



Instruction
Harmony Series

Harmony Input/Output System I/O and Auxiliary Blocks



ABB

Preface



The Harmony Input/Output (I/O) System sets new standards for user convenience in industrial I/O. A wide variety of I/O building blocks can be combined to form an optimum solution for a specific application. The Harmony I/O system is part of the Symphony Enterprise Management and Control System. It is, however, fully compatible with the INFI 90® OPEN Strategic Enterprise Management System.

This instruction overviews the Harmony I/O system; describes the analog, digital, and control I/O blocks and auxiliary blocks used for field I/O interface; and provides I/O and auxiliary block installation and connection procedures.



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Safety Summary



Electrostatic Sensitive Device

Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous. (p. 3-7, PR3-1, PR28-1)

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. PR19-1, PR20-1, PR21-2, PR22-1, PR23-1, PR31-1)

Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage. (p. PR27-1)

Verify power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete. (p. PR33-1, PR34-1)



Safety Summary (continued)

SPECIFIC CAUTIONS

For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops. (p. PR6-1, PR8-1, PR11-1, PR28-1)

Insure the setting for the digital input field power monitor jumper DIFP-J2 matches the actual field power voltage (IFP or LFP). Circuit damage will occur if the LFP voltage is greater than the voltage setting of jumper DIFP-J2. (p. PR12-1)

Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used. (p. PR16-1, PR32-1, PR33-1, PR34-1)

Support Services



ABB will provide assistance in the operation and repair of its products. Requests for sales or application services should be made to your nearest sales or service office. ABB can also provide installation, repair and maintenance contract services.

When ordering parts, use nomenclature or part numbers and part descriptions from equipment manuals. Parts without a description must be ordered from the nearest sales or service office. Recommended spare parts lists, including prices are available through the nearest sales or service office.

ABB has modern training facilities available for training your personnel. On-site training is also available. Contact your nearest ABB sales office for specific information and scheduling.

Additional copies of this instruction, or other instructions, can be obtained from the nearest ABB sales office at a reasonable charge.



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Preface



The Harmony Input/Output (I/O) System sets new standards for user convenience in industrial I/O. A wide variety of I/O building blocks can be combined to form an optimum solution for a specific application. The Harmony I/O system is part of the Symphony Enterprise Management and Control System. It is, however, fully compatible with the INFI 90® OPEN Strategic Enterprise Management System.

This instruction overviews the Harmony I/O system; describes the analog, digital, and control I/O blocks and auxiliary blocks used for field I/O interface; and provides I/O and auxiliary block installation and connection procedures.



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Safety Summary



Electrostatic Sensitive Device

Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous. (p. 3-7, PR3-1, PR28-1)

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. PR19-1, PR20-1, PR21-2, PR22-1, PR23-1, PR31-1)

Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage. (p. PR27-1)

Verify power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete. (p. PR33-1, PR34-1)



Safety Summary (continued)

SPECIFIC CAUTIONS

For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops. (p. PR6-1, PR8-1, PR11-1, PR28-1)

Insure the setting for the digital input field power monitor jumper DIFP-J2 matches the actual field power voltage (IFP or LFP). Circuit damage will occur if the LFP voltage is greater than the voltage setting of jumper DIFP-J2. (p. PR12-1)

Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used. (p. PR16-1, PR32-1, PR33-1, PR34-1)

Support Services



ABB will provide assistance in the operation and repair of its products. Requests for sales or application services should be made to your nearest sales or service office. ABB can also provide installation, repair and maintenance contract services.

When ordering parts, use nomenclature or part numbers and part descriptions from equipment manuals. Parts without a description must be ordered from the nearest sales or service office. Recommended spare parts lists, including prices are available through the nearest sales or service office.

ABB has modern training facilities available for training your personnel. On-site training is also available. Contact your nearest ABB sales office for specific information and scheduling.

Additional copies of this instruction, or other instructions, can be obtained from the nearest ABB sales office at a reasonable charge.



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The Harmony Input/Output (I/O) System sets new standards for user convenience in industrial I/O. A wide variety of I/O building blocks can be combined to form an optimum solution for a specific application. The Harmony I/O system is part of the Symphony Enterprise Management and Control System. It is, however, fully compatible with the INFI 90® OPEN Strategic Enterprise Management System.

This instruction overviews the Harmony I/O system; describes the analog, digital, and control I/O blocks and auxiliary blocks used for field I/O interface; and provides I/O and auxiliary block installation and connection procedures.



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Safety Summary



Electrostatic Sensitive Device

Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous. (p. 3-7, PR3-1, PR28-1)

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. PR19-1, PR20-1, PR21-2, PR22-1, PR23-1, PR31-1)

Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage. (p. PR27-1)

Verify power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete. (p. PR33-1, PR34-1)



Safety Summary (continued)

SPECIFIC CAUTIONS

For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops. (p. PR6-1, PR8-1, PR11-1, PR28-1)

Insure the setting for the digital input field power monitor jumper DIFP-J2 matches the actual field power voltage (IFP or LFP). Circuit damage will occur if the LFP voltage is greater than the voltage setting of jumper DIFP-J2. (p. PR12-1)

Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used. (p. PR16-1, PR32-1, PR33-1, PR34-1)

Support Services



ABB will provide assistance in the operation and repair of its products. Requests for sales or application services should be made to your nearest sales or service office. ABB can also provide installation, repair and maintenance contract services.

When ordering parts, use nomenclature or part numbers and part descriptions from equipment manuals. Parts without a description must be ordered from the nearest sales or service office. Recommended spare parts lists, including prices are available through the nearest sales or service office.

ABB has modern training facilities available for training your personnel. On-site training is also available. Contact your nearest ABB sales office for specific information and scheduling.

Additional copies of this instruction, or other instructions, can be obtained from the nearest ABB sales office at a reasonable charge.



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The Harmony Input/Output (I/O) System sets new standards for user convenience in industrial I/O. A wide variety of I/O building blocks can be combined to form an optimum solution for a specific application. The Harmony I/O system is part of the Symphony Enterprise Management and Control System. It is, however, fully compatible with the INFI 90® OPEN Strategic Enterprise Management System.

This instruction overviews the Harmony I/O system; describes the analog, digital, and control I/O blocks and auxiliary blocks used for field I/O interface; and provides I/O and auxiliary block installation and connection procedures.



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Safety Summary



Electrostatic Sensitive Device

Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous. (p. 3-7, PR3-1, PR28-1)

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. PR19-1, PR20-1, PR21-2, PR22-1, PR23-1, PR31-1)

Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage. (p. PR27-1)

Verify power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete. (p. PR33-1, PR34-1)



Safety Summary (continued)

SPECIFIC CAUTIONS

For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops. (p. PR6-1, PR8-1, PR11-1, PR28-1)

Insure the setting for the digital input field power monitor jumper DIFP-J2 matches the actual field power voltage (IFP or LFP). Circuit damage will occur if the LFP voltage is greater than the voltage setting of jumper DIFP-J2. (p. PR12-1)

Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used. (p. PR16-1, PR32-1, PR33-1, PR34-1)

Support Services



ABB will provide assistance in the operation and repair of its products. Requests for sales or application services should be made to your nearest sales or service office. ABB can also provide installation, repair and maintenance contract services.

When ordering parts, use nomenclature or part numbers and part descriptions from equipment manuals. Parts without a description must be ordered from the nearest sales or service office. Recommended spare parts lists, including prices are available through the nearest sales or service office.

ABB has modern training facilities available for training your personnel. On-site training is also available. Contact your nearest ABB sales office for specific information and scheduling.

Additional copies of this instruction, or other instructions, can be obtained from the nearest ABB sales office at a reasonable charge.



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Preface



The Harmony Input/Output (I/O) System sets new standards for user convenience in industrial I/O. A wide variety of I/O building blocks can be combined to form an optimum solution for a specific application. The Harmony I/O system is part of the Symphony Enterprise Management and Control System. It is, however, fully compatible with the INFI 90® OPEN Strategic Enterprise Management System.

This instruction overviews the Harmony I/O system; describes the analog, digital, and control I/O blocks and auxiliary blocks used for field I/O interface; and provides I/O and auxiliary block installation and connection procedures.



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Safety Summary



Electrostatic Sensitive Device

Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous. (p. 3-7, PR3-1, PR28-1)

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. PR19-1, PR20-1, PR21-2, PR22-1, PR23-1, PR31-1)

Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage. (p. PR27-1)

Verify power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete. (p. PR33-1, PR34-1)



Safety Summary (continued)

SPECIFIC CAUTIONS

For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops. (p. PR6-1, PR8-1, PR11-1, PR28-1)

Insure the setting for the digital input field power monitor jumper DIFP-J2 matches the actual field power voltage (IFP or LFP). Circuit damage will occur if the LFP voltage is greater than the voltage setting of jumper DIFP-J2. (p. PR12-1)

Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used. (p. PR16-1, PR32-1, PR33-1, PR34-1)

Support Services



ABB will provide assistance in the operation and repair of its products. Requests for sales or application services should be made to your nearest sales or service office. ABB can also provide installation, repair and maintenance contract services.

When ordering parts, use nomenclature or part numbers and part descriptions from equipment manuals. Parts without a description must be ordered from the nearest sales or service office. Recommended spare parts lists, including prices are available through the nearest sales or service office.

ABB has modern training facilities available for training your personnel. On-site training is also available. Contact your nearest ABB sales office for specific information and scheduling.

Additional copies of this instruction, or other instructions, can be obtained from the nearest ABB sales office at a reasonable charge.



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™ Composer
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Purpose

The Harmony Input/Output (I/O) System interfaces field inputs and outputs for the Symphony Enterprise Management and Control System to monitor and control a process. The Harmony I/O system incorporates a variety of input and output devices (blocks) to interface process signals. Blocks for analog, digital, and control I/O interface along with remote I/O communication combine to create a complete I/O system.

The Harmony I/O system offers a complete solution in a modular, easy to use package. In addition to the I/O devices, the Harmony solution provides many options for ready-to-use I/O communications, I/O mounting, field wiring management, power distribution, and cooling.

The Harmony I/O system is intended to be an alternative to rack I/O modules and terminations. It provides flexibility in system design, enhanced I/O signal processing, and reduced installation complexity and installation time.

NOTE: Abbreviated nomenclature is used in this instruction whenever possible (refer to Table 1-5). Refer to [Section 11](#) for complete nomenclature.

Harmony I/O System Documentation

Complete information about Harmony I/O system installation and operation is contained in the following instructions:

I/O and Auxiliary Blocks - overviews the Harmony I/O system; describes the analog, digital, and control I/O blocks and auxiliary blocks used for field I/O interface; and provides I/O and auxiliary block installation and connection procedures.

Block Power and Mounting Hardware - describes the block mounting hardware, describes the block operating power and field power options, and provides mounting hardware installation and power connection procedures.

Harmony Communications Network (Hnet) - describes the Harmony Communications Network or Hnet, details network



architecture options, and provides Hnet component installation and connection procedures.

Harmony I/O data sheets supplement the information provided in these instructions.

System Overview

Figures 1-1 and 1-2 are hierarchical views of the Symphony system showing the various system communication levels and the position of the Harmony I/O system within these levels. Figure 1-1 shows a Harmony area controller with I/O blocks. Figure 1-2 shows a rack-mounted Harmony bridge controller with I/O blocks.

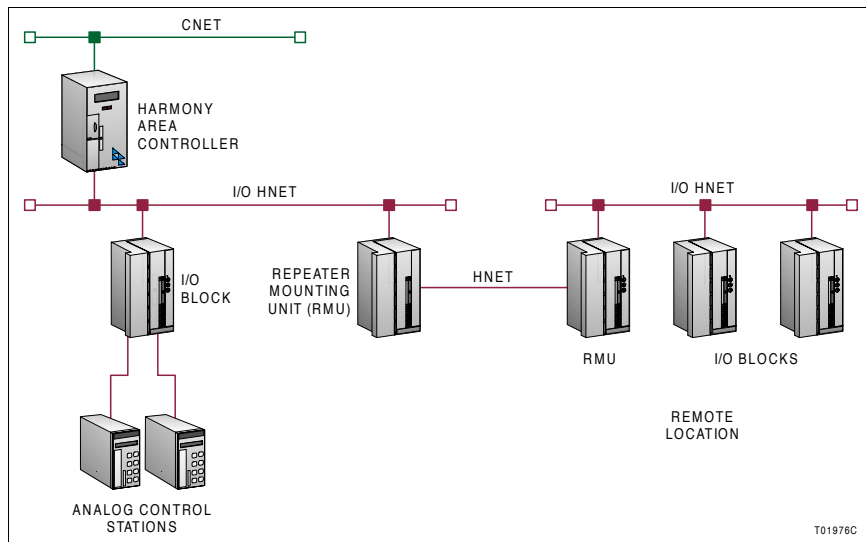


Figure 1-1. Harmony Area Controller with Harmony I/O Blocks

The main components of the Harmony I/O system are I/O blocks and Hnet (Fig. 1-3). Together they operate as a subsystem dedicated to the Harmony controller. Hnet is the redundant network over which Harmony controllers and Harmony I/O blocks communicate. The controller performs the actual control functions. The I/O blocks process any inputs

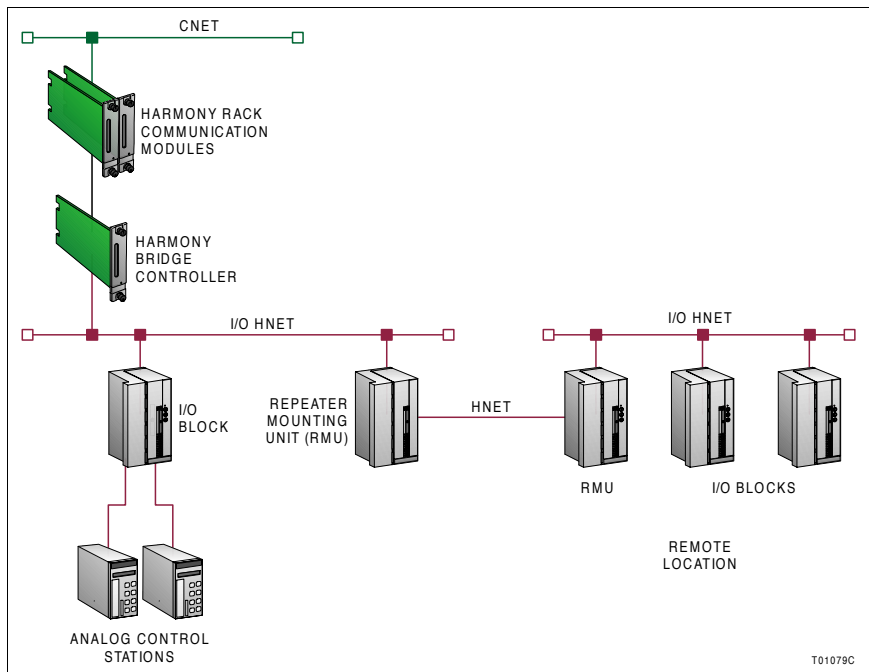


Figure 1-2. Harmony Bridge Controller with Harmony I/O Blocks

from and outputs to field devices for the controller. The controller can communicate with up to 64 Hnet devices.

The I/O types include:

- Analog input (AIN).
- Analog output (AOT).
- Control loop input/output (CIO).
- Digital input/output (DIO).
- Digital output (DOT).

The repeater mounting unit (RMU) is also an important component of the Harmony I/O system. The repeater mounting unit provides mounting slots for Hnet repeaters used to communicate with remote enclosures over fiber optic cables.

