 190 for RTP internal schematic.
4	**Connect field wiring.** Refer to Figure 61 through Figure 67 for field wiring. Any input type can be wired to any of the 8 inputs. After wiring, double check DIP switches are set correctly for each input type (Step 3).

8 Point Analog Input	
Step	**Action**

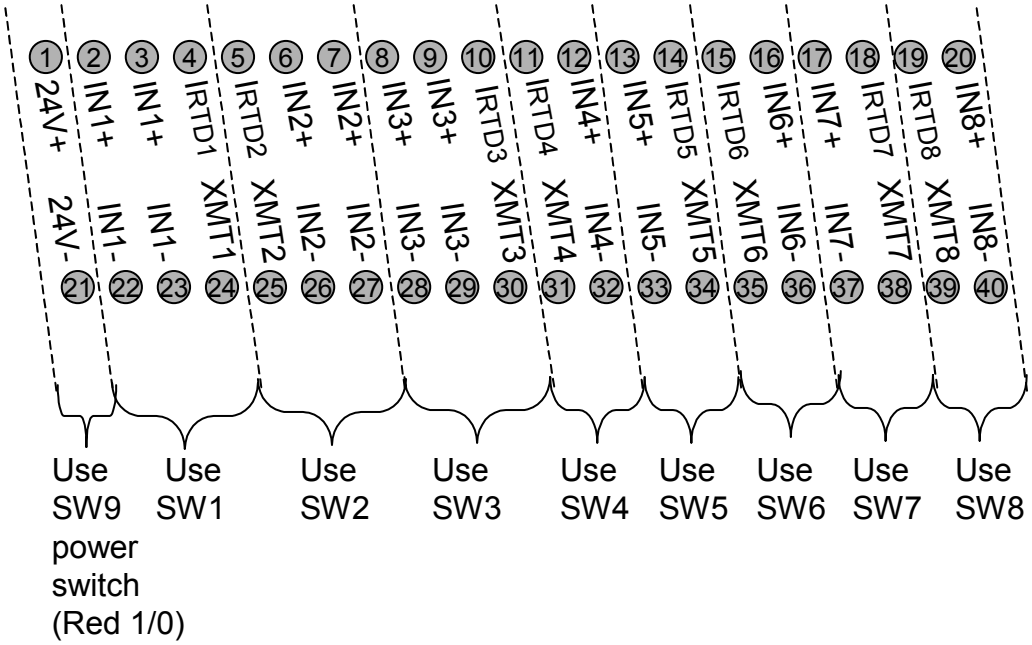


Figure 61 Analog input terminal and DIP switch designations

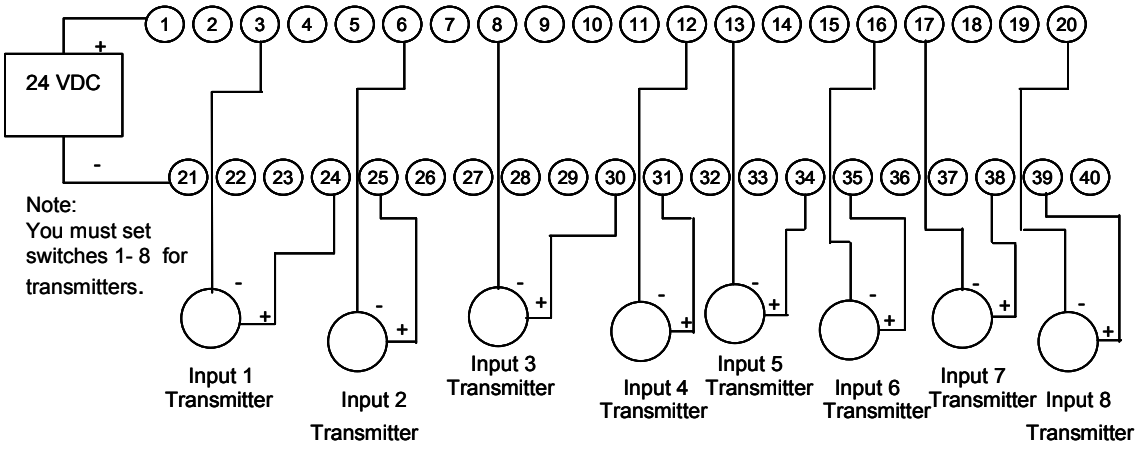


Figure 62 Two–wire transmitter connections with common 24 VDC supply

8 Point Analog Input	
Step	**Action**