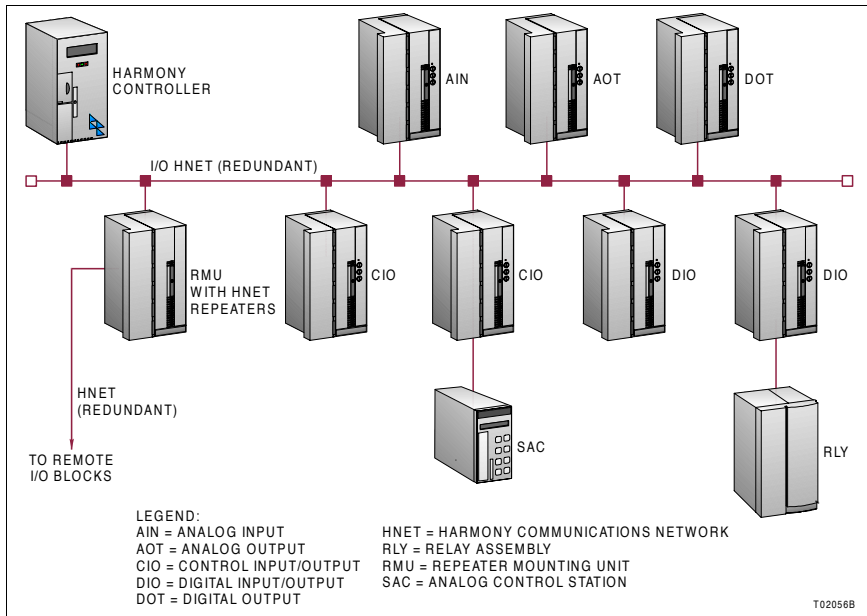


Figure 1-3. Harmony I/O System

The Harmony I/O system is powered by redundant 24 VDC and provides for separate distribution of field power. The I/O system can be powered by the Modular Power System II.

One or more control enclosures house all I/O system components. The block mounting hardware within the enclosure supports a variety of arrangements. Small cabinet or enclosure mounting is also supported.

Although not specifically part of the Harmony I/O system, analog control stations (SAC) can connect and communicate through CIO blocks as shown in Figure 1-3. Communication is over an RS-485 serial station link.

Input/Output

The Harmony I/O system supports a variety of input/output blocks to interface analog, digital, and control I/O. Table 1-1

lists the currently available I/O and auxiliary blocks. Table 1-2 summarizes I/O block capabilities. Refer to [Section 2](#) for a description of each block and its specifications.

Table 1-1. Available I/O and Auxiliary Blocks

Block	Description
AIN-120	Current, high level voltage in
AIN-200	Isolated high level voltage, low level voltage, TC in
AIN-220	Isolated current, high level voltage, low level voltage, TC in
AIN-300	Isolated RTD in
AOT-150	Current out
CIO-100	Control loop in/out
CIO-110	Electric drive/pulse positioner termination (for CIO-100) ¹
DIO-400	Universal digital in, 24 or 48 VDC digital out
DOT-100	Onboard electromechanical relay out
DOT-120	Onboard monitored electromechanical relay out (with fusing)
RLY-100	Electromechanical relay assembly (for DIO-400) ¹
RLY-200	Solid state relay assembly (for DIO-400) ¹

NOTE:

1. Auxiliary block used to extend I/O block capabilities.

Harmony Controllers

A Harmony controller, either a Harmony bridge controller or Harmony area controller, performs the actual process control. It receives its process inputs from either or both Harmony I/O blocks and Harmony rack I/O devices and provides the control outputs through these blocks and devices.

The controller can communicate with Harmony I/O blocks and Harmony rack I/O devices simultaneously. All Harmony I/O system configuration is performed through the controller.

Harmony Bridge Controller

A Harmony bridge controller (BRC) is a rack-mounted controller that occupies one slot in a module mounting unit. It supports Hnet communication protocol, device labeling, and the function code environment necessary to configure and operate the Harmony I/O system. Refer to the **Harmony Bridge Controller** instruction for a detailed description.



Table 1-2. I/O Block Capabilities

I/O		Range/Type	AIN-120	AIN-200	AIN-220	AIN-300	AOT-150	CIO-100	DIO-400	DOT-100	DOT-120
Analog In	Current	4 to 20 mA	•		•			•			
	High level VDC	-10 to + 10 VDC	•	•	•			• ¹			
	Low level VDC	-100 to +100 mV		•	•						
	Thermocouple	B, E, J, K, L, N (14/28 AWG), R, S, T, U, Chinese E, S		•	•						
	3-wire RTD	10 Ω copper 100 Ω platinum: U.S. Lab. Standard 100 Ω platinum: U.S. Industry Standard 100 Ω platinum: European Standard 120 Ω nickel Chinese 53 Ω copper				•					
	Channels		16	16	16	16		4			
	Isolated			•	•	•					
Analog Out	Current	4 to 20 mA					•	•			
	High level VDC	1 to 5 VDC						•			
	Channels						16	2			
	Isolated										
Digital In	24 VDC	19.5 to 28 VDC						•	•		
	48 VDC	39 to 56 VDC						•	•		
	125 VDC	95 to 144 VDC						•	•		
	120 VAC	85 to 138 VAC						•	•		
	240 VAC	190 to 265 VAC						•	•		
	Channels							4	16		
	Isolated							•	•		
Digital Out	Open collector	24 VDC at 250 mA						•	•		
		48 VDC at 250 mA							•		
	SPDT EM relay	24, 48, 125 VDC								•	•
		120, 240 VAC								•	•
	Channels							4	8	16	16
	Isolated							•	•	•	•
Supports redundant I/O electronics			•	•	•	•	•		•	•	•

NOTE:

1. 1 to 5 VDC only.

The controller can read and send I/O block channel data, configuration information, and status over Hnet (Fig. 1-4). The controller can also simultaneously communicate with rack I/O devices over the I/O expander bus.

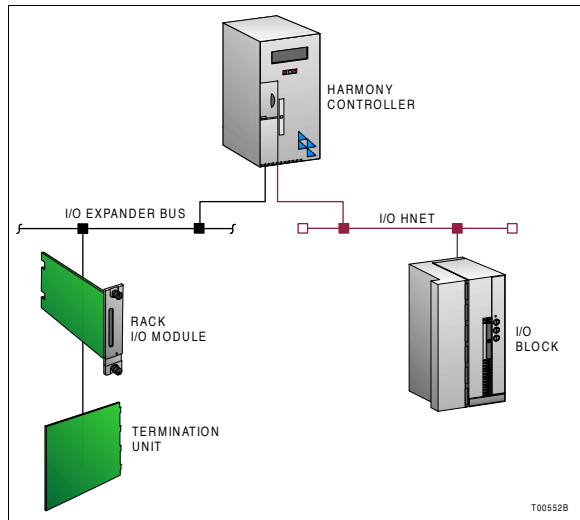


Figure 1-4. Controller I/O Communication

Harmony Area Controller

Like the bridge controller, the Harmony area controller (HAC) supports the communications protocol and configuration environment necessary to operate the Harmony I/O system. It collects process I/O data, performs control algorithms, and outputs control signals to final control elements through either or both Harmony I/O blocks and rack I/O devices (Fig. 1-4). The controller offers enhanced communications and process interface abilities. Refer to the **Harmony Area Controller** instruction for a detailed description.



Function Codes

When interfacing to Harmony I/O blocks, the controller utilizes single channel I/O function codes:

- Analog input/channel (FC 222).
- Analog output/channel (FC 223).
- Digital input/channel (FC 224).
- Digital output/channel (FC 225).

These single channel function codes simplify configuration: one function code configures one channel. A single I/O device definition function code (FC 221) groups the single channel function codes for an entire I/O block. Refer to the **Function Code Application Manual** for detailed function code descriptions.

Compatibility

The Harmony I/O system is fully compatible with existing INFI 90 OPEN systems. The I/O system can be integrated into established installations that currently use INFI 90 OPEN I/O to interface and process input and output signals. Or, the I/O system can be installed to replace existing INFI 90 OPEN I/O.

The Harmony controller can communicate with Harmony I/O and INFI 90 OPEN I/O simultaneously. Communication is over Hnet for Harmony I/O blocks and over I/O expander bus for INFI 90 OPEN I/O.

Features

Intelligent I/O system: A microprocessor in each I/O assembly executes the I/O portion of the control strategy and provides advanced functions and diagnostics.

High performance, deterministic I/O network: Uses a redundant, high speed serial communication network with an inherent capability for remote communication.

Distributed capability: A high speed I/O communication network designed for long distances combined with flexible enclosure mounting options enables both centralized and remote I/O locations.

Inherent redundancy design: Designed with redundant block power inputs (24 VDC), redundant communications, and optionally redundant I/O modules.

Wide variety of I/O types: Analog (high level, low level, and temperature), digital, and control I/O.

Significant reduction of installation costs: I/O assemblies combine chassis, cabling, I/O electronics, power conversion, and termination into one device. Distribution of I/O reduces cable costs.

Reduction in total operating costs: Simplified user configuration with no calibration required, no address switches to set, and downloadable firmware.

Compatibility with existing systems: Works with both the Harmony bridge controller and Harmony area controller; works in combination with Harmony rack I/O and INFI 90 OPEN I/O.

Advanced features:

- Downloadable firmware eliminates PROM changes.
- User-assignable software device labels eliminate the need to manually set hardware addresses.
- User-assignable I/O channel labels simplify configuration. The same label can be used to identify an I/O channel and to define a tag in the system database for easier I/O point recognition.
- Advanced diagnostics of I/O block, I/O channel, and Hnet traffic identifies system problems.
- I/O status can be inhibited from contributing to block status, eliminating nuisance alarms.
- Manual override of I/O channel values simplifies system maintenance.

Intended User

This instruction is intended for technical personnel responsible for installation, operation, maintenance, and repair of the Harmony I/O system. System engineers and technicians with



a background in process control systems should read this instruction thoroughly before installing and using the system.

Instruction Content

Introduction	Gives an overview of the Harmony I/O system and describes the content and intended user of this instruction. It also highlights I/O system features, lists reference documents, and contains system and general block specification information.
Input/Output Blocks	Provides a brief description of the available I/O and auxiliary blocks, and provides specifications for each.
Description and Operation	Provides a general description of Harmony I/O blocks and details functional operation.
Redundancy	Provides a general description of block redundancy, and details redundancy for specific block types.
Installation	Describes I/O and auxiliary block installation and connection.
Configuration	Describes controller and I/O block function code configuration and operation.
Operating Procedures	Details I/O block and auxiliary block front and rear panel items, startup, stop/reset, and initialization procedures.
Troubleshooting	Provides troubleshooting information including LED error indications, status codes, and problem reports; and describes online and offline diagnostics for testing I/O electronics integrity.
Maintenance	Includes a preventive maintenance schedule and lists the related procedures.
Repair and Replacement	Describes repair and replacement procedures for I/O and auxiliary blocks.
Replacement and Spare Parts	Provides a list of part nomenclature and part numbers.
Procedures	Individual procedure sections (e.g., PR1, PR6, PR27, etc.) detail installation, maintenance, and replacement actions. A procedure section typically gives the steps for a single task. Installation flowcharts and replacement flowcharts indicate the order in which these procedures are to be performed.

Worksheets Worksheets are provided for each I/O block type and are only intended to aid in the installation process. In some cases, the information recorded on the worksheets may already be available or provided in some other form.

How to Use this Instruction

When installing a complete Harmony I/O system:

1. Refer to the ***Block Power and Mounting Hardware*** instruction to install and connect the block mounting hardware and to connect power.
2. Refer to the ***Harmony Communication Network (Hnet)*** instruction to install and connect Hnet components for communication.
3. Refer to this instruction when installing, operating, troubleshooting, maintaining, and replacing individual I/O and auxiliary blocks.

To use this instruction:

1. Read **Section 1** for an overview of the Harmony I/O system and a description of the instruction content.
2. Refer to **Section 2** for I/O and auxiliary block descriptions and specifications.
3. Read **Section 3** and **Section 4** to become familiar with I/O and auxiliary blocks.
4. Read **Section 5** to install I/O and auxiliary blocks. The section contains flowcharts that point to the various procedures that must be performed to complete installation and connection.
5. Read **Section 6** for controller and function code configuration information.
6. Read **Section 7** for I/O block operating details.
7. Refer to Sections **8, 9, and 10** for troubleshooting, maintenance, and replacement information respectively.
8. Refer to **Section 11** for installation, replacement, and spare part nomenclature and part numbers.



Document Conventions

The ? in a nomenclature or part number indicates a variable for that position (e.g., 1949480?1). In a part number and document number, the ? is a place holder for the revision letter.

Glossary of Terms and Abbreviations

Table 1-3 is a glossary of terms and abbreviations used in the instruction. It contains those terms and abbreviations that are unique to ABB Automation or have a definition that is different from standard industry usage.

Table 1-3. Glossary of Terms and Abbreviations

Term	Definition
Auxiliary block	I/O system device that enhances I/O block capabilities.
Base	Mounting base for a block. For I/O blocks it supports screw terminals, clamp terminals, or cable connection of field wiring.
BRC	Harmony bridge controller.
Channel label	Optional name (i.e., character string) assigned to an I/O channel.
Device label	Name (i.e., character string) assigned to an I/O block. The device label identifies a block instead of a hardware address.
Exception report	Information update generated when the status or value of a point changes by more than a specified significant amount.
Function code (FC)	An algorithm that manipulates specific functions. These functions are linked together to form the control strategy.
HAC	Harmony area controller.
Harmony network (Hnet)	Redundant serial communications system that allows data to be transmitted between Harmony devices.
I/O block	Generic name for a processor based Harmony input/output device: AIN-120, AOT-150, DIO-400, etc.; comprised of an I/O module and a base.
I/O expander bus	Parallel communication bus between the Harmony controller and rack I/O.
I/O module	Houses the I/O block circuitry that processes inputs and outputs; part of an I/O block.
Machine fault time (MFT)	Reset by the block processor during normal operation. If not reset regularly, the MFT times out and the I/O block stops.
Module mounting unit (MMU)	Card cage that provides electrical and communication support for Harmony rack I/O.

Table 1-3. Glossary of Terms and Abbreviations *(continued)*

Term	Definition
PBA	Processor bus adapter.
Processor bus adapter	Adapter that connects a Harmony bridge controller to Hnet.
Repeater mounting unit	Generic name for a block that contains Hnet repeaters.
RFO	Fiber optic repeater used to connect Hnet between enclosures.
RMU	Repeater mounting unit.

Reference Documents

Table 1-4 lists additional documents that relate to the Harmony I/O system and are referenced in this instruction.

Table 1-4. Reference Documents

Number	Document Title
WPPEEUD240001??	Harmony Analog I/O Data Sheet
WPPEEUD240002??	Harmony Digital I/O Data Sheet
WPPEEUD240003??	Harmony Control I/O Data Sheet
WPPEEUI200505??	Symphony Site Planning and Preparation
WPPEEUI210504??	Symphony Function Code Application Manual
WPPEEUI230017??	Harmony Bridge Controller
WPPEEUI230022??	IISAC01 Analog Control Station
WPPEEUI230023??	Harmony Area Controller
WPPEEUI240760??	Harmony I/O System, Block Power and Mounting Hardware
WPPEEUI240761??	Harmony Communications Network (Hnet)
WPPEEUI270002??	Composer™, Primary Interface
WPPEEUI270003??	Composer, Automation Architect

Abbreviated Harmony I/O Nomenclature

Table 1-5 lists the abbreviated nomenclature used throughout the instruction to identify various Harmony I/O system components and related hardware. Refer to [Section 11](#) for complete Harmony I/O system component nomenclature.



Table 1-5. Abbreviated Harmony I/O System Nomenclature

Nomenclature	Description
AIN-120, AIN-200, AIN-220, AIN-300	Analog input block
AOT-150	Analog output block
BLK-100	Blank block
BRC-PBA	Processor bus adapter
CIO-100	Control input/output block
CIO-110	Electric drive/pulse positioner termination block
DIO-400	Digital input/output block
DOT-100, DOT-120	Digital output block
HRM-RLY, HRM-RTS	Cables
RLY-100, RLY-200	Auxiliary relay assembly

Related Nomenclature

Refer to [Section 11](#) for a listing of Harmony I/O system nomenclature and part numbers. Table 1-6 provides a listing of Harmony I/O related nomenclature.

Table 1-6. Related Nomenclature

Nomenclature	Description
IISAC01	Analog control station
P-HC-BRC-10000000	Harmony bridge controller
P-HC-PLT-20221100 P-HC-DOC-220??000	Harmony area controller

Design Standards

Table 1-7 lists the design standards for the Harmony I/O system.

Table 1-7. Design Standards

Category	Standard	Description
Safety	CSA C22.2 No. 142	Safety standards for process control equipment
	ANSI/ISA S82.01-1994	
	IEC 61010-1	Safety standards for process control equipment
	CSA C22.2 No. 1010.1	
Environmental	IEC 60068-2-1,2,14	Operating temperature
	IEC 60068-2-3,30	Operating relative humidity
	MIL-STD-810E 502.3 & 501.3	Storage/transportation temperature
	ISA S71.04 (level 1 liquids, solids, gases)	Air quality
	IEC 60068-2-6	Operating vibration (sinusoidal)
	MIL-STD-810E 514.4	Storage/transportation vibration Category 1, basic transportation
Vibration	MIL-STD-810E 514.4	Transportation
	IEC 60068-2-27	Shock
	IEC 61298-3	Endurance
EMI, RFI, and electrical surge	IEC 61000-4-2 (level 3)	ESD
	IEC 61000-4-3 (level 3)	EMI susceptibility
	IEC 61000-4-4 (level 3)	Electrical fast transient
	IEC 61000-4-5 (level 3)	Electrical surges
	IEC 61000-4-6 (level 3)	Conducted immunity
	IEC 61000-4-8 (level 3)	Magnetic fields
	CISPR-11	Radiated emissions
Flammable atmospheres	CSA C22.2 No. 213	Nonincendive equipment
	ISA S12.12	Nonincendive equipment
	FM Class 3611	Division 2 equipment
Flammability of product components	IEEE 383	Intercabinet cables
	UL rating VW-1	Intracabinet cables
	UL 94 V-0, V-1, or V-2	Flammability of plastic materials

**Table 1-7. Design Standards** *(continued)*

Category	Standard	Description
CE Mark directives	73/23/EEC	Low voltage directive
	89/336/EEC	EMC directive
	92/31/EEC	
	90/683/EEC	CE marking directives
	93/68/EEC	
	93/465/EEC	
Certifications	CSA	Certified for use as process control equipment in an ordinary (nonhazardous) location
	Factory Mutual (FM)	Approved for use in Class I; Division 2; Groups A, B, C, D; hazardous locations.

SUBJECT TO CHANGE WITHOUT NOTICE

Specifications

Tables 1-8 through 1-10 are general I/O and auxiliary block specifications.

NOTE: Refer to the Harmony I/O data sheets (Table 1-4) for current consumption and heat dissipation specifications.

Table 1-8. General I/O Block Specifications

Property	Characteristic/Value ¹			
I/O blocks (Refer to indicated table for individual block specifications)	Block	Refer To	Block	Refer To
	AIN-120	Table 2-1	CIO-100	Table 2-7
	AIN-200	Table 2-2	DIO-400	Table 2-9
	AIN-220	Table 2-3	DOT-100	Table 2-10
	AIN-300	Table 2-4	DOT-120	Table 2-11
	AOT-150	Table 2-5		
Microprocessor	16-bit processor running at 16 MHz			
Memory	64 kb SRAM 512 kb flash ROM			
Redundancy link data rate	1 Mbaud			
Block logic power (BLP)	21.6 VDC minimum 24.0 VDC nominal 28.0 VDC maximum			

Table 1-8. General I/O Block Specifications *(continued)*

Property	Characteristic/Value ¹																																		
Field power (IFP/LFP)	24.0 VDC nominal 48.0 VDC nominal 125.0 VDC nominal 120.0 VAC nominal 240.0 VAC nominal																																		
LFP terminals	3.0 A																																		
Fusing	Refer to the individual block specifications in Section 2																																		
Common mode isolation ² Tested	300 VDC/V _{RMS} at 60 Hz 1,400 V _{RMS} at 60 Hz for 2 sec																																		
Differential input voltage without damage	±15 VDC/V _{RMS} continuous																																		
Common mode voltage ³	±5 VDC/V _{RMS} continuous																																		
Input/output protection	Continuous short to ground - protected with current limiting																																		
Dimensions	<table><tr><th rowspan="2">Type</th><th colspan="2">Height</th><th colspan="2">Width</th><th colspan="2">Depth</th></tr><tr><th>mm</th><th>in.</th><th>mm</th><th>in.</th><th>mm</th><th>in.</th></tr><tr><td>I/O module</td><td>266</td><td>10.5</td><td>76</td><td>3.0</td><td>162</td><td>6.4</td></tr><tr><td>Nonredundant base</td><td>267</td><td>10.5</td><td>138</td><td>5.4</td><td>169</td><td>6.7</td></tr><tr><td>Redundant base</td><td>267</td><td>10.5</td><td>217</td><td>8.5</td><td>169</td><td>6.7</td></tr></table> NOTE: Refer to Appendix A for hardware drawings.	Type	Height		Width		Depth		mm	in.	mm	in.	mm	in.	I/O module	266	10.5	76	3.0	162	6.4	Nonredundant base	267	10.5	138	5.4	169	6.7	Redundant base	267	10.5	217	8.5	169	6.7
Type	Height		Width		Depth																														
	mm	in.	mm	in.	mm	in.																													
I/O module	266	10.5	76	3.0	162	6.4																													
Nonredundant base	267	10.5	138	5.4	169	6.7																													
Redundant base	267	10.5	217	8.5	169	6.7																													
Overvoltage (installation) category	ANSI/ISA-S82.01-1994 and IEC 1010-1 I for circuits above 150 V II for circuits below 150 V																																		

NOTES:

1. All specification values are maximums unless stated otherwise.

2. Applies only to blocks with isolated input and output channels. Refer to [Section 2](#) to determine if a block has isolated channels.3. Applies only to blocks with nonisolated input and output channels. Refer to [Section 2](#) to determine if a block has isolated channels.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Table 1-9. General Auxiliary Block Specifications

Property	Characteristic/Value	
Auxiliary blocks (Refer to indicated table for individual block specifications)	Block	Refer To
	CIO-110	Table 2-8
	RLY-100	Table 2-12
	RLY-200	Table 2-13

Table 1-9. General Auxiliary Block Specifications *(continued)*

Property	Characteristic/Value					
Dimensions	Height		Width		Depth	
	mm	in.	mm	in.	mm	in.
	266	10.5	144	5.7	169	6.7

NOTE: Refer to [Appendix A](#) for hardware drawings.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Table 1-10. Environmental Specifications

Environment	Operating	Storage and Transportation
Air quality	Noncorrosive	Noncorrosive
Altitude	Sea level to 3,048 m (10,000 ft)	Sea level to 12,000 m (40,000 ft)
Relative humidity (noncondensing)	20% to 95% up to 55°C (131°F) 20% to 45% at 55° to 70°C (131° to 158°F)	20% to 95% up to 55°C (131°F) 20% to 45% at 55° to 70°C (131° to 158°F)
Temperature	0° to 70°C (32° to 158°F) (internal enclosure)	-40° to +85°C (-40° to 185°F)
Vibration	10 to 60 Hz, 1.37 mm (0.054 in.) pp 60 to 150 Hz, 1.0 G sine	0.74 G _{RMS} longitudinal 0.20 G _{RMS} transverse 1.04 G _{RMS} vertical 10 to 500 Hz random
Shock	—	15 G, 11 msec

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Introduction

This section provides a brief description of the available I/O and auxiliary blocks, and provides specifications for each. Refer to Tables 1-8 and 1-9 for general specifications that apply to all I/O and auxiliary blocks.

NOTES:

1. Refer to **Inputs and Outputs** in Section 3 for further explanation of analog and digital input and output capabilities.
2. Refer to the Harmony I/O data sheets (Table 1-4) for current consumption and heat dissipation specifications.

AIN-120

Current, High Level Voltage In

Analog input signals:

- 4 to 20 milliampere.
- -10 to +10 VDC high level, differential.
- -10 to +10 VDC high level, single-ended.

The AIN-120 block supports 16 nonisolated input channels that are individually hardware configurable for either voltage or current mode and software configurable for voltage range. The block supports redundant I/O electronics.

Table 2-1. AIN-120 Specifications

Property	Characteristic/Value ¹
Input range	4 to 20 mA -10 to +10 VDC
Channels	16 nonisolated
Input impedance	10 M Ω minimum
Full scale range	20 V
Maximum error ²	
Current	$\pm 0.06\%$ of full scale range
Voltage	$\pm 0.05\%$ of full scale range

**Table 2-1. AIN-120 Specifications** *(continued)*

Property	Characteristic/Value ¹
Temperature effect (0° to 70°C)	±0.005%/°C
Settling time for all 16 channels (100% step change)	75 msec to 95% of final value
Update rate ³	All channels 40 times per second (25 msec)
Rejection (50-60 Hz)	
Normal mode	–70 dB
Common mode	–90 dB
Number of A-to-D converters	1
Full scale resolution	16 bit resolution for –10 to +10 VDC range
Fault currents per channel ⁴ (current mode)	Each channel provides current limiting and automatic recovery
Shorted transmitter	60 mA nominal (IFP/LFP) 100 mA nominal (RFP)
Shorted positive to ground	160 mA nominal (IFP/LFP)
BLP fuse (A and B)	1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
IFP/LFP fuse	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)
Weight	
Module	1.0 kg (2.2 lb)
Nonredundant base	1.3 kg (2.8 lb)
Redundant base	1.7 kg (3.9 lb)

NOTES:

1. All specification values are maximums unless stated otherwise.

2. Maximum error includes effects of nonlinearity, repeatability, hysteresis, noise, and quantization error.

3. This is the rate at which the block reads and updates values. The rate at which the values are actually read and become available to the system depends on the scan cycle of the controller.

4. Remote field powered I/O may need external protection.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

AIN-200

Isolated High Level Voltage, Low Level Voltage, Thermocouple In

Analog input signals:

- –10 to +10 VDC high level, differential.
- –100 to +100 millivolt (DC) low level, differential.
- Thermocouple (refer to Table 2-2 for types supported).

The AIN-200 block supports 16 isolated input channels that operate in voltage mode only. Each input channel is individually software configurable for voltage range or thermocouple type. Cold junction compensation for thermocouple inputs is included. The block supports redundant I/O electronics.

Table 2-2. AIN-200 Specifications

Property	Characteristic/Value ¹
Input range	–10 to +10 VDC –100 to +100 mVDC
Thermocouple types	B, E, J, K, L, N (14 AWG), N (28 AWG), R, S, T, U Chinese E, S
Channels	16 isolated
Input impedance	10 M Ω minimum
Full scale range	20 V or 200 mV
Maximum error ²	$\pm 0.05\%$ of full scale range
Temperature effect (0° to 70°C)	$\pm 0.005\%/^{\circ}\text{C}$
Settling time per channel (100% step change)	170 msec to 95% of final value
Update rate ³	All channels 18 times per second (56 msec)
Rejection (50-60 Hz) Normal mode Common mode	–70 dB –120 dB
Number of A-to-D converters	16 + 1 for cold junction
Full scale resolution	18 bit resolution for –10 to +10 VDC range or –100 to +100 mVDC range
BLP fuse (A and B)	1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
IFP/LFP fuse	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)
Weight Module Nonredundant base Redundant base	1.0 kg (2.2 lb) 1.2 kg (2.7 lb) 1.6 kg (3.4 lb)

NOTES:

1. All specification values are maximums unless stated otherwise.

2. Maximum error includes effects of nonlinearity, repeatability, hysteresis, noise, and quantization error.

3. This is the rate at which the block reads and updates values. The rate at which the values are actually read and become available to the system depends on the scan cycle of the controller.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



AIN-220

Isolated Current, High Level Voltage, Low Level Voltage, Thermocouple In

Analog input signals:

- 4 to 20 milliamperes.
- -10 to +10 VDC high level, differential.
- -10 to +10 VDC high level, single-ended.
- -100 to +100 millivolt (DC) low level, differential.
- -100 to +100 millivolt (DC) low level, single-ended.
- Thermocouple (refer to Table 2-3 for types supported).

The AIN-220 block supports 16 isolated input channels that are individually hardware configurable for either voltage or current mode and software configurable for voltage range or thermocouple type. Cold junction compensation for thermocouple inputs is included. The block supports redundant I/O electronics.

Table 2-3. AIN-220 Specifications

Property	Characteristic/Value ¹
Input range	4 to 20 mA -10 to +10 VDC -100 to +100 mVDC
Thermocouple types	B, E, J, K, L, N (14 AWG), N (28 AWG), R, S, T, U Chinese E, S
Channels	16 isolated
Input impedance	10 M Ω minimum
Full scale range	20 V or 200 mV
Maximum error ²	
Current	$\pm 0.06\%$ of full scale range
Voltage	$\pm 0.05\%$ of full scale range
Temperature effect (0° to 70°C)	$\pm 0.005\%/^{\circ}\text{C}$
Settling time per channel (100% step change)	170 msec to 95% of final value
Update rate ³	All channels 18 times per second (56 msec)
Rejection (50-60 Hz)	
Normal mode	-70 dB
Common mode	-120 dB
Number of A-to-D converters	16 + 1 for cold junction

Table 2-3. AIN-220 Specifications *(continued)*

Property	Characteristic/Value ¹
Full scale resolution	18 bit resolution for –10 to +10 VDC range or –100 to +100 mVDC range
Fault currents per channel ⁴ (current mode)	Each channel provides current limiting and automatic recovery
Shorted transmitter	60 mA nominal (IFP/LFP) 100 mA nominal (RFP)
Shorted positive to ground	160 mA nominal (IFP/LFP)
BLP fuse (A and B)	1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
IFP/LFP fuse	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)
Weight	
Module	1.0 kg (2.2 lb)
Nonredundant base	1.2 kg (2.7 lb)
Redundant base	1.6 kg (3.4 lb)

NOTES:

1. All specification values are maximums unless stated otherwise.

2. Maximum error includes effects of nonlinearity, repeatability, hysteresis, noise, and quantization error.

3. This is the rate at which the block reads and updates values. The rate at which the values are actually read and become available to the system depends on the scan cycle of the controller.

4. Remote field powered I/O may need external protection.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

AIN-300

Isolated RTD In

The AIN-300 block interfaces three-wire RTD analog input signals. It supports 16 isolated input channels individually software configurable for RTD type (refer to Table 2-4 for types supported). The block supports redundant I/O electronics.

Table 2-4. AIN-300 Specifications

Property	Characteristic/Value ¹
RTD types (3-wire)	10 Ω copper 100 Ω platinum: U.S. Lab. Standard 100 Ω platinum: U.S. Industry Standard 100 Ω platinum: European Standard 120 Ω nickel Chinese 53 Ω copper
Channels	16 isolated
Full scale range	500 Ω



Table 2-4. AIN-300 Specifications (continued)

Property	Characteristic/Value ¹
Maximum error ²	±0.10% of full scale range
Temperature effect (0° to 70°C)	±0.005%/°C
Settling time per channel (100% step change)	170 msec to 95% of final value
Update rate ³	All channels 18 times per second (56 msec)
Rejection (50-60 Hz)	
Normal mode	–70 dB
Common mode	–120 dB
Number of A-to-D converters	16
Full scale resolution	18 bit
BLP fuse (A and B)	1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
IFP/LFP fuse	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)
Weight	
Module	1.0 kg (2.2 lb)
Nonredundant base	1.4 kg (3.1 lb)
Redundant base	1.7 kg (3.7 lb)

NOTES:

1. All specification values are maximums unless stated otherwise.

2. Maximum error includes effects of nonlinearity, repeatability, hysteresis, noise, and quantization error.

3. This is the rate at which the block reads and updates values. The rate at which the values are actually read and become available to the system depends on the scan cycle of the controller.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

AOT-150

Current Out

The AOT-150 block interfaces high level analog output signals. It supports 16 nonisolated output channels that operate in current mode (4 to 20 milliamperes). Special output circuitry allows this block to support redundant I/O electronics.