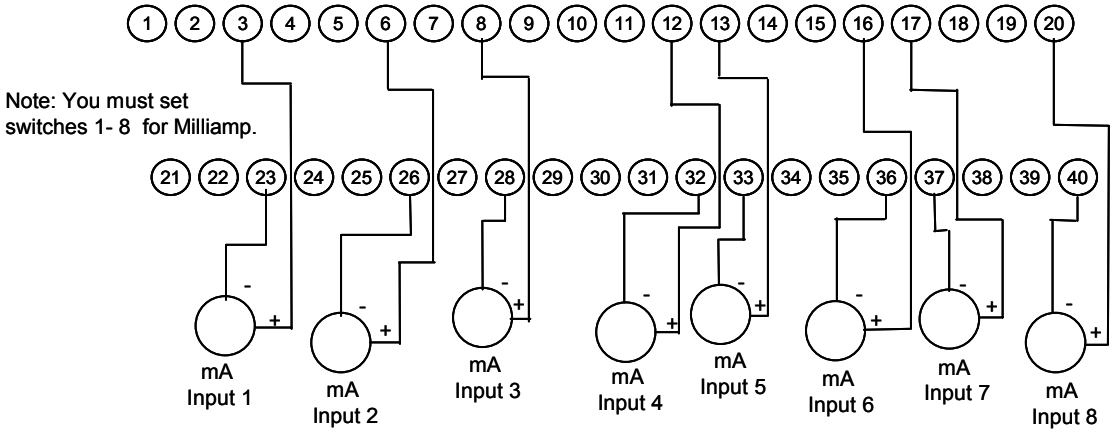


Figure 63 Milliamp input connections with 250 ohm shunt resistance

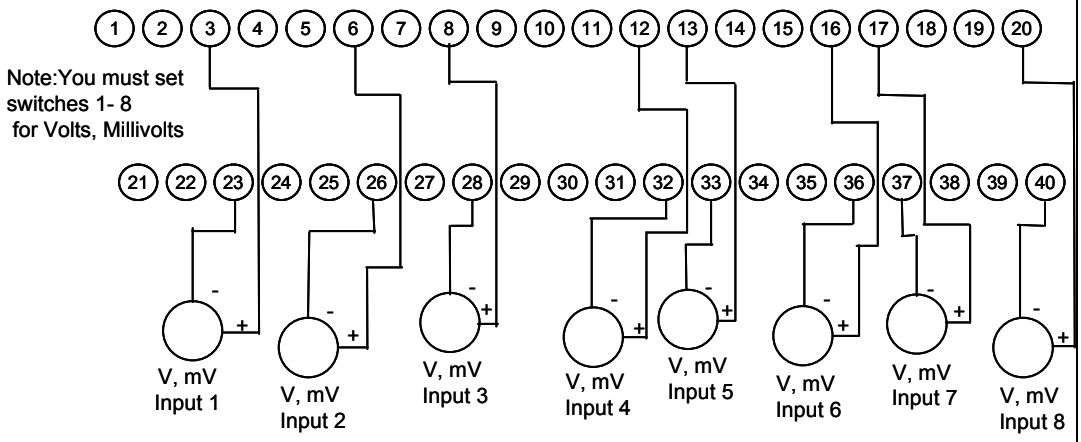


Figure 64 Volt, millivolt input connections

8 Point Analog Input	
Step	**Action**

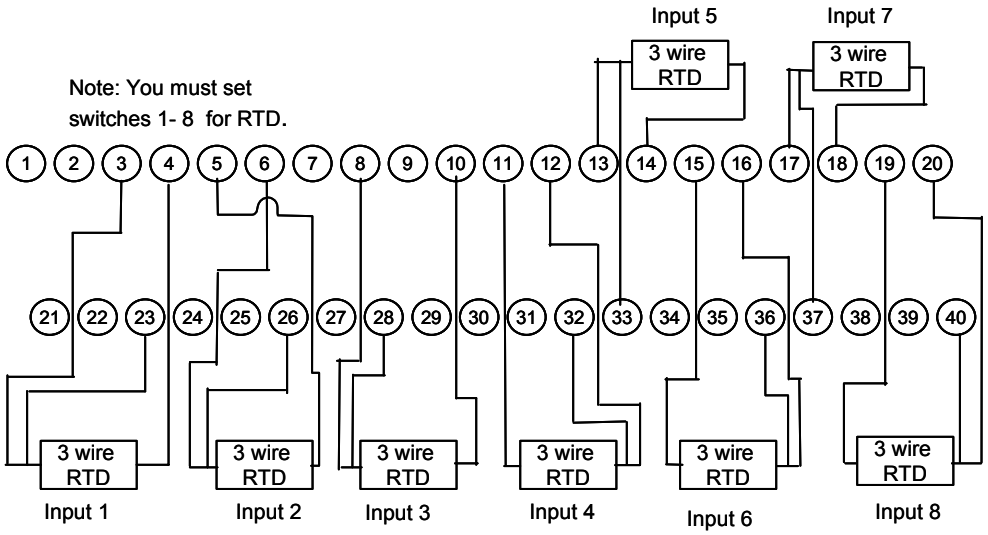


Figure 65 Three-wire RTD input connections

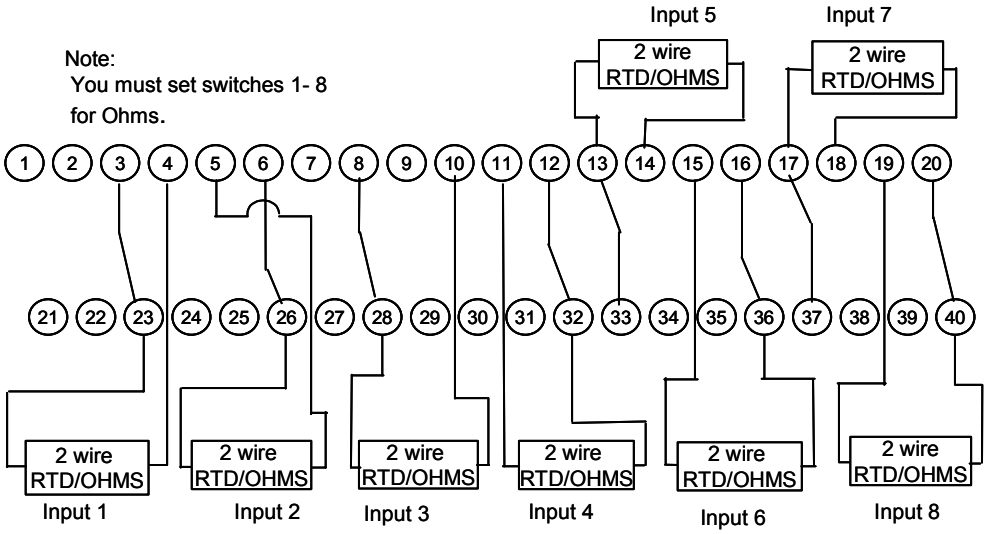


Figure 66 Two-wire RTD or ohm input connections

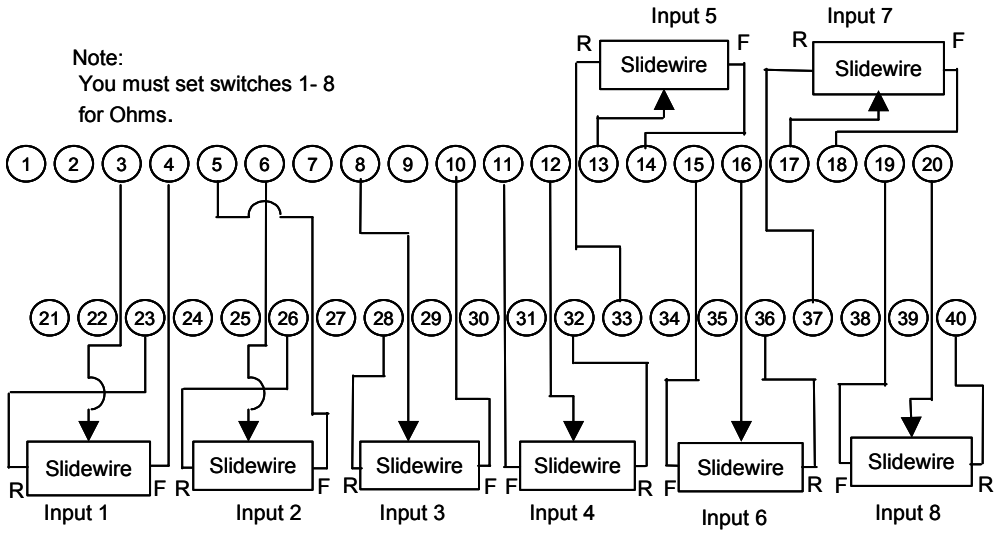
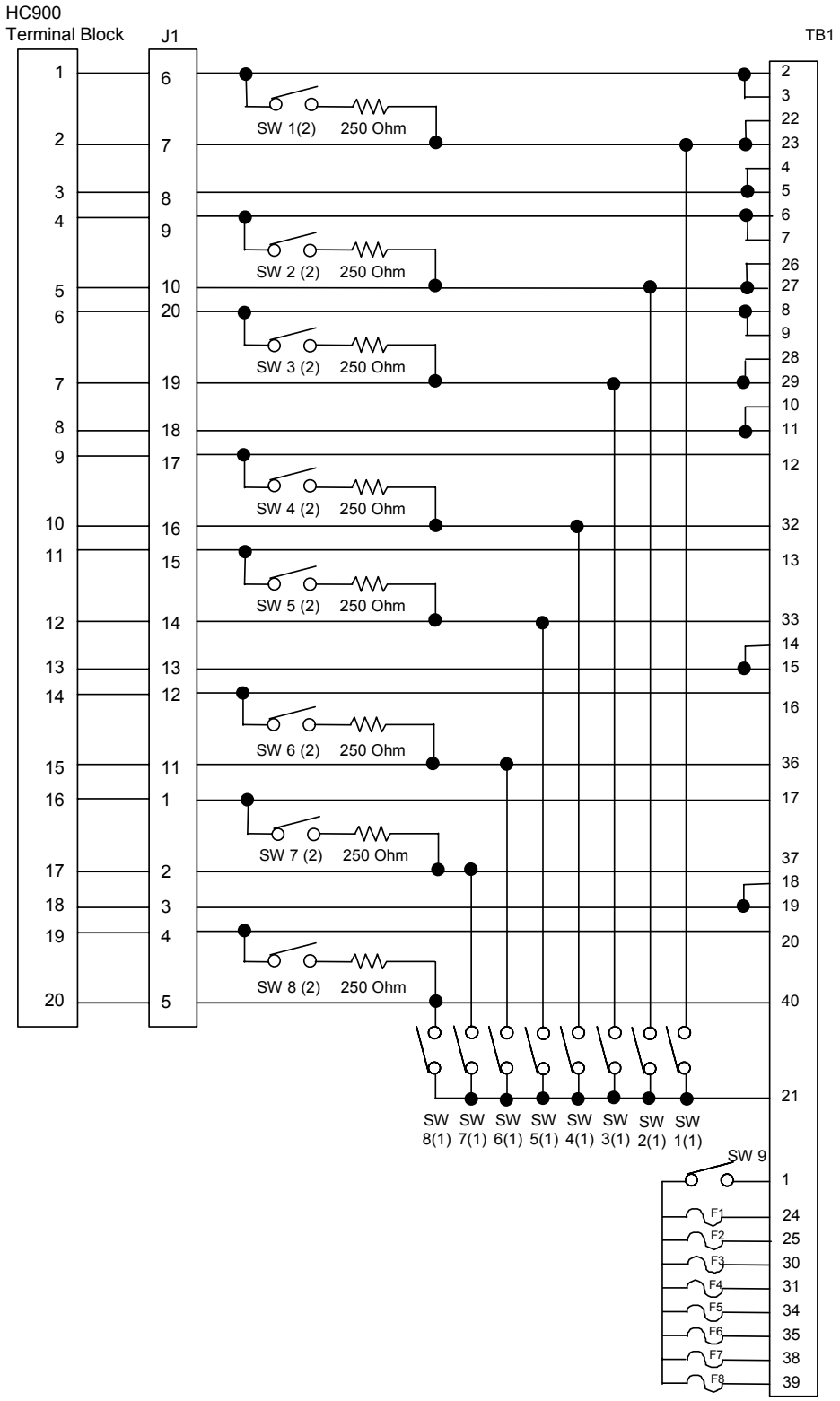
8 Point Analog Input	
Step	**Action**
	