Table 2-5. AOT-150 Specifications

Property	Characteristic/Value ¹
Output range	4 to 20 mA
Channels	16 nonisolated
Full scale range	18 mA

Table 2-5. AOT-150 Specifications (continued)

Property	Characteristic/Value ¹
Maximum error ²	±0.15% of full scale range
Temperature effect (0° to 70°C)	±0.005%/°C
Update rate ³	All channels 16 times per second (63 msec)
Settling time per channel (100% step change)	50 μ sec (resistive load) to 95% of final value
Number of D-to-A converters	1
D-to-A full scale resolution	12 bit
Number of A-to-D converters	1 (readback)
A-to-D full scale resolution	16 bit (readback)
Load compliance Resistive Inductive	0 to 750 Ω 600 mH
BLP fuse (A and B)	1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
IFP/LFP fuse	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)
Weight Module Nonredundant base Redundant base	1.0 kg (2.3 lb) 1.3 kg (2.9 lb) 1.5 kg (3.4 lb)

NOTES:

1. All specification values are maximums unless stated otherwise.

2. Maximum error includes effects of nonlinearity, repeatability, hysteresis, noise, and quantization error.

3. This is the rate at which the block reads and updates values. The rate at which the values are actually read and become available to the system depends on the scan cycle of the controller.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

BLK-100

Blank Block

The BLK-100 block is used to fill empty block positions on a column. Any empty positions within a column of blocks must be filled to maintain airflow. Blank blocks are not required, however, in empty positions at the bottom of a column. The block supports redundant blank modules.



Table 2-6. BLK-100 Specifications

Property	Characteristic/Value
Weight	
Module	0.9 kg (2.1 lb)
Nonredundant base	1.1 kg (2.4 lb)
Redundant base	1.4 kg (3.2 lb)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CIO-100

Control Loop In/Out

The CIO-100 supports the following control inputs and outputs:

- Four nonisolated 4 to 20 milliampere or 1 to 5 VDC high level, analog inputs.
- Two nonisolated 4 to 20 milliampere or 1 to 5 VDC high level, analog outputs.
- Four isolated digital inputs individually selectable for 24 VDC, 48 VDC, 125 VDC, 120 VAC, and 240 VAC.
- Four isolated 24 VDC digital outputs with a maximum load current of 250 milliamperes.

Analog input and output channels are individually hardware configurable for either voltage or current mode. Digital input channels are individually hardware configurable for input voltage range. The digital outputs are open-collector output channels.

The CIO-100 block provides two station connectors to support connection of up to eight IISAC01 Analog Control Stations (Fig. 2-1). Up to four stations can be daisy-chained from each connector. The first station connected can be configured as a bypass control station while the remaining three daisy-chained from the first station operate as indicator stations (i.e., no bypass capability).

A bypass station can be setup as a current bypass station or an electric drive/pulse positioner bypass station. A current bypass station connects directly to the CIO-100 block. An electric drive/pulse positioner bypass station requires a CIO-100 and CIO-110 block pair for connection (Fig. 2-2).

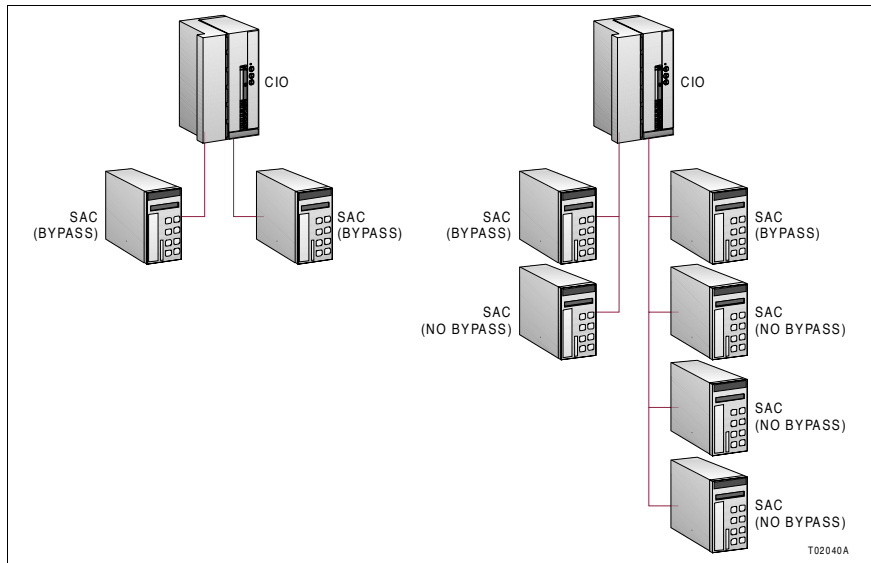


Figure 2-1. Analog Control Station Interface

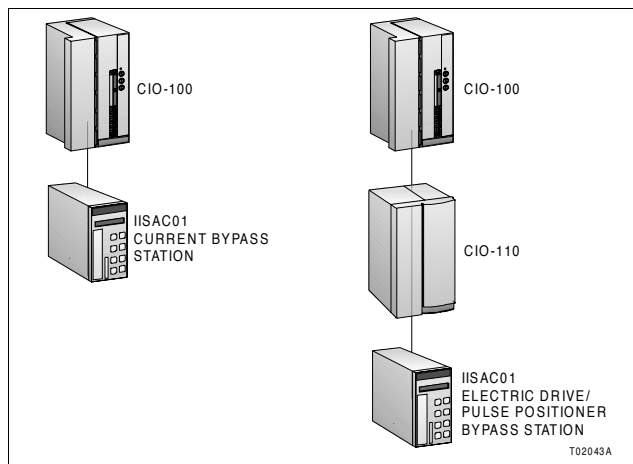


Figure 2-2. Station Connection



The CIO-100 does not support redundant I/O electronics. Instead, the analog control station (IISAC01) can be used with the CIO block to provide automatic or manual backup.

Table 2-7. CIO-100 Specifications

Property		Characteristic/Value ¹
Channels		4 nonisolated analog inputs 2 nonisolated analog outputs 4 isolated digital inputs 4 isolated digital outputs
AI	Input range	4 to 20 mA 1 to 5 VDC
	Input impedance	1 M Ω minimum
	Full scale range Current Voltage	18 mA 4.5 V
AI	Maximum error ² Current Voltage	$\pm 0.20\%$ of full scale range $\pm 0.05\%$ of full scale range
	Temperature effect (0° to 70°C)	$\pm 0.005\%/^{\circ}\text{C}$
	Update rate ³	All channels 40 times per second (25 msec)
	Settling time for all four channels (100% step change)	700 msec to 95% of final value
	Number of A-to-D converters	1
	A-to-D full scale resolution	16 bit
	Rejection (50-60 Hz) Normal mode Common mode	-70 dB -90 dB
	Fault currents per channel Shorted transmitter Shorted + to ground	Each channel provides current limiting and automatic recovery 70 mA nominal (IFP/LFP) 186 mA nominal (IFP/LFP)
AO	Output range	4 to 20 mA 1 to 5 VDC
	Full scale range Current Voltage	18 mA 4.5 V
	Maximum error ² Current Voltage	$\pm 0.20\%$ of full scale range $\pm 0.10\%$ of full scale range

Table 2-7. CIO-100 Specifications (continued)

	Property	Characteristic/Value ¹
AO	Temperature effect (0° to 70°C)	±0.005%/°C
	Update rate ³	All channels 40 times per second (25 msec)
	Settling time per channel (100% step change)	500 μ sec (resistive load) to 95% of final value
	Number of D-to-A converters	2
	D-to-A full scale resolution	12 bit
	Number of A-to-D converters	1 (readback)
	A-to-D full scale resolution	16 bit (readback)
	Load compliance Resistive (current) Resistive (voltage) Inductive	0 to 600 Ω >1 k Ω 600 mH
	Fault currents per channel (voltage and current modes)	50 mA nominal (IFP/LFP)
DI	24 VDC 48 VDC 125 VDC 120 VAC 240 VAC	19.5 to 28 VDC 39 to 56 VDC 95 to 144 VDC 85 to 138 VAC 190 to 265 VAC
	Sample rate	All channels 1,000 times per second (1 msec)
	Update rate	All channels 63 times per second (16 msec) when debounce ⁴ = 0
	Turn ON voltage 24 VDC 48 VDC 125 VDC 120 VAC 240 VAC	19.5 VDC minimum 39 VDC minimum 95 VDC minimum 85 VAC minimum 190 VAC minimum
	Turn OFF voltage 24 VDC 48 VDC 125 VDC 120 VAC 240 VAC	12 VDC 18 VDC 58 VDC 40 VAC 87 VAC
	ON current ⁵	4.6 to 7.3 mA typical
	OFF leakage current	<1.5 mA
	AC frequency	47 to 63 Hz



Table 2-7. CIO-100 Specifications (continued)

Property		Characteristic/Value ¹											
DI	Fault currents per channel: 24 VDC 48 VDC 125 VDC 120 VAC 240 VAC	Each channel provides current limiting and automatic recovery 31 mA nominal 8.1 mA nominal 14 mA nominal 15 mA nominal 15 mA nominal											
DO	Open collector outputs	<table><tr><th>Output</th><th>Off</th><th>On</th><th>Load</th></tr><tr><td>24 VDC</td><td>28 VDC</td><td>2.5 VDC</td><td>250 mA</td></tr></table>				Output	Off	On	Load	24 VDC	28 VDC	2.5 VDC	250 mA
	Output	Off	On	Load									
	24 VDC	28 VDC	2.5 VDC	250 mA									
	Update rate	All channels 63 times per second (16 msec)											
	Switching speed	<0.25 msec											
OFF leakage current	<1 mA												
Station connectors		2											
Station fuse (24 VDC LFP)		6.3 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)											
Station link (RS-485)		40 kbaud											
BLP fuse (A and B)		1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)											
IFP/LFP fuse		3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)											
Weight													
Module		1.0 kg (2.2 lb)											
Base		1.4 kg (3.1 lb)											

NOTES:

1. All specification values are maximums unless stated otherwise.
2. Maximum error includes effects of nonlinearity, repeatability, hysteresis, noise, and quantization error.
3. This is the rate at which the block reads and updates values. The rate at which the values are actually read and become available to the system depends on the scan cycle of the controller.
4. Software selectable in 1-msec increments up to 255 msec (debounce period).
5. Actual input current depends on input type selection.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CIO-110

Electric Drive/Pulse Positioner Termination

The CIO-110 block is an auxiliary block used with a CIO-100 block to connect a manual/auto station that operates in electric drive/pulse positioner bypass mode. The CIO-110 block provides the terminals necessary for proper wiring connection. The CIO-110 block cable connects to the CIO-100 block.

Table 2-8. CIO-110 Specifications

Property	Characteristic/Value
Station connectors	2
Field power (LFP) voltage ¹	24.0 VDC nominal
Station fuse (24 VDC LFP)	4.0 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
Weight	1.5 kg (3.2 lb)

NOTE:

1. 24 VDC to power manual/auto stations. Refer to *IISAC01 Analog Control Station* instruction for station current requirements.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DIO-400

Universal Digital In, 24 or 48 VDC Digital Out

The DIO-400 block interfaces digital input and output signals used to read on or off device states and to switch DC voltages. It supports 16 isolated input channels and eight isolated output channels. Input channels are individually hardware configurable for input voltage range. Open-collector output channels can switch voltages of 24 or 48 VDC with a maximum load current of 250 milliamperes. The DIO block can cable connect to an RLY-100 or RLY-200 auxiliary relay block to provide relay outputs. The block supports redundant I/O electronics.

Table 2-9. DIO-400 Specifications

Property		Characteristic/Value ¹
Channels		16 isolated digital input 8 isolated digital output
In	24 VDC	19.5 to 28 VDC
	48 VDC	39 to 56 VDC
	125 VDC	95 to 144 VDC
	120 VAC	85 to 138 VAC
	240 VAC	190 to 265 VAC
	AC frequency	47 to 63 Hz
	Sample rate	All channels 1,000 times per second (1 msec)
	Update rate	All channels 83 times per second (12 msec) when debounce ² = 0



Table 2-9. DIO-400 Specifications (continued)

Property		Characteristic/Value ¹			
In	Turn ON voltage	19.5 VDC minimum			
	24 VDC	39 VDC minimum			
	48 VDC	95 VDC minimum			
	125 VDC	85 VAC minimum			
	120 VAC	190 VAC minimum			
	240 VAC				
	Turn OFF voltage				
	24 VDC	12 VDC			
	48 VDC	18 VDC			
	125 VDC	58 VDC			
120 VAC	40 VAC				
240 VAC	87 VAC				
	ON current ³	4.6 to 7.3 mA typical			
	OFF leakage current	<1.5 mA			
	Fault currents per channel	Each channel provides current limiting and automatic recovery			
	24 VDC	31 mA nominal			
	48 VDC	8.1 mA nominal			
	125 VDC	14 mA nominal			
	120 VAC	15 mA nominal			
	240 VAC	15 mA nominal			
Out	Open collector	Output	Off	On	Load
		24 VDC	28 VDC	2.5 VDC	250 mA
		48 VDC	56 VDC	2.5 VDC	250 mA
	Update rate	All channels 83 times per second (12 msec)			
	Switching speed	<0.25 msec			
	OFF leakage current	<1 mA			
	BLP fuse (A and B)		1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)		
IFP/LFP fuse		3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)			
Weight					
Module		1.0 kg (2.2 lb)			
Nonredundant base		1.3 kg (2.9 lb)			
Redundant base		1.7 kg (3.7 lb)			

NOTES:

1. All specification values are maximums unless stated otherwise.
2. Software selectable in 1-msec increments up to 255 msec (debounce period).
3. Actual input current depends on input type selection.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DOT-100

Onboard Electromechanical Relay Out

The DOT-100 block interfaces digital output signals and is used in AC/DC switching applications. It supports 16 isolated output channels (i.e., relay contacts). Each channel can be wired as either a normally open or normally closed output. Relays are socketed for easy replacement. Output channels can switch voltages up to 240 VAC and maximum load currents up to 3.0 amperes. Arc suppressors protect the contacts when driving inductive loads. The block supports redundant I/O electronics.

Table 2-10. DOT-100 Specifications

Property		Characteristic/Value ¹																																			
Outputs		24 VDC, 48 VDC, 125 VDC 120 VAC, 240 VAC																																			
Channels		16 isolated (relay contacts)																																			
Update rate		All channels 83 times per second (12 msec)																																			
Relay	Type	Magnacraft miniature epoxy sealed PC board EM relay																																			
	Coil nominal voltage	24 VDC																																			
	Coil nominal current	23 mA																																			
	Contact configuration	SPDT (1 form C)																																			
	Contact material	Silver cadmium oxide																																			
	Contact resistance	100 mΩ																																			
	Cycle rate	30 operations per minute at rated load																																			
	Minimum switching load	10 VDC at 10 mA																																			
	Switching speed	15 msec																																			
	Bounce time	1.2 msec (average)																																			
No. of operations		150,000																																			
Currents		<table><tr><th>Property</th><th>24 VDC</th><th>48 VDC</th><th>125 VDC</th><th>120 VAC</th><th>240 VAC</th></tr><tr><td>Make</td><td>6.0 A</td><td>6.0 A</td><td>6.0 A</td><td>6.0 A</td><td>3.0 A</td></tr><tr><td>Carry</td><td>3.0 A</td><td>3.0 A</td><td>3.0 A</td><td>3.0 A</td><td>1.5 A</td></tr><tr><td>Resistive break</td><td>3.0 A</td><td>3.0 A</td><td>3.0 A</td><td>3.0 A</td><td>1.5 A</td></tr><tr><td>Inductive break</td><td>1.0 A</td><td>1.0 A</td><td>1.0 A</td><td>1.0 A</td><td>0.5 A</td></tr></table> NOTE: L/R = 7.0 msec; pf = 40%						Property	24 VDC	48 VDC	125 VDC	120 VAC	240 VAC	Make	6.0 A	6.0 A	6.0 A	6.0 A	3.0 A	Carry	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A	Resistive break	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A	Inductive break	1.0 A	1.0 A	1.0 A	1.0 A	0.5 A
Property	24 VDC	48 VDC	125 VDC	120 VAC	240 VAC																																
Make	6.0 A	6.0 A	6.0 A	6.0 A	3.0 A																																
Carry	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A																																
Resistive break	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A																																
Inductive break	1.0 A	1.0 A	1.0 A	1.0 A	0.5 A																																
BLP fuse (A and B)		1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)																																			

Table 2-10. DOT-100 Specifications *(continued)*

Property	Characteristic/Value ¹
IFP/LFP fuse	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)
Weight	
Module	1.3 kg (2.8 lb)
Nonredundant base	1.4 kg (3.0 lb)
Redundant base	1.6 kg (3.5 lb)

NOTES:

1. All specification values are maximums unless stated otherwise.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

DOT-120

Onboard Monitored Electromechanical Relay Out (with Fusing)

The DIO-120 block is the same as the DOT-100 block, but provides contact readback circuitry for digital output verification and output channel fusing. The block supports redundant I/O electronics.

Table 2-11. DOT-120 Specifications

Property		Characteristic/Value ¹
Outputs		24 VDC, 48 VDC, 125 VDC 120 VAC, 240 VAC
Channels		16 isolated (relay contacts)
Update rate		All channels 83 times per second (12 msec)
Channel fuse		6.3 A, 250 V, 5 x 20 mm, time-lag, high break capacity (IEC 127-2/VI)
Relay	Type	Magnacraft miniature epoxy sealed PC board EM relay
	Coil nominal voltage	24 VDC
	Coil nominal current	23 mA
	Contact configuration	SPDT (1 form C)
	Contact material	Silver cadmium oxide
	Contact resistance	100 mΩ
	Cycle rate	30 operations per minute at rated load
	Minimum switching load	10 VDC at 10 mA
	Switching speed	15 msec
Bounce time		1.2 msec (average)
No. of operations		150,000

Table 2-11. DOT-120 Specifications (continued)

Property		Characteristic/Value ¹					
Relay <i>(cont)</i>	Currents	Property	24 VDC	48 VDC	125 VDC	120 VAC	240 VAC
		Make	6.0 A	6.0 A	6.0 A	6.0 A	3.0 A
		Carry	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A
		Resistive break	3.0 A	3.0 A	3.0 A	3.0 A	1.5 A
		Inductive break	1.0 A	1.0 A	1.0 A	1.0 A	0.5 A
		NOTE: L/R = 7.0 msec; pf = 40%					
OFF leakage current		3 mA					
BLP fuse (A and B)		1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)					
IFP/LFP fuse		3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity (IEC 127-2/VI)					
Weight							
Module		1.4 kg (3.1 lb)					
Nonredundant base		1.4 kg (3.0 lb)					
Redundant base		1.6 kg (3.5 lb)					

NOTES:

1. All specification values are maximums unless stated otherwise.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

RLY-100

Electromechanical Relay Assembly

The RLY-100 block is an auxiliary block that connects eight electromechanical relay sockets for use with a DIO block. The RLY block comes populated with eight DPDT electromechanical relays. Output channels can switch voltages up to 240 VAC and maximum load currents up to 10.0 amperes. Relays are plug-in replaceable.

Table 2-12. RLY-100 Specifications (Electromechanical Relays)

Property		Characteristic/Value ¹
Outputs		24 VDC, 48 VDC, 125 VDC 120 VAC, 240 VAC
Channels		8 (relay contacts)
Relay	Type	Systems control output EM relay (MSD type 283 with blowout magnets)
	Coil nominal voltage	24 VDC

**Table 2-12. RLY-100 Specifications (Electromechanical Relays)** *(continued)*

Property		Characteristic/Value ¹																																		
Relay <i>(cont)</i>	Coil nominal current	75 mA																																		
	Contact configuration	DPDT (2 form C)																																		
	Contact material	Silver cadmium oxide, gold flashed																																		
	Contact resistance	50 mΩ																																		
	Cycle rate	30 operations per minute at rated load																																		
	Minimum switching load	24 VDC at 10 mA																																		
	Switching speed	15 msec																																		
	Bounce time	15 msec (average)																																		
	No. of operations	100,000																																		
	Currents	<table><tr><th>Property</th><th>24 VDC</th><th>48 VDC</th><th>125 VDC</th><th>120 VAC</th><th>240 VAC</th></tr><tr><td>Make</td><td>30 A</td><td>30 A</td><td>30 A</td><td>30 A</td><td>30 A</td></tr><tr><td>Carry</td><td>10 A</td><td>10 A</td><td>10 A</td><td>10 A</td><td>10 A</td></tr><tr><td>Resistive break</td><td>10 A</td><td>7 A</td><td>3 A</td><td>10 A</td><td>10 A</td></tr><tr><td>Inductive break</td><td>10 A</td><td>5 A</td><td>1 A</td><td>3 A</td><td>1 A</td></tr></table> NOTE: L/R = 20 msec; pf = 80%						Property	24 VDC	48 VDC	125 VDC	120 VAC	240 VAC	Make	30 A	30 A	30 A	30 A	30 A	Carry	10 A	10 A	10 A	10 A	10 A	Resistive break	10 A	7 A	3 A	10 A	10 A	Inductive break	10 A	5 A	1 A	3 A
Property	24 VDC	48 VDC	125 VDC	120 VAC	240 VAC																															
Make	30 A	30 A	30 A	30 A	30 A																															
Carry	10 A	10 A	10 A	10 A	10 A																															
Resistive break	10 A	7 A	3 A	10 A	10 A																															
Inductive break	10 A	5 A	1 A	3 A	1 A																															
Field power (IFP/LFP) voltage ²		24.0 VDC nominal																																		
Weight (with relays)		2.3 kg (5.2 lb)																																		

NOTES:

1. All specification values are maximums unless stated otherwise.
2. 24 VDC from DIO block to power relay coils.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

RLY-200

Solid State Relay Assembly

The RLY-200 block is an auxiliary block that connects eight solid state relay sockets for use with a DIO block. The RLY block can be populated with 24 VDC, 125 VDC, 120 VAC, and 240 VAC solid state relays in any combination. Relay outputs are fused. Relays are plug-in replaceable and are supplied separately (refer to Table 11-12).

Table 2-13. RLY-200 Specifications (Solid State Relays)

Property	Characteristic/Value ¹																											
Outputs	24 VDC, 125 VDC 120 VAC, 240 VAC																											
Channels	8																											
Relays	<table><tr><th>Property</th><th>24 VDC</th><th>125 VDC</th><th>120/240 VAC</th></tr><tr><td>Output range (VDC/VAC)</td><td>5 to 60</td><td>10 to 200</td><td>12 to 280</td></tr><tr><td>Output current (A)²; 0° to 30°C (32° to 86°F) 15° to 25°C (59° to 77°F) at 70°C (158°F)</td><td>— 3.0 1.2</td><td>— 1.0 0.4</td><td>— 3.0 1.2</td></tr><tr><td>Load frequency (Hz)</td><td>—</td><td>—</td><td>47 to 63</td></tr><tr><td>Leakage current (mA)²</td><td>0.01</td><td>0.01</td><td>0.75</td></tr><tr><td>One cycle surge (A)³</td><td>5.0</td><td>1.5</td><td>85.0</td></tr></table>				Property	24 VDC	125 VDC	120/240 VAC	Output range (VDC/VAC)	5 to 60	10 to 200	12 to 280	Output current (A) ² ; 0° to 30°C (32° to 86°F) 15° to 25°C (59° to 77°F) at 70°C (158°F)	— 3.0 1.2	— 1.0 0.4	— 3.0 1.2	Load frequency (Hz)	—	—	47 to 63	Leakage current (mA) ²	0.01	0.01	0.75	One cycle surge (A) ³	5.0	1.5	85.0
Property	24 VDC	125 VDC	120/240 VAC																									
Output range (VDC/VAC)	5 to 60	10 to 200	12 to 280																									
Output current (A) ² ; 0° to 30°C (32° to 86°F) 15° to 25°C (59° to 77°F) at 70°C (158°F)	— 3.0 1.2	— 1.0 0.4	— 3.0 1.2																									
Load frequency (Hz)	—	—	47 to 63																									
Leakage current (mA) ²	0.01	0.01	0.75																									
One cycle surge (A) ³	5.0	1.5	85.0																									
Relay fusing	<table><tr><th>Relay</th><th>Fuse</th><th>Description</th></tr><tr><td>24 VDC</td><td>3.15 A, 250 V</td><td>5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)</td></tr><tr><td>125 VDC</td><td>1.0 A, 250 V</td><td>5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)</td></tr><tr><td>120 VAC 240 VAC</td><td>3.15 A, 250 V</td><td>5 x 20 mm, time-lag, high break capacity (IEC 127-2/V)</td></tr></table>				Relay	Fuse	Description	24 VDC	3.15 A, 250 V	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)	125 VDC	1.0 A, 250 V	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)	120 VAC 240 VAC	3.15 A, 250 V	5 x 20 mm, time-lag, high break capacity (IEC 127-2/V)												
Relay	Fuse	Description																										
24 VDC	3.15 A, 250 V	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)																										
125 VDC	1.0 A, 250 V	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)																										
120 VAC 240 VAC	3.15 A, 250 V	5 x 20 mm, time-lag, high break capacity (IEC 127-2/V)																										
Field power (IFP/LFP) voltage ⁴	24.0 VDC nominal																											
Weight (with relays)	1.8 kg (4.0 lb)																											

NOTES:

1. All specification values are maximums unless stated otherwise.

2. AC_{RMS} current.3. AC_{PEAK} current.

4. 24 VDC from DIO block to power relay coils.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE





Introduction

This section describes the following capabilities and components of the Harmony I/O system:

- Inputs and outputs.
- I/O blocks.
- Auxiliary blocks.
- I/O system configuration.

Inputs and Outputs

The Harmony I/O system supports a variety of input and output types, both analog and digital. Analog signals, for example, include pressure and flow transmitter signals, and thermocouple (TC) and RTD temperature inputs. Digital signals are two-state signals that have discrete on and off voltage levels such as relay contacts, switches, and solenoids. Inputs and outputs can be either internally I/O system powered or externally powered.

Analog Input

The following analog inputs are supported (Fig. 3-1):

- 4 to 20 milliampere high level.
- -10 to +10 VDC high level.
- -100 to +100 millivolt (DC) low level.
- Thermocouple:
B, E, J, K, L, N (14 AWG), N (28 AWG), R, S, T, U.
Chinese E, S.
- RTD:
10 Ω copper.
100 Ω platinum (U.S. Lab. Standard, U.S. Industry Standard, European Standard).
120 Ω nickel.
Chinese 53 Ω copper.

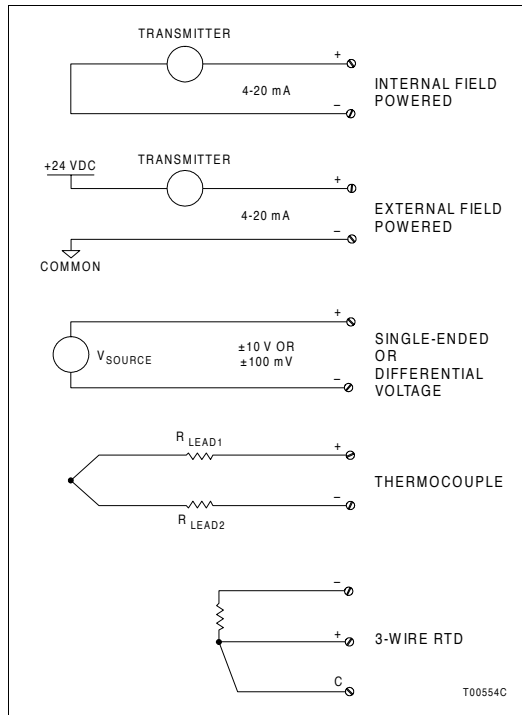


Figure 3-1. Analog Input

Data Conversion

An I/O block that supports analog inputs reads currents or voltages at its input channels, scales and converts the inputs to real values in engineering units, then reports the input values to the Harmony controller. The block provides channel status information along with each reported input.

High and low level inputs are converted to the proper engineering units based on input type and engineering unit high and low value specifications. Thermocouple and RTD inputs are converted to the proper engineering units (degrees C or degrees F) using predefined conversion tables for each type of thermocouple and RTD supported.

Calibrations

No field calibrations for analog inputs are required. The electronics automatically perform the following adjustments to the raw analog inputs depending on input type:

- Drift correction using onboard zero and span reference voltages.
- Lead wire resistance adjustment for low level, thermocouple, and RTD inputs.
- Cold junction temperature compensation for thermocouple inputs using either an internal or external cold junction reference.

Analog Output

The following analog outputs are supported (Fig. 3-2):

- 4 to 20 milliampere high level.
- 1 to 5 VDC high level.

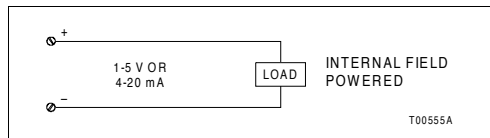


Figure 3-2. Analog Output

Data Conversion

An I/O block that supports analog outputs receives output demand values in engineering units from the Harmony controller, scales the demand values to percentages of output, and converts them to analog voltages or currents at the output channels. User selectable default states of zero percent, 100 percent, or hold output are provided.

Calibrations

The electronics automatically adjust analog outputs to compensate for supply voltage variations. Field calibration of analog outputs is not required.



Readback

Each analog output channel is monitored on the block. This readback function serves two purposes:

- Provides high accuracy by using a software compensation algorithm in combination with the analog output readback value.
- The integrity of the hardware and field wiring is constantly monitored by way of checking the readback value.

The block also reports the readback values to the controller. It automatically scales the values to their proper engineering units before reporting them. The readback values are converted to the proper engineering units based on engineering unit high and low value specifications.

Digital Input

Digital input channels can be used to read the states of switches, relay contacts, and solenoids (Fig. 3-3). The following digital inputs are supported:

- 24, 48, and 125 VDC.
- 120 and 240 VAC.

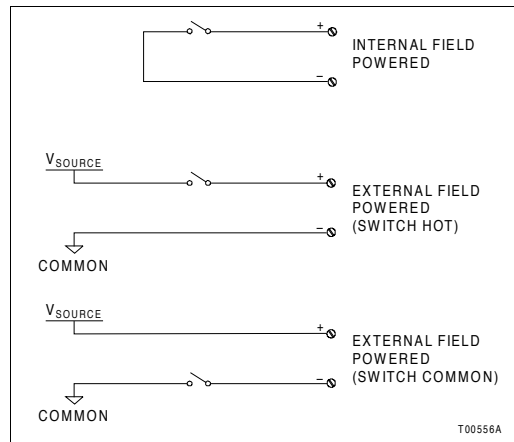


Figure 3-3. Digital Input

An I/O block that supports digital inputs reads voltage levels at its input channels, converts the voltages to boolean logic states (0 or 1), then reports the input states to the Harmony controller. The block provides channel status information along with each reported input.