Figure 67 Slidewire feedback connections for actuators

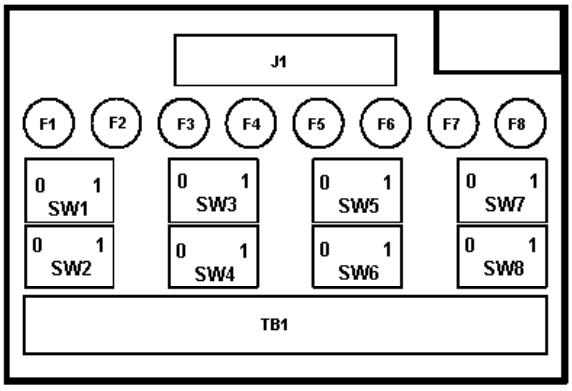
Analog Input accuracy specification

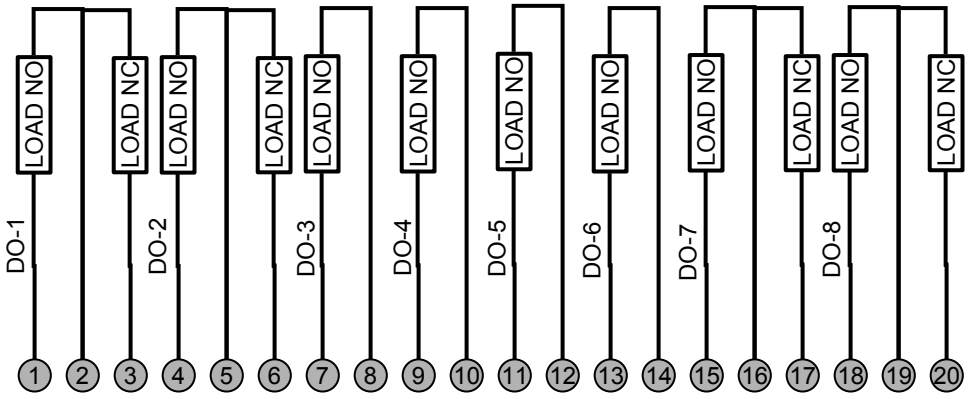
Range	AI Module Accuracy	RTP + Cable Accuracy	AI Module + RTP Accuracy
100Ω Plat. RTD	±0.1% of Range	±0.04% Range (0.357°C)	±0.14% of Range
JIS RTD	±0.1% of Range	±0.12% Range (0.824°C)	±0.22% of Range
10Ω Cu. RTD	±0.1% of Range	±0.57% Range (1.540°C)	±0.67% of Range
200Ω OHMS	±0.1% of Range	±0.07% Range (0.140Ω)	±0.17% of Range
0-10mV LINEAR	±0.1% of Range	±0.04% Range (0.004mV)	±0.14% of Range

Analog Input RTP Internal schematic



Relay Output

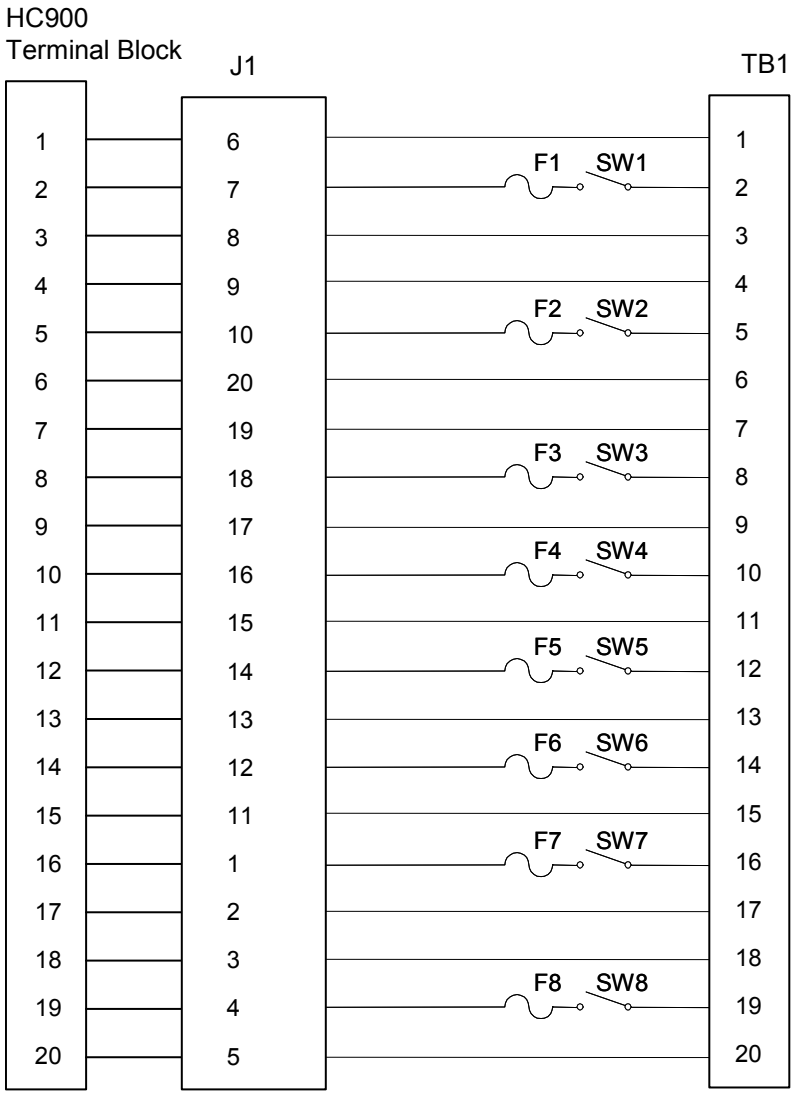
Relay Output	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to relay output module at controller. Choose from: 900RTC-H010 Remote Terminal High Voltage Cable assembly, 1.0 meters long 900RTC-H025 Remote Terminal High Voltage Cable assembly, 2.5 meters long 900RTC-H050 Remote Terminal High Voltage Cable assembly, 5.0 meters long ***ATTENTION:*** ***Cable power is limited to 24 Amps per module at 60C (140 degrees F) and 32 Amps at 54C (129 degrees F).*** • Install relay output module label onto the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP.
3	**Set switch positions SW1 through SW8.**  Fuses: 6.3A Time Lag Wickmann part #3741630041 UL/CSA approved for 250V Module Removal / Insertion Under Power (RIUP) is supported by turning off all eight switches to allow removal of the module from the rack without causing an arc. Please see page 62 for more details. See page 193 for RTP internal schematic.

Relay Output	
Step	**Action**
4	**Connect field wiring.** 

ATTENTION

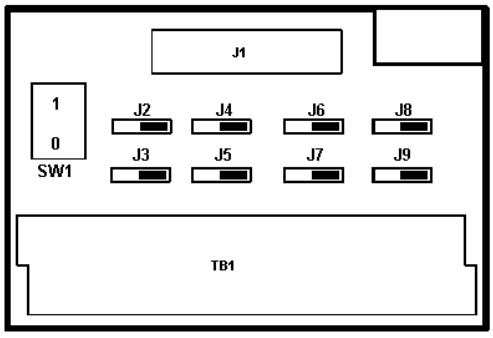
Cable power is limited to 24 Amps per module at 60C (140 degrees F) and 32 Amps at 54C (129 degrees F).

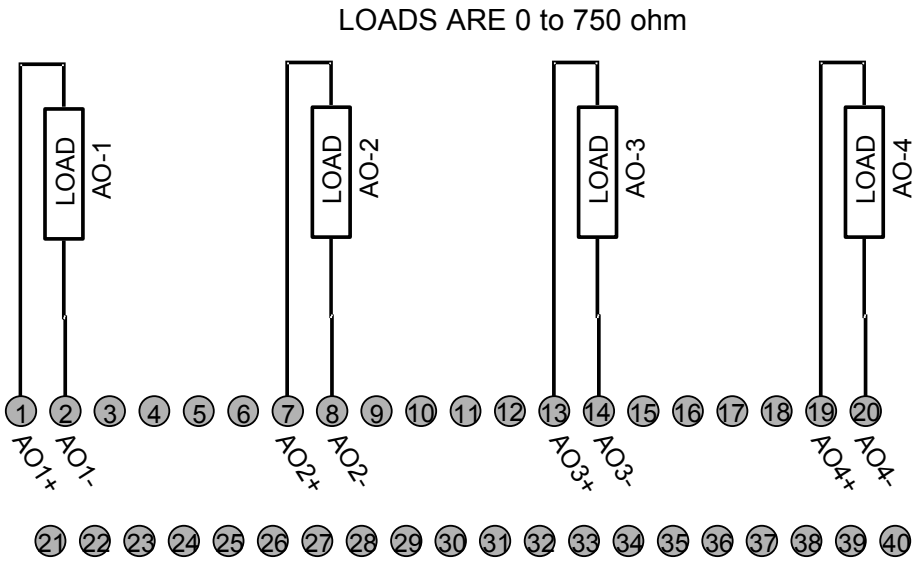
Relay Output RTP Internal schematic



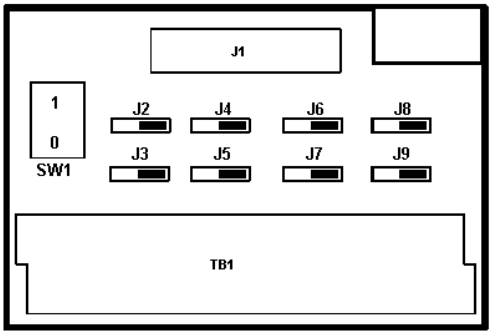
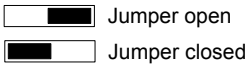
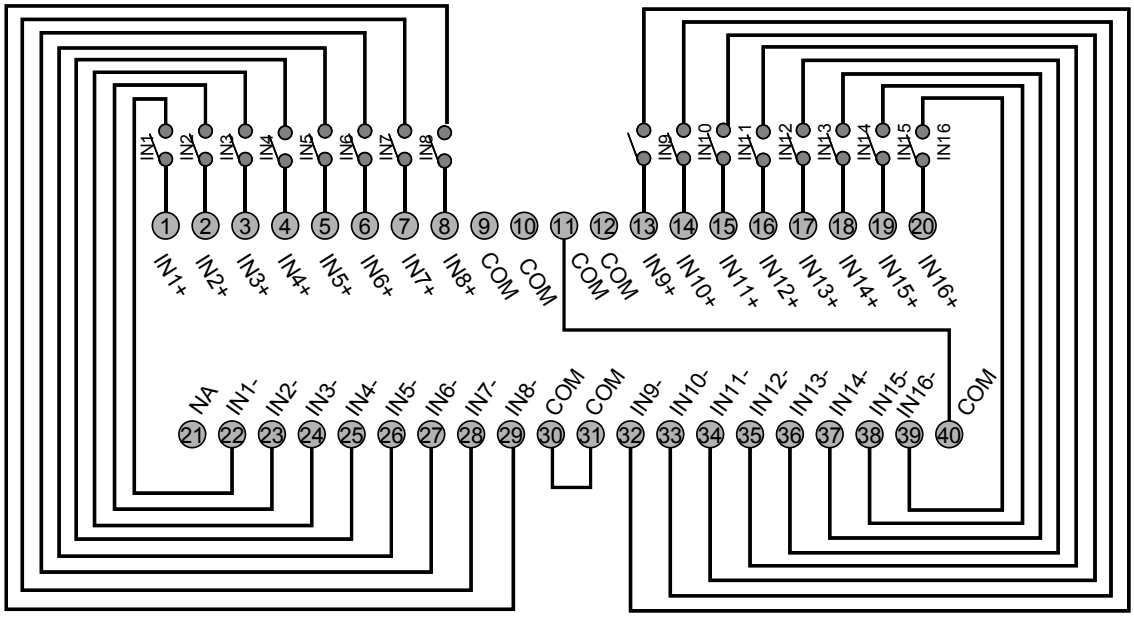
Digital Input/Digital Output/Analog Output