Digital Output

Digital output channels can be used to drive annunciators such as buzzers and lamps and to drive two-state final control elements such as actuators, relays, and solenoids (Fig. 3-4). The following digital output voltages are supported:

- 24, 48, and 125 VDC.
- 120 and 240 VAC.

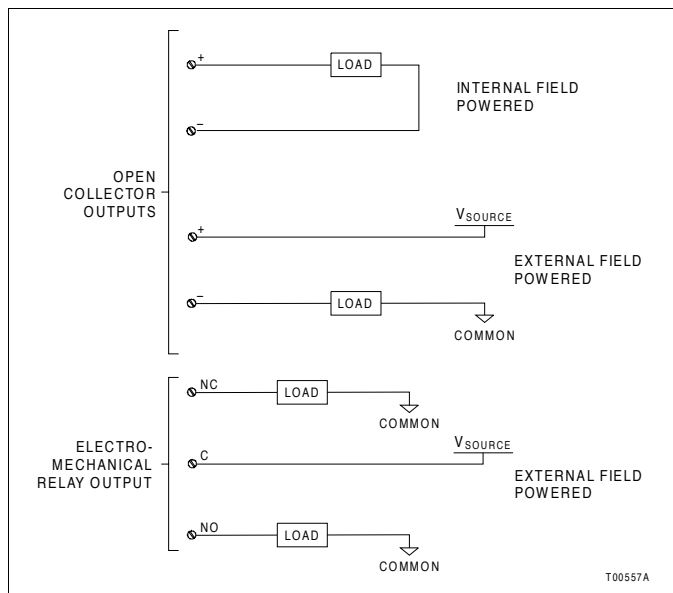


Figure 3-4. Digital Output

The system can support current loads up to 10 amperes with auxiliary relay assemblies used with DIO blocks.



An I/O block that supports digital outputs receives boolean logic states (0 or 1) from the Harmony controller and converts them to digital voltages to switch the output channels.

The DOT-120 output channels are fused and monitored through readback circuitry on the block. The block constantly monitors readback from the output contacts to verify and insure hardware and field wiring integrity. The block also reports the readback values to the controller.

I/O Block

An I/O block interfaces and processes field device input and output signals. An I/O module mounted on a termination base forms an I/O block (Fig. 3-5). The I/O module contains the electronics. It handles the Hnet communication and stores and executes a portion of the process configuration. In general, a base is a passive device that connects and distributes signals between the I/O module and field wiring terminals and between redundant I/O modules.

There are several different I/O block types available (refer to Table 1-1). The three basic types being analog (A), digital (D), and control (C). All share the same housing layout and connection, configuration, and mounting methods. Refer to Table 1-2 for a summary of I/O block capabilities.

The front panel of an I/O block communicates a considerable amount of information including block type, operating mode, and operating status. Front panel features include:

- Text-based front panel mode and status indicators.
- Front accessed power fuses with status indicators.
- Front accessed stop/reset button.
- Front mounted device ID and user label area protected by a clear plastic cover.

Refer to **I/O Block** in Section 7 for further explanation of front panel items.

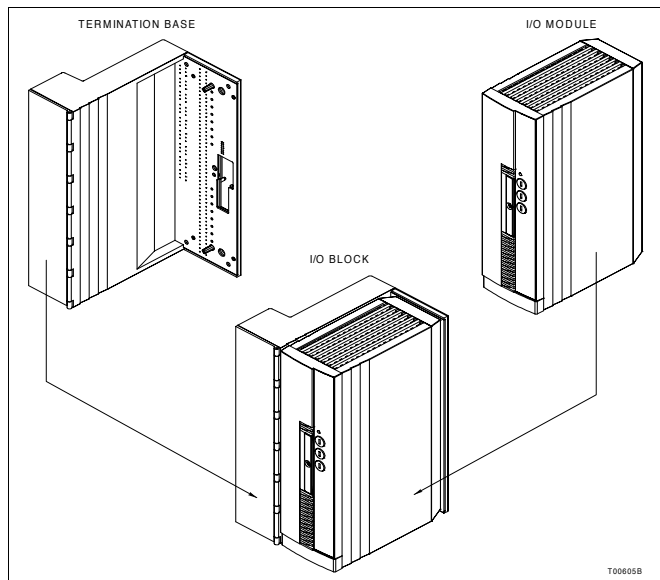


Figure 3-5. I/O Block

I/O Module

The I/O module (Fig. 3-5) contains the I/O processing circuitry. The circuitry consists of multiple printed circuit boards that perform signal conditioning and processing dependent on I/O type. An onboard processor performs engineering units conversion, online diagnostics, and Hnet communications interface. Power conversion functions are also provided. Front panel LEDs provide power and digital I/O status indications.

The block packaging provides access to configuration jumpers on the circuit boards as required by removing the side of the I/O module (Fig. 3-6). A retractable handle facilitates the installation and removal of the I/O module.

WARNING

An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous.

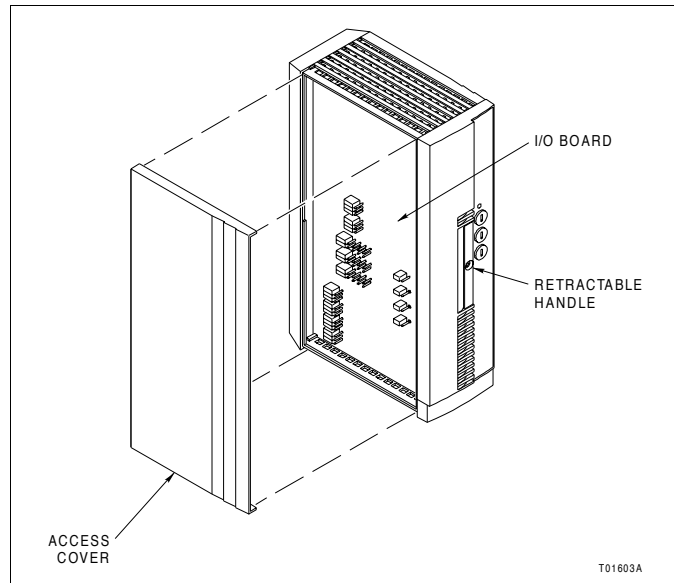


Figure 3-6. Configuration Jumper Access

I/O modules can be removed and installed while system power is applied. With the I/O module removed, current mode analog input channels are maintained if configured to use local field power (refer to **Block Power** in this section). Voltage mode analog input channels, however, and analog output, digital input, and digital output channels are in an open circuit state in a nonredundant configuration. I/O channels will continue to operate normally when one of the modules in a redundant configuration is removed.

Figure 3-7 is a block diagram of the I/O circuitry. The block diagram generally reflects the operation of all I/O blocks. The I/O section varies from block to block.

Block Power

Each block provides onboard regulation for any operating voltages it requires. The I/O module accepts redundant 24 VDC inputs which it filters, auctioneers, and regulates to produce

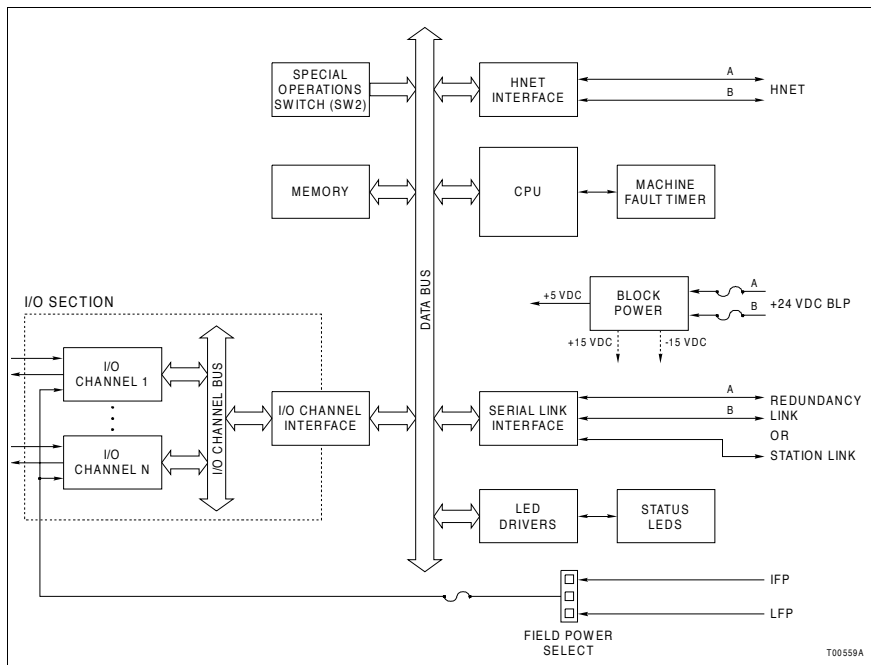


Figure 3-7. Block Diagram - I/O Module

its operating voltages. Each 24 VDC input is fused and monitored. Figure 3-8 details the block power section.

Logic Power Redundant 24 VDC block logic power (BLP) is bussed through the mounting column to the I/O module. The redundant BLP power is auctioneered through summing diodes into a single 24 VDC. Onboard DC-to-DC converters develop +5 VDC, +15 VDC, and -15 VDC operating voltages from the integrated 24 VDC.

The I/O module tests itself for a +5 VDC out-of-range condition. When this voltage is outside its normal operating range, a hardware fault (i.e., power on reset) will occur and the block operation will halt.

Power Monitor The power monitor circuits test and report the status of the redundant 24 VDC BLP inputs. The inputs are only tested for

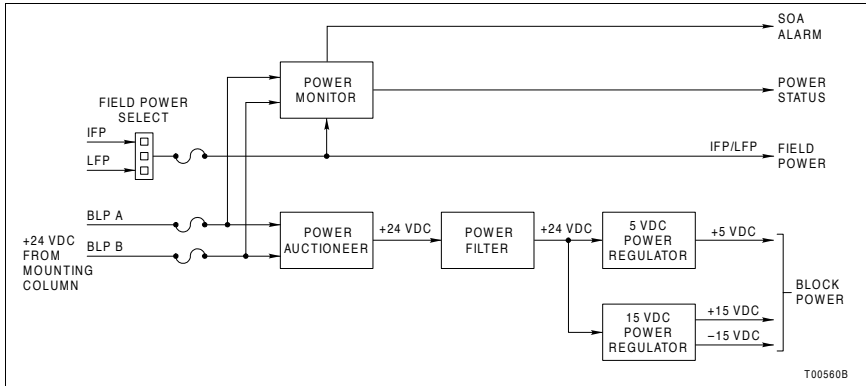


Figure 3-8. Block Power

their presence or absence. The circuits do not test the inputs for voltage range.

The power monitor circuits also test and report status for the internal field power (IFP) or external local field power (LFP) input depending on the field power select jumper setting. Again, the circuits only test for the presence or absence of the field power input.

The I/O block will generate an SOA alarm if the fuse for any of these inputs is bad or if the input voltage is absent.

Refer to the **Block Power and Mounting Hardware** instruction for a complete explanation of BLP, IFP, and LFP power, and the SOA alarm signal for power status monitoring.

Central Processing Unit

The central processing unit (CPU) contains a microprocessor and its supporting circuitry. The CPU interprets and executes instructions to control the I/O block functions. Its responsibilities include executing the I/O block portion of the control configuration and controlling:

- Hnet communication.
- Analog and digital I/O processing.
- Redundancy or station link communication.
- Block diagnostics.

- Status reporting.

Memory

The I/O block utilizes static-RAM memory and flash-ROM memory. The static-RAM memory provides temporary storage for the CPU to perform calculations and data manipulation. The Hnet interface also uses a portion of the RAM memory to store received messages and messages to be transmitted. The flash-ROM memory stores the I/O block operating firmware and the block's portion of the control configuration. This type of memory allows firmware upgrades to be downloaded from the controller. The electronic ID of the block is stored in ROM memory.

Hnet Interface

Hnet is the redundant, serial communication protocol over which the Harmony controller communicates with I/O blocks. Figure 3-9 details the Hnet interface section of the I/O module circuitry. The Hnet interface encodes and transmits Hnet messages, receives and decodes Hnet messages, and monitors Hnet status.

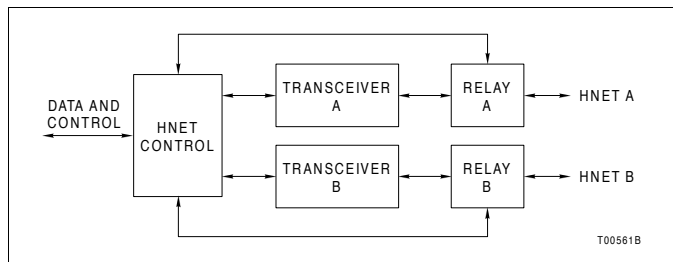


Figure 3-9. Hnet Interface

The Hnet control portion of the interface is a custom, application-specific integrated circuit (ASIC). This circuit manages the serial communication protocol between the I/O block and Harmony controller. It also performs data integrity checks. The interface checks for the following message errors: Data transmission error using cyclic redundancy check (CRC) method, maximum message reply time expired, and reply message overrun.



The Hnet control section also provides a means for the CPU to interrogate the Hnet to determine its condition. If a bus failure or stall is detected on either of the Hnet channels, the channel will be shut down locally until the problem is corrected. The capability to detect a bus failure allows the I/O module to set the appropriate output channel default states if communication with the Harmony controller is completely lost.

The signal relays (A and B) allow the I/O module to isolate itself from the Hnet in the event of a component failure or to perform diagnostics. This important feature assures that a fault in one block cannot affect the communications of other blocks. The Hnet interface circuitry includes the logic that controls the relays.

Machine Fault Timer

The machine fault timer (MFT) is a security feature built into the I/O module. The timer is a one-shot timer that must be periodically reset by the CPU to prevent it from timing out. If an error condition exists that causes the I/O module to fail or operate incorrectly, the timer will not be reset and will cause a time-out condition. A time-out condition triggers a reset signal to shut down the I/O module.

The I/O module performs a series of online diagnostics to verify circuit integrity. A detected hardware failure may cause a time-out condition. If the cause of the problem is not a hardware failure such as a configuration error, the I/O module and timer can be reset by the manual reset switch accessed through the block front panel. A hardware failure will most likely require an I/O module replacement.

Serial Link Interface

Besides the Hnet interface, an I/O module supports an additional external serial link used for either redundancy or manual/auto station communication. The CIO-100 block uses the serial channel for station link. All other blocks use the serial channel for redundancy link.

Figure 3-10 details the serial link interface. The I/O module uses a dual universal asynchronous receiver/transmitter (DUART) circuit to direct data transfer over the serial links. The DUART receives parallel data from the CPU and converts it to serial data that it sends to one of the serial link interfaces. It

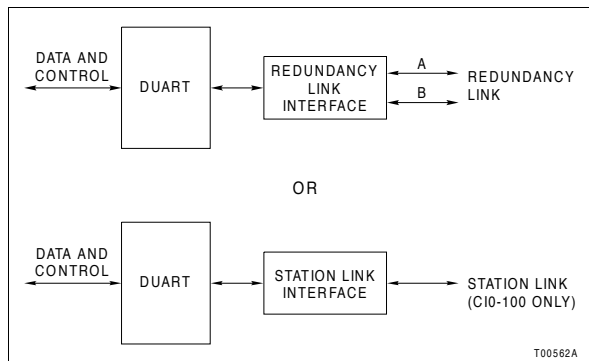


Figure 3-10. Serial Link Interface

also performs serial to parallel data conversion on data received serially from the interface circuits.

Redundancy Link The redundancy link allows redundant I/O modules to communicate. The backplane on the base makes the redundancy link hardware connection between redundant I/O modules. The link operates at a one-megabaud rate and is itself redundant. Redundant I/O modules exchange the following information:

- I/O channel configuration.
- Status and availability of all I/O channels.
- Electronic ID.
- Device label.

Station Link The station link interfaces the RS-485 serial link to communicate with an analog control station (IISAC01). This interface acts as a communications gateway between the Harmony controller and the station. The station link operates at a 40-kilobaud rate and supports up to eight analog control stations. The base makes the station link hardware connection between the I/O module and stations.

NOTE: Only the CIO-100 block supports the station link.



LED Drivers and Status LEDs

The LED drivers control the front panel status indicators as directed by the CPU. The indicators show I/O module operating status, error codes, digital I/O states, and power status.

I/O Channel Interface

The I/O channel interface allows the CPU to select an I/O channel. For an output channel, the CPU can write control information to the channel and can acquire readback data and status. For an input channel, the CPU can read input data and status from the channel.

NOTE: The block diagram (Fig. 3-7) shows the interface in schematic fashion. The actual implementation may vary depending on block type; however, the interface function still applies.

I/O Section

The I/O section varies based on the I/O block capabilities. Each I/O block is populated with varying numbers and types of I/O channels. The I/O channel types include:

AI - analog input.
AO - analog output.
DI - digital input.
DO - digital output.

In general, the I/O section circuitry provides:

- Range and mode selection for analog I/O.
- Voltage threshold selection for universal digital inputs.
- Signal buffering.
- Signal conditioning.
- Signal isolation.
- Noise rejection.
- Analog-to-digital and digital-to-analog conversion; one A/D per channel on AIN-200, AIN-220, and AIN-300.
- Readback of outputs.
- Open and short detection.

- Circuit protection (surges, shorts, overvoltages, etc.).

Special Operations Switch (SW2)

The special operations switch (SW2) is used to enable normal operation, to initialize the I/O module, and to select offline diagnostics. Refer to Table 7-4 for normal operation and initialize switch settings. Refer to **Diagnostics** in Section 8 for a description of the diagnostics.

Base

There are two types of I/O block bases (Fig. 3-5): screw terminal and clamp terminal. There is a nonredundant and redundant version of each base. In general, a block supports four different base versions. The base has several purposes:

- Field wiring termination.
- I/O channel signal routing.
- I/O module mounting.
- Hardware keying of base to I/O module.
- Shield (i.e., chassis ground) connection.

NOTE: The terminal strip can be removed from the clamp termination base for cable connection applications. Refer to **Cable Connection** in this section.

The base attaches directly to a block mounting column. Alignment posts help locate the base on the mounting column. The assembly is physically mounted using two captive screws (four screws for a redundant base). Tabs on the base insert into slots in the mounting column to help further secure the base in place. I/O signals connect to the base and are routed internally to I/O module connectors. Field connections remain undisturbed if the module is removed or replaced.

A nonredundant base provides mounting and connection for a single I/O module. A redundant base is available to provide mounting and connection for two I/O modules that operate redundantly. The redundant base is wider than the nonredundant base by the width of an I/O module and requires a redundant block mounting column.

Screw and Clamp Termination Bases

A termination base supports either screw terminals (S type) or clamp terminals (C type) for direct field wire connection. The



screw terminals accommodate wire lugs and the clamp terminals accommodate stripped wires. Figure 3-11 shows the screw terminal base and Figure 3-12 shows the clamp terminal base.

NOTE: A DIO block uses an R type base to connect its digital outputs to an RLY block. When an RLY block is connected, the DIO block outputs drive either electromechanical or solid state relays. The R type base has screw or clamp terminals for digital input wiring, and a connector to cable the digital outputs to the RLY block.

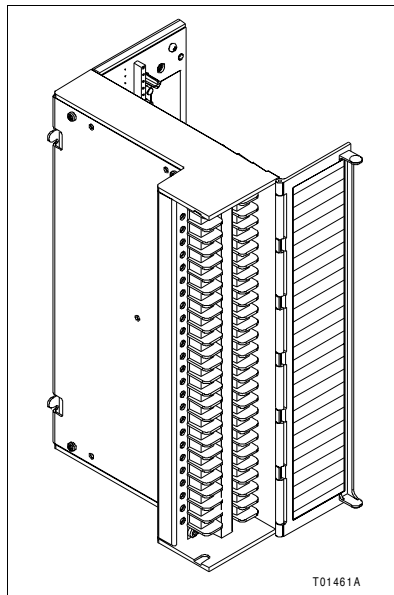


Figure 3-11. Screw Terminal Base (S Type)

The terminals accept wiring with a cross-sectional area of up to 3.3 square millimeters stranded (12 AWG stranded). The number of terminals depends on the number and types of I/O channels.

To simplify the installation process, the terminals are clearly marked to identify positive (+) and negative (-) polarity, and three-wire RTD, normally open relay contact, and normally

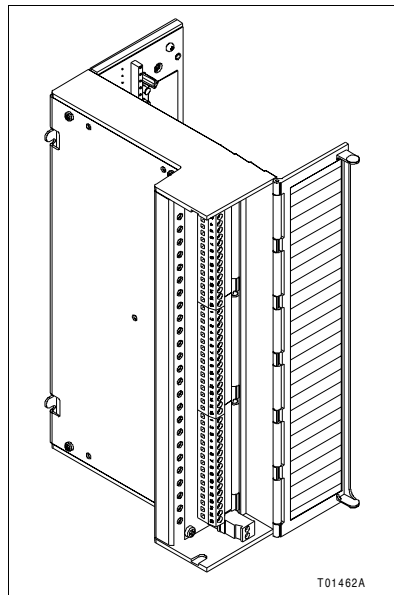


Figure 3-12. Clamp Terminal Base (C Type)

closed relay contact wiring connections (Fig. 3-13). Additionally, input and output channel terminals are color coded for easier recognition. The markings and color coding allow wiring of input and output channels without requiring any additional documentation:

- Black letter on blue background - analog input channel.
- Blue letter on black background - analog output channel.
- Black letter on orange background - digital input channel.
- Orange letter on black background - digital output channel.

The base has a front panel door to conceal the terminal strips and connectors, and to prevent accidental contact. A label is affixed to the inside of the door for identifying field wires.

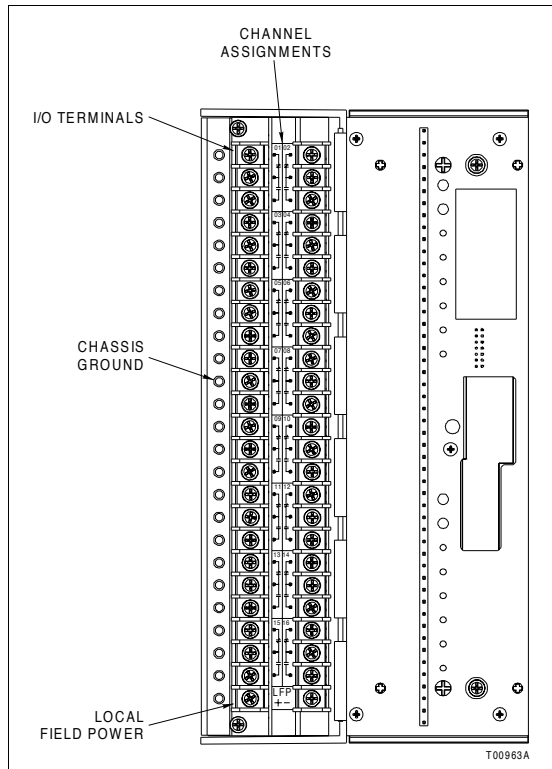


Figure 3-13. Terminal Markings (Door Removed)

Cable Connection

The clamp terminals can be removed from the C type base to provide cable connection of field wiring. A cable with a plug-in cable connector is used instead. This supports applications that require a cable connection to external devices or terminations that are part of a remote termination system (RTS). Figure 3-14 shows the C type base with the clamp terminals removed.

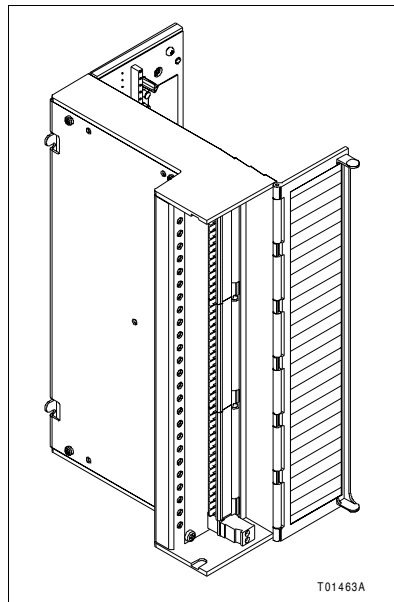


Figure 3-14. C Type Base for Cable Connection

One or more HRM-RTS cables, which are terminated at both ends with connectors, are used to connect the I/O block to the remote termination system.

Shield Terminations (Chassis Ground)

The back panel of the base is a ground plate that connects to chassis ground (Fig. 3-13). The ground plate has screw terminals to connect shield wires requiring termination to chassis ground. Attaching the assembly to the mounting column makes the connection between the ground plate and chassis ground.

I/O Module Mounting

The I/O module attaches to the base. This attachment connects the I/O channels, Hnet communications, and power to the module. For redundant I/O modules, the attachment also



connects the redundancy link. For the CIO block, it also connects the station link to the module.

I/O modules can be inserted or removed without having to power down the system. A captive mounting screw on the I/O module secures it in place.

Hardware Keying

Each type of I/O module requires its own type of termination base. Hardware keying using posts on the base and holes in the back of the I/O module prevents an accidental mismatch of I/O module and base. The block type and model number shown on the front panel of an I/O module and base are the same to easily identify that they are compatible.

I/O Redundancy

Redundancy allows backup electronics to read inputs and to drive outputs in the event of a primary failure. As a background diagnostic task, the backup is continuously monitoring its ability to read field inputs and to drive field outputs.

I/O redundancy is accomplished by using two I/O modules of the same type, a wider base to mount and connect the two modules, and a wider mounting column to attach the redundant base (Fig. 3-15). In this arrangement, the field wiring connects once at the base and is internally routed to both modules. The redundancy feature allows a failed I/O module to be replaced without affecting the operating module in the redundant pair. Refer to [Section 4](#) for further explanation of redundancy.

Failure Mode (Outputs)

To insure known output conditions in the event of an I/O block failure, output channels have two failure modes: default state output and failure state output. The failure mode an output channel enters depends on the type of failure. If Hnet communication or communication with the Harmony controller is lost, block outputs enter their default states. This assumes, however, the I/O block is 100 percent operational. If critical I/O block circuitry fails, block outputs will enter their failure states.

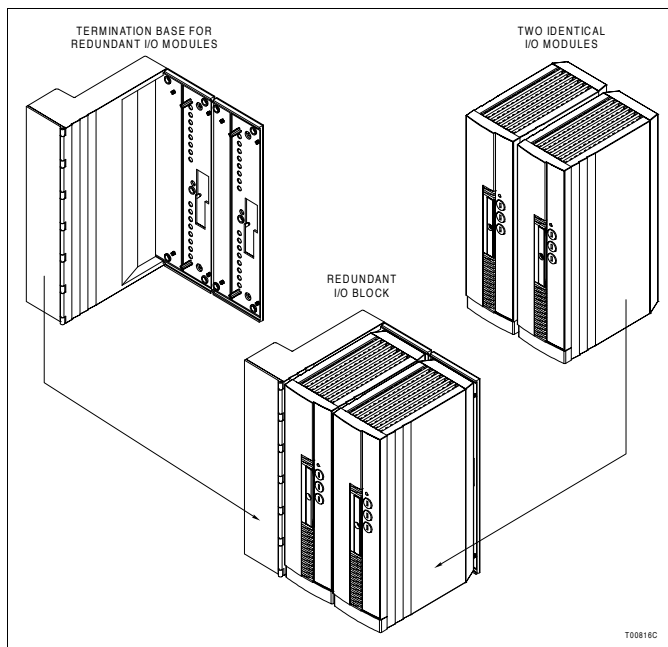


Figure 3-15. Redundant I/O Block

Default States Default states for outputs are selected during function code configuration. The outputs will automatically return to normal operation after communication has been restored. For an analog output, the default state is either zero percent output, 100 percent output, or hold the current output. For a digital output, the default state is either zero state output, one state output, or hold the current output. Refer to **Function Codes** in Section 6 for information about default state specifications.

Failure States Failure states for outputs are by default their unpowered or off states. A nonredundant output channel will enter its failure state when:

- All power to the I/O module is lost.
- Machine fault timer error occurs (refer to **Machine Fault Timer** in this section).



- Stop or reset occurs.

In some cases, a reset may be enough to return the outputs to normal operation. If a reset does not, then an I/O module replacement will most likely be required. Table 3-1 summarizes the I/O block output channel conditions based on type of event.

Table 3-1. I/O Block Failure Mode Output Conditions

Event	Output Condition
Loss of all power	Failure state
MFT time-out	Failure state
Redundant I/O module failure	
Primary	Backup assumes output control
Backup	No effect; outputs under primary control
Loss of communication:	
Hnet (primary)	Backup assumes output control
Hnet (backup)	No effect; outputs under primary control
Hnet (both redundant I/O modules)	Default state
Harmony controller	Default state
Reset	Failure state
Channel error	Error dependent

Short Circuit Protection

Most I/O blocks incorporate some type of current limiting where appropriate to protect against short circuits in the field wiring. This current limiting often makes I/O fusing unnecessary. The current limiting prevents excessive current levels at faulted terminals which could cause circuit damage. Specifically, I/O block channels are protected against shorts across the transmitter or load, across positive and negative terminals, from the positive terminal to ground, and from the negative

terminal to ground. A channel will recover to full function after correcting the fault condition.

NOTES:

1. In the case of external remote field powered I/O, some type of external protection such as fusing should be incorporated where appropriate. Refer to the **Block Power and Mounting Hardware** instruction for an explanation of the various field power options available.
2. The DOT-100 block has no fusing or current limiting. The DOT-120 block provides fusing for the contact outputs. The fusing is present for only one set of contacts per output.
3. The RLY-200 block has fusing for the solid state outputs.

Table 3-2 lists the fault currents present as a result of a short condition. For blocks that are not listed, the channels are in a no current condition or operate within their normal operating range. In these cases, the I/O block sees a zero volt input or a zero ohm load which are both valid. Refer to Figures 3-1, 3-2, 3-3, and 3-4 for examples of I/O connections.

Table 3-2. Channel Fault Currents (Nominal) Under Short Conditions

Block	I/O	Mode	Power	Short Condition		
				+/-	+/Gnd	-/Gnd
AIN-120	AI	Current	IFP/LFP	60 mA	160 mA	Note 1
			RFP	100 mA ²	Note 1	—
AIN-220	AI	Current	IFP/LFP	60 mA	160 mA	Note 1
			RFP	100 mA ²	Note 1	—
CIO-100	AI	Current	IFP/LFP	70 mA	186 mA	Note 1
	AO	Current	IFP/LFP	50 mA		
		Voltage	IFP/LFP	50 mA		—
CIO-100, DIO-400 ³	DI	24 VDC	IFP/LFP	31 mA		
		48 VDC	LFP	8.1 mA		
		125 VDC	LFP	14 mA		
		120 VAC	LFP	15 mA		
		240 VAC	LFP	15 mA		

NOTES:

1. The current is limited by the transmitter. Some type of external protection may be necessary.
2. Transmitter shorted.
3. Open collector outputs are not current limited.



Auxiliary Block

An auxiliary block extends I/O block capabilities (Fig. 3-16). There are different types of auxiliary blocks available (refer to Table 1-1).