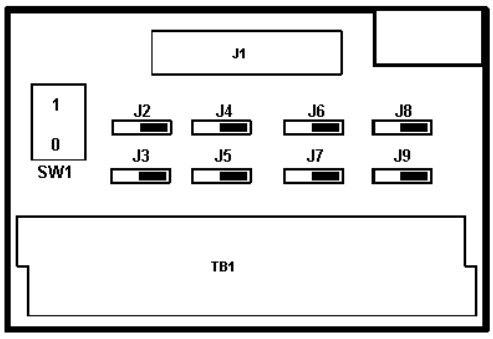
The DI/DO/AO-RTP is for use with the following modules:

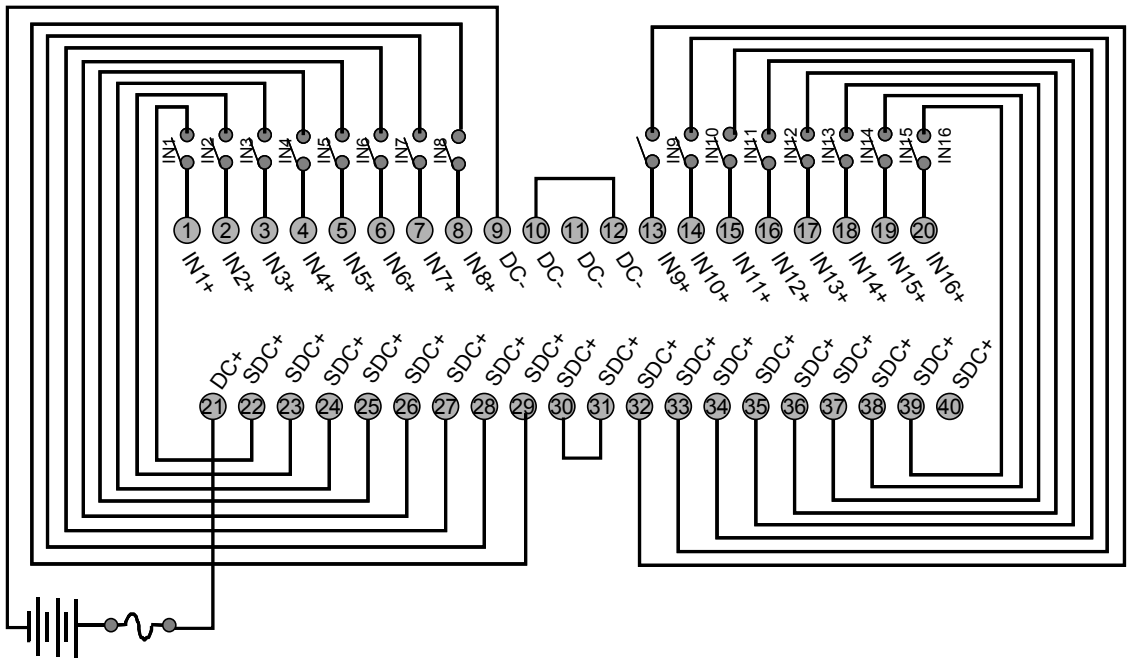
4 Point Analog Output	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to AO module at controller. Choose from: 900RTC-L010 Remote Terminal Low Voltage Cable Assembly, 1.0 meters long 900RTC-L025 Remote Terminal Low Voltage Cable Assembly, 2.5 meters long. 900RTC-L050 Remote Terminal Low Voltage Cable Assembly, 5.0 meters long • Install AO module label onto the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP
3	**Set/verify jumper positions as shown for use with an analog output module.**  SW1 is not used. Module RIUP is not affected by using the RTP. See page 203 for RTP internal schematic.

4 Point Analog Output	
Step	**Action**
4	**Connect field wiring.** 

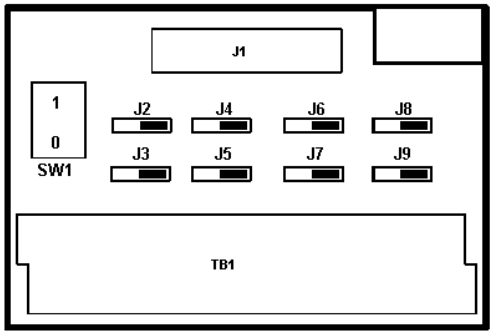
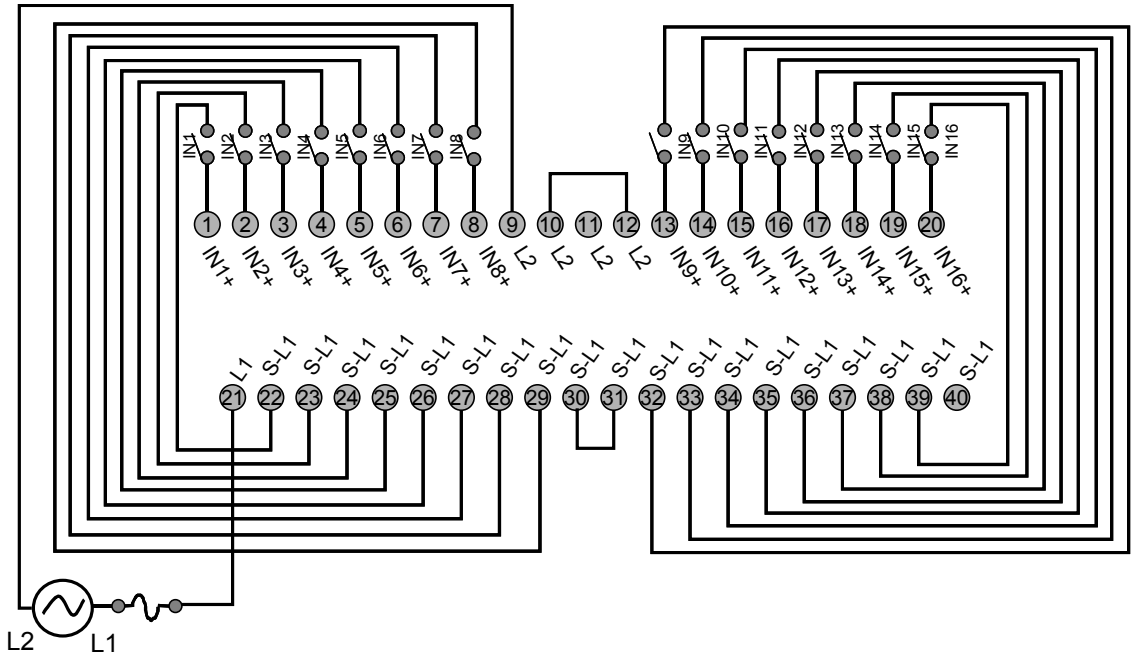
16 Point Contact Digital Input	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to 16 point Contact DI module at controller. Choose from: 900RTC-L010 Remote Terminal Low Voltage Cable Assembly, 1.0 meters long 900RTC-L025 Remote Terminal Low Voltage Cable Assembly, 2.5 meters long. 900RTC-L050 Remote Terminal Low Voltage Cable Assembly, 5.0 meters long • Install DI module label into the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP

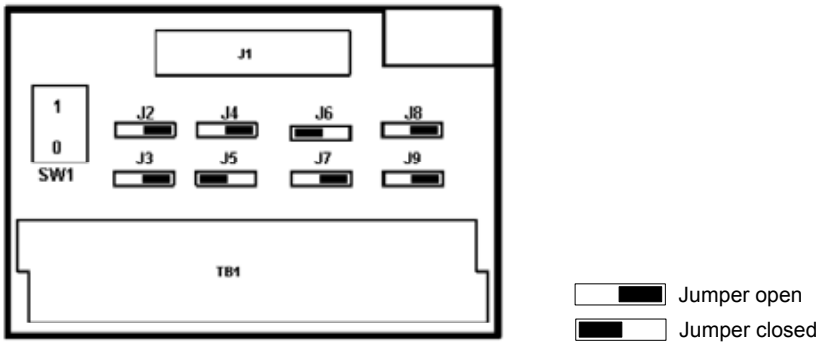
16 Point Contact Digital Input	
Step	**Action**
3	**Set jumper positions as shown for the 16 point contact digital input module.**   SW1 is not used. Module RIUP is not affected by using the RTP. See page 203 for RTP internal schematic.
4	**Connect field wiring.** 

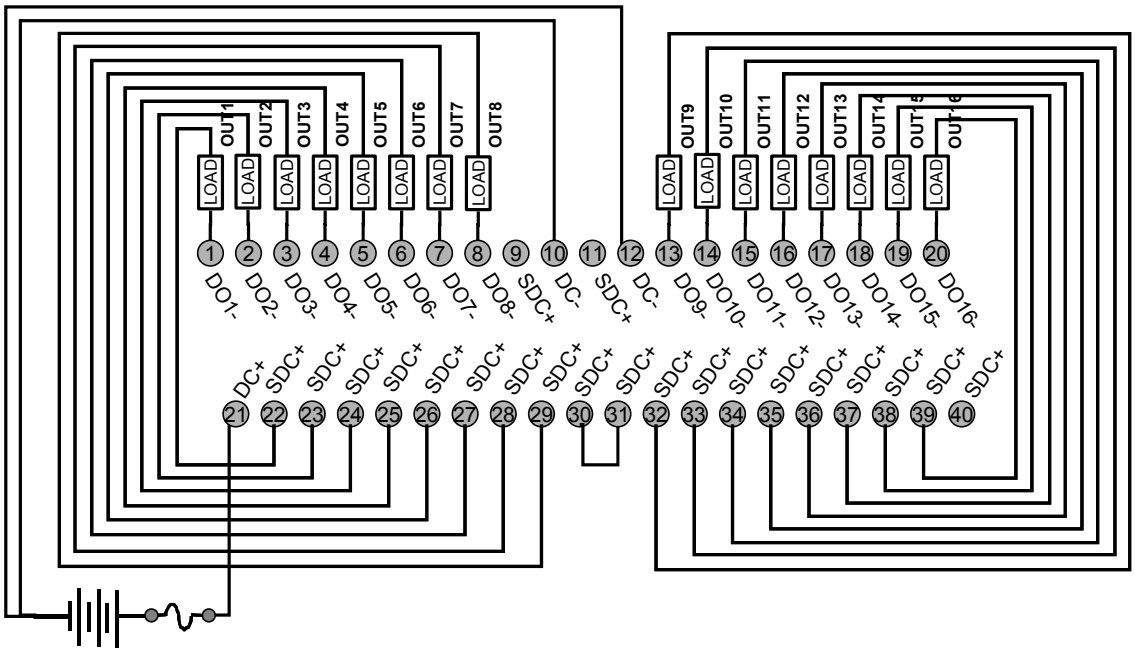
16 Point DC Digital Input	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to 16 point DC DI module at controller. Choose from: 900RTC-L010 Remote Terminal Low Voltage Cable Assembly, 1.0 meters long 900RTC-L025 Remote Terminal Low Voltage Cable Assembly, 2.5 meters long. 900RTC-L050 Remote Terminal Low Voltage Cable Assembly, 5.0 meters long • Install DC DI module label into the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP
3	**Set/verify jumper positions as shown for the 16 point digital input module.**  Module Removal / Insertion Under Power (RIUP) is supported by turning off Switch SW1 to allow removal of the module from the rack without causing an arc. Please see page 62 for more details. See page 203 for RTP internal schematic.

16 Point DC Digital Input	
Step	**Action**
4	**Connect field wiring.** Note: SDC+ in the wiring figure below refers to power that is disconnected from these screw terminals when switch SW1 is open (0). 

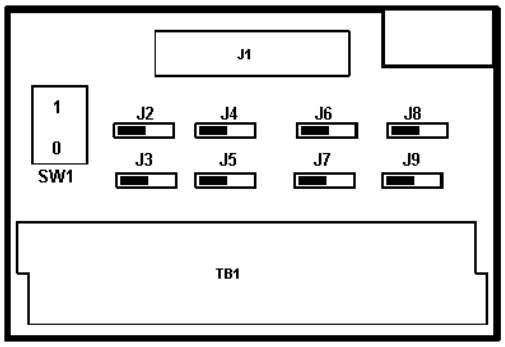
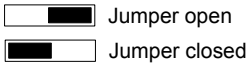
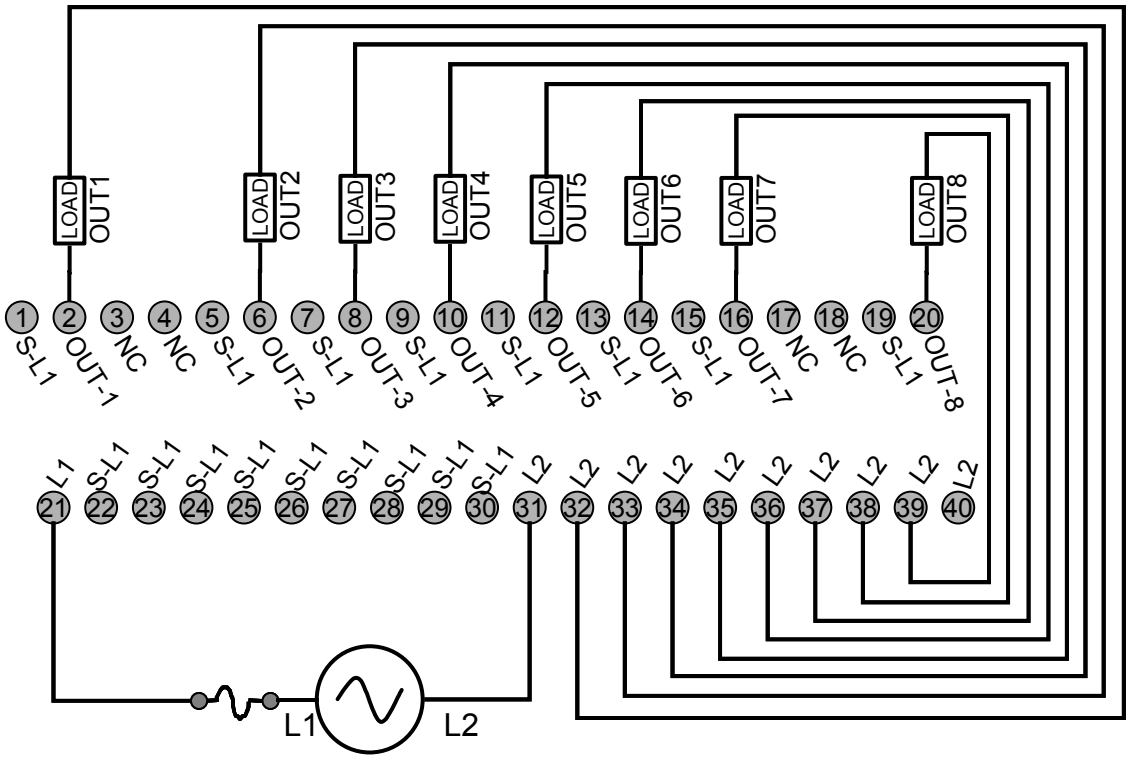
16 Point AC Digital Input	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to 16 point AC DI module at controller. Choose from: 900RTC-H010 Remote Terminal High Voltage Cable assembly, 1.0 meters long 900RTC-H025 Remote Terminal High Voltage Cable assembly, 2.5 meters long 900RTC-H050 Remote Terminal High Voltage Cable assembly, 5.0 meters long • Install AC DI module label into module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).

16 Point AC Digital Input	
Step	**Action**
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP
3	**Set/verify jumper positions as shown.**  Module Removal / Insertion Under Power (RIUP) is supported by turning off Switch SW1 to allow removal of the module from the rack without causing an arc. Please see page 62 for more details. See page 203 for RTP internal schematic.
4	**Connect field wiring.** Note: S-L1 in the wiring figure below refers to power that is disconnected from these screw terminals when switch SW1 is open (0). 

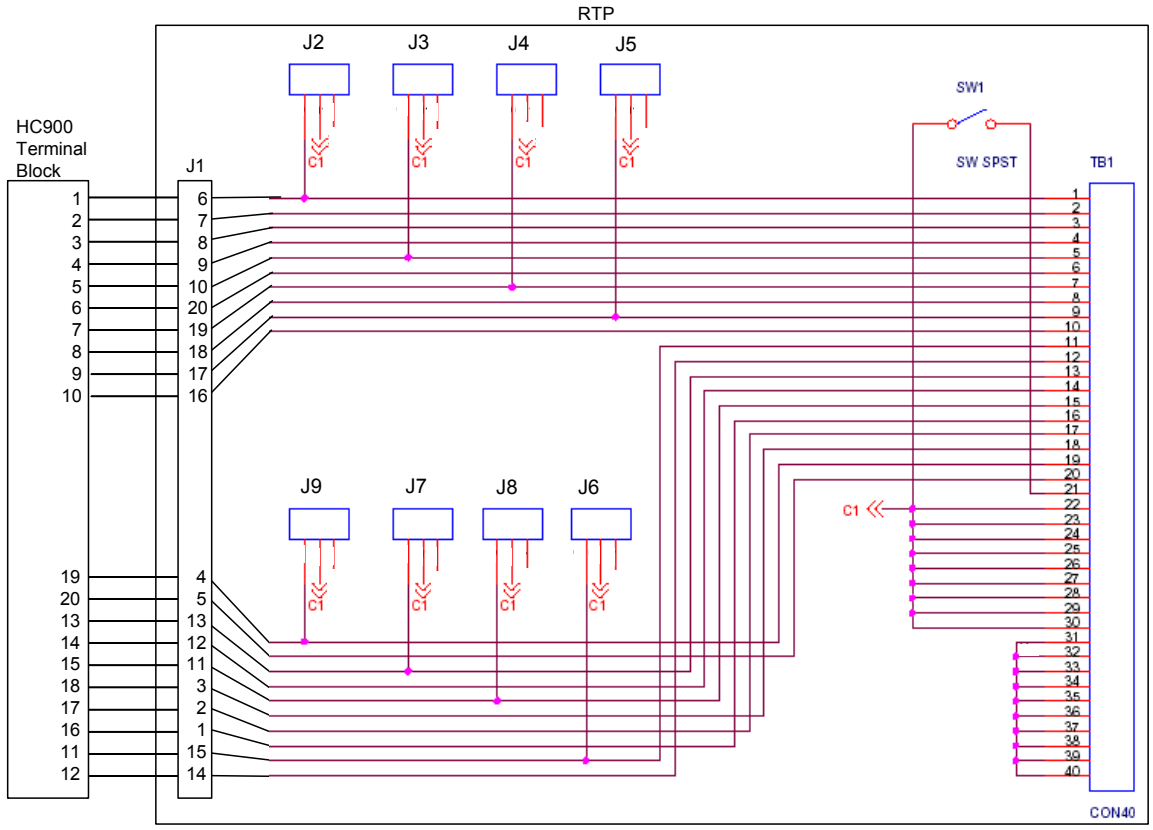
16 Point DC Digital Output	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **ATTENTION: DC Digital Output is rated at 8A per module and 1A per output. Limited to 4A per group of 8.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to 16 point DC DO module at controller. Choose from: 900RTC-L010 Remote Terminal Low Voltage Cable Assembly, 1.0 meters long 900RTC-L025 Remote Terminal Low Voltage Cable Assembly, 2.5 meters long. 900RTC-L050 Remote Terminal Low Voltage Cable Assembly, 5.0 meters long • Install DC DO label into the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP
3	**Set/verify jumper positions as shown.**  Module Removal / Insertion Under Power (RIUP) is supported by turning off Switch SW1 to allow removal of the module from the rack without causing an arc. Please see page 62 for more details. See page 203 for RTP internal schematic.

16 Point DC Digital Output	
Step	**Action**
4	**Connect field wiring.** Note: SDC+ in the wiring figure below refers to power that is disconnected from these screw terminals when switch SW1 is open (0).  DC Supply

8 Point AC Digital Output	
Step	**Action**
1	**ATTENTION: RTP and cables are intended for permanent installation within their own enclosure.** **ATTENTION: AC Digital Output is limited to 6A per RTP for 240Vac applications and 8A per RTP/2A per output for 120Vac applications.** **Mount RTP cable assembly to HC900 Controller** (Figure 60). • Remove appropriate key tabs from terminal block to allow mating with the module. See page 64. • Connect desired cable to 8 point AC DO module at controller. Choose from: 900RTC-H010 Remote Terminal High Voltage Cable assembly, 1.0 meters long 900RTC-H025 Remote Terminal High Voltage Cable assembly, 2.5 meters long 900RTC-H050 Remote Terminal High Voltage Cable assembly, 5.0 meters long • Install AC DO label into the module connector cover. • Connect shield drain wire to the grounding bars at the base of the HC900 rack. All field-wiring shields must be grounded as described in the shield grounding section (page 60).

8 Point AC Digital Output	
Step	**Action**
2	**Mount RTP to DIN rail.** • Latch to rail. See page 205. • Connect cable to RTP
3	**Set/verify jumper positions as shown.**   Module Removal / Insertion Under Power (RIUP) is supported by turning off Switch SW1 to allow removal of the module from the rack without causing an arc. Please see page 62 for more details. See page 203 for RTP internal schematic.
4	**Connect field wiring.** Note: S-L1 in the wiring figure below refers to power that is disconnected from these screw terminals when switch SW1 is open (0). 

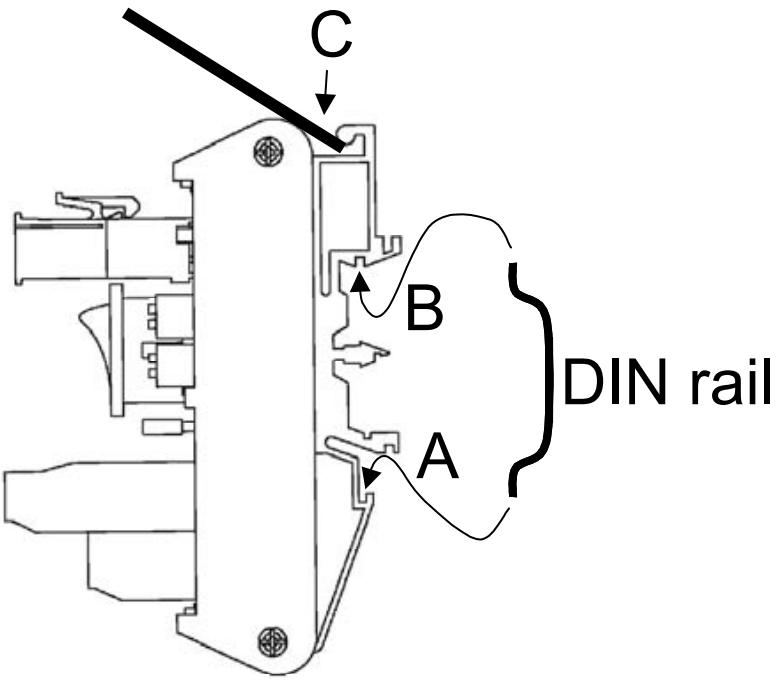
Digital Input/Digital Output/Analog Output RTP Internal schematic



RTP Cable wire positions and colors

Twisted Pair Number	HC900 Module TB Position	RTP J1 Plug Connector	Color
1	1	6	Black
	2	7	Red
2	4	9	Black
	5	10	White
3	6	20	Black
	7	19	Green
4	9	17	Black
	10	16	Blue
5	11	15	Black
	12	14	Yellow
6	14	12	Black
	15	11	Brown
7	16	1	Black
	17	2	Orange
8	19	4	Red
	20	5	White
9	3	8	Red
	8	18	Green
10	13	13	Red
	18	3	Blue

Latch/Unlatch RTP to rail

Step	Action
1	**Mounting screws must be installed at each end of the mounting rail, with additional screws approx. every 8"(203mm) to prevent twisting of the rail.**
2	**Insert one side of DIN rail at A.** 
3	**Insert other side of DIN rail at B, and push B over the rail to snap into place.**
4	**To remove, using slot screwdriver to lift C up gently (plastic is fragile) to disengage at B. Lift up and over rail, then disengage at A.**

Index

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Honeywell

51452403, Revision A

DECLARATION OF CONFORMITY

CE

We declare that the following product,

HC900 Racks

Models: **900R04**
900R08
900R012

is in conformity with the protection requirements of Council Directives: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC on the harmonization of the laws of the Member States relating to Electromagnetic Compatibility, and 73/23/EEC as amended by 93/68/EEC on the harmonization of the laws of the Member States relating to the safety of equipment designed for use within certain voltage limits.

The models covered by this Declaration are listed in, and evidence of conformity is provided by, Technical Files: **51452404** and **51452405**

The following standards are referenced in the file:

EN 55011-1991	Limits and Methods of measurement of electromagnetic disturbances of ISM radio frequency equipment
EN 61326 –1998	Electrical equipment for measurement, control and laboratory use - EMC requirements.
EN 61010-1-1993	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. Part 1: General Requirements

Manufacturer: Honeywell International, Inc.
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1100 Virginia Drive
Fort Washington, PA 19034

S. A. Arcara

Sam Arcara
Director, Control Products Engineering

Issue Date: 4/22 20 02

51452401, Revision A

DECLARATION OF CONFORMITY

CE

We declare that the following product,

HC900 Modules

Models:

900A01	**900B01**
900C51	**900C52**
900C53	**900G01**
900G02	**900G03**
900H01	**900H02**
900H03	**900P01**

is in conformity with the protection requirements of Council Directives: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC on the harmonization of the laws of the Member States relating to Electromagnetic Compatibility, and 73/23/EEC as amended by 93/68/EEC on the harmonization of the laws of the Member States relating to the safety of equipment designed for use within certain voltage limits.

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Issue Date: 4/22 20 02

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51-52-25-107 Rev. 5 0903 Printed in USA

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