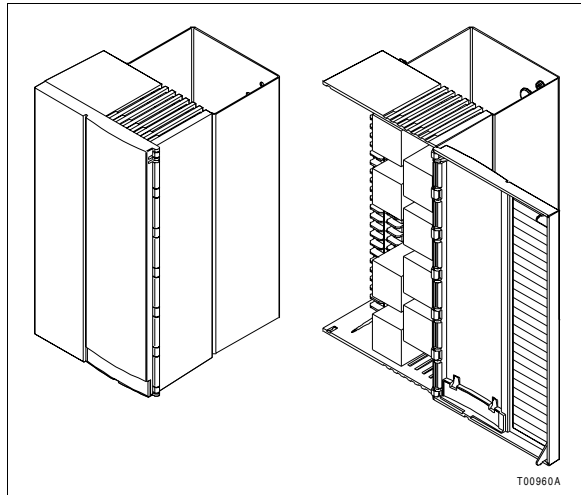


Figure 3-16. Auxiliary Block

An auxiliary block shares a similar housing layout with I/O blocks. Its mounting method is slightly different, however. The block occupies one block position on the mounting column, but does not connect to either power or Hnet. A front panel door conceals the terminal strips and various circuitry to prevent accidental contact.

I/O System Configuration

Harmony I/O system configuration requirements are minimal:

- **Auxiliary blocks** - either require no configuration or require minimal configuration (i.e., jumper setting) depending on type.

- **I/O blocks** - most require some minimal hardware configuration; all require function code configuration (Fig. 3-17).
- **Repeater mounting units** - Hnet repeaters in repeater mounting units require no configuration.

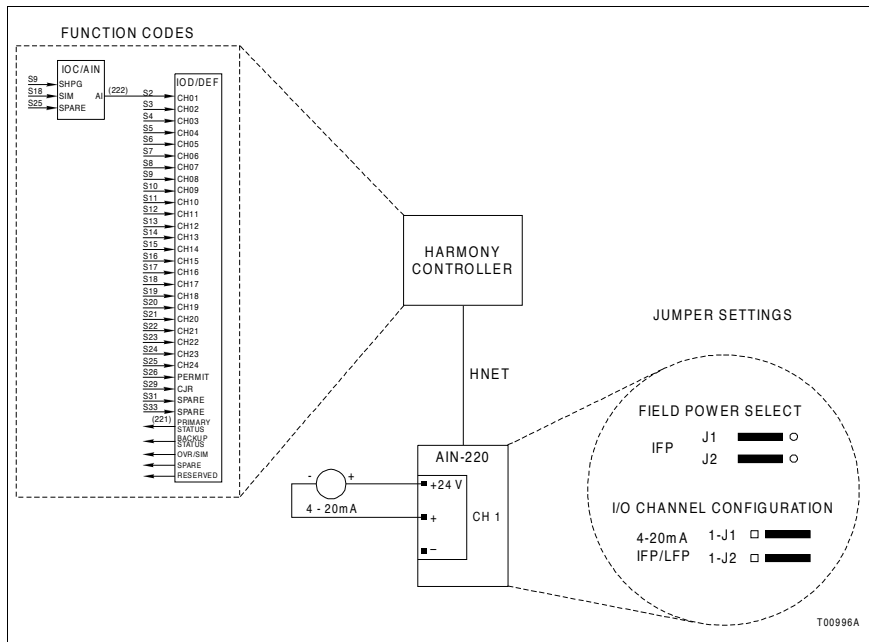


Figure 3-17. Example I/O Connection, Setup, and Configuration

I/O Block Hardware

Generally, I/O block hardware configuration consists of setting the special operations switch (SW2), field power select jumpers, and various I/O channel jumpers. Some blocks do not require any I/O channel configuration.

I/O Block Function Codes

I/O block function code configuration includes defining a device label and adding function codes to the control



configuration in the Harmony controller. A device label is normally defined during installation. I/O block function codes are normally added to the control configuration during its creation; however, they can be added at any time to existing configurations. Refer to [Section 6](#) for detailed information about using configuration tools.



Introduction

This section provides a general description of block redundancy, and details redundancy for specific block types. Redundancy allows backup electronics to read inputs and to drive outputs in the event of a primary failure. The backup is continuously monitoring its ability to read field inputs and to drive field outputs as a background diagnostic task.

NOTE: A CIO block cannot be redundant. However, the analog control station (IISAC01) can be used with the CIO block to provide automatic or manual backup. Refer to the *IISAC01 Analog Control Station* instruction for further explanation.

Description

Redundancy in I/O blocks protects against most common power, communications, and block hardware and software failures and some I/O channel failures. A failover from primary I/O module to backup I/O module is not instantaneous. Typically, failover should occur in less than 100 milliseconds.

Online diagnostics and readback checks are used to determine the operating status of an I/O module. Both the primary and the backup module perform the same diagnostics and readback tests. In all cases, the Harmony controller handles the data management.

The redundant I/O modules utilize the serial redundancy link to verify redundant hardware connection, monitor and verify operation, resolve primary/backup modes, and to exchange status information. Connectors and signal lines on the backplane of the base establish the redundancy link. The redundancy link is also redundant.

For all redundant capable I/O blocks, both I/O modules are active and both report data to and receive data from the controller. Both modules contain the same device label and function code configuration. The input and output channels are internally routed on the base to both I/O modules. If the



primary and backup I/O modules report different values for the same channel to the controller, the controller will mark the value as suspect. Refer to **Suspect Condition** in Section 6 for further explanation.

Redundancy Arbitration

Primary and backup responsibilities are determined by an arbitration process performed during startup. The redundancy link between the I/O modules allows them to communicate directly with each other. Basically, the first module up and running assumes the primary role. A feature built into the I/O block, however, ensures that the left module always assumes the primary role and the right module assumes the backup role as long as both I/O modules are mounted on the base when the block starts up. The front panel status LEDs indicate which I/O module is the primary and which is the backup. Refer to Table 7-2 for the LED indications.

The arbitration process also insures that a labeled I/O module becomes the primary when there is an unlabeled I/O module in the redundant pair. After the labeled module starts up and assumes the primary role, it will then automatically configure the unlabeled backup module with its label so both share identical device labels.

Failover

The backup I/O module automatically assumes the primary module's responsibilities if the primary fails. Catastrophic failures that will cause a failover from primary to backup include:

- Primary halts completely.
- Primary loses block logic power (both BLP A and BLP B).

If a catastrophic failure of the primary module occurs, the backup module will become the primary even if it has some type of non catastrophic failure. Non catastrophic failures include:

- Primary's Hnet communications fail (both channels).
- One of the primary's I/O channels fail.
- Primary loses IFP or LFP field power.

If a non catastrophic failure of the primary module occurs, the failover will only occur if the backup I/O module is 100 percent

operational. If the backup I/O module has detected a problem such as an Hnet communication failure, I/O channel failure, and IFP or LFP field power failure, then no failover will occur.

When a failover occurs due to a non catastrophic failure of the primary module, the primary will halt with LEDs one and two on. When a failover occurs due to a catastrophic failure (i.e., FAULT lit), an error code will display on LEDs one through eight of the primary module. Refer to Table 8-3 for a description of the LED status codes.

Analog Input

For analog input capable blocks, channels are directly wired in parallel to both I/O modules (Figs. 4-1 through 4-7). A short across an input of one I/O module due to an I/O block fault will not allow either I/O module to read the input. An open in an input channel circuit of the base will not allow either I/O module to read the input.

AIN-120 Failures detectable by an AIN-120 module that cause a failover to the backup module include:

- Multiplexer failure.
- Amplifier failure.
- A-to-D converter failure.
- Bad voltage reference.
- Channel failure or out of range.

AIN-200/220 Failures detectable by an AIN-200/220 module that cause a failover to the backup module include:

- Amplifier failure.
- A-to-D converter failure (one per channel).
- Opto-coupler failure.
- Bad voltage reference.
- Bad TC cold junction reference (A-to-D and RTD).
- Channel failure or out of range.

AIN-300 The AIN-300 block has special circuitry to disconnect the RTD current source on the backup I/O module during normal operation. This prevents two current sources from being connected to the RTD at one time. Failures detectable by an AIN-300 module that cause a failover to the backup module include:

- Amplifier failure.

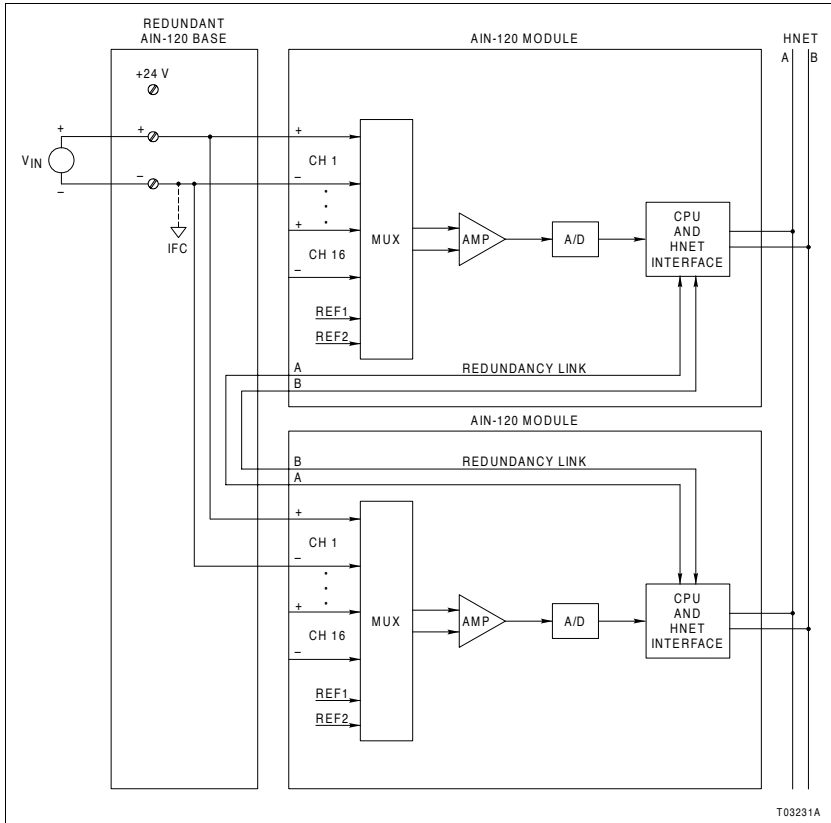


Figure 4-1. AIN-120 Block - Voltage Mode (Differential or Single -Ended)

- A-to-D converter failure (one per channel).
- Opto-coupler failure.
- Bad voltage reference.
- Channel failure or out of range.

Analog Output

The AOT-150 block has special circuitry that switches the channels between the primary I/O module and the backup I/O

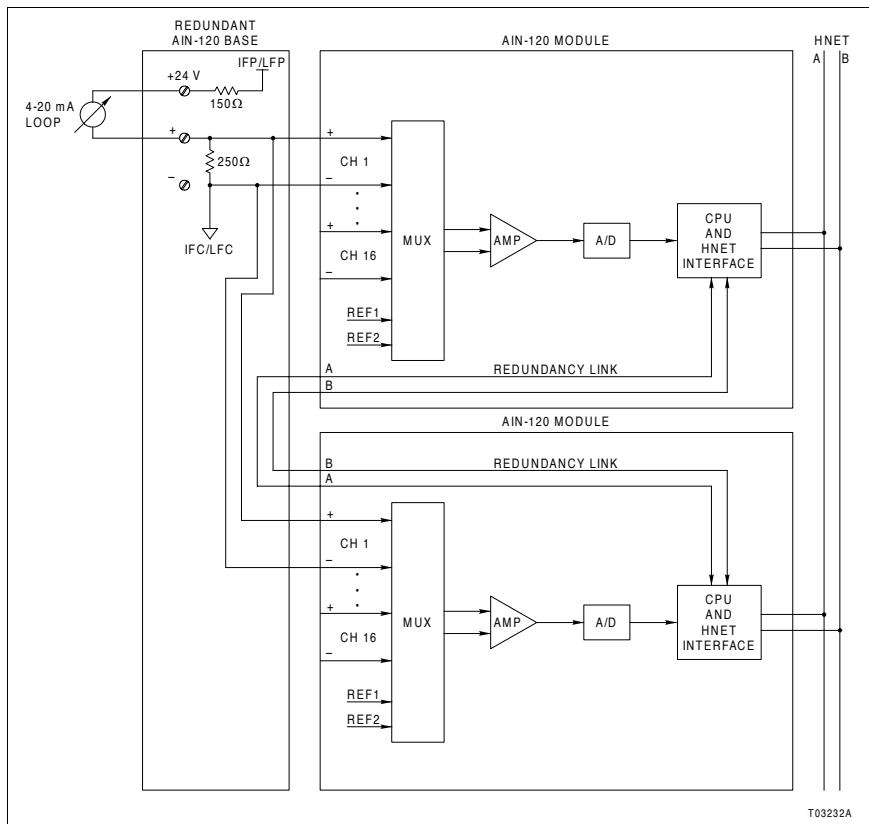


Figure 4-2. AIN-120 Block - Current Mode (IFP or LFP Powered)

module so that only one I/O module is driving the outputs at a time (Fig. 4-8). A short across an output of one I/O module due to an I/O block fault will not affect the output of the other I/O module. An open in the output channel circuit of the base will not allow either I/O module to control the output.

NOTE: Normal failover time for the AOT-150 block is less than 100 milliseconds. Under rare conditions, the output channels could be affected by a failover for up to 200 milliseconds.

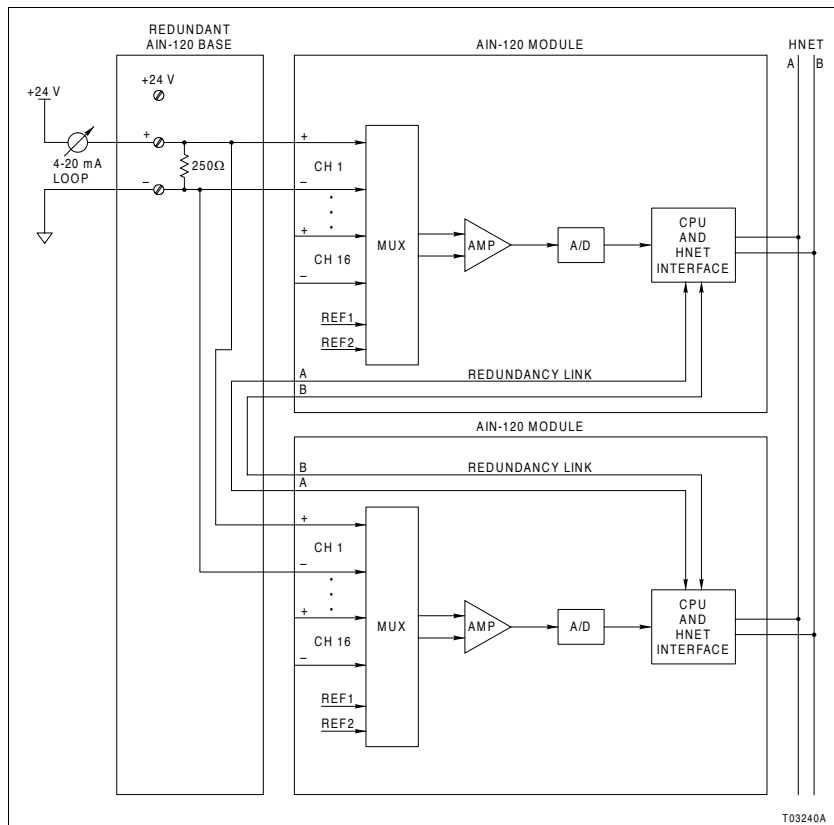


Figure 4-3. AIN-120 Block - Current Mode (RFP Powered)

Analog output channel failures detectable by the primary I/O module that cause a failover to the backup I/O module include:

- Failed output driver.
- Failed output amplifier.
- Failed output sample and hold circuit.
- Failed readback circuit.
- Amplifier failure.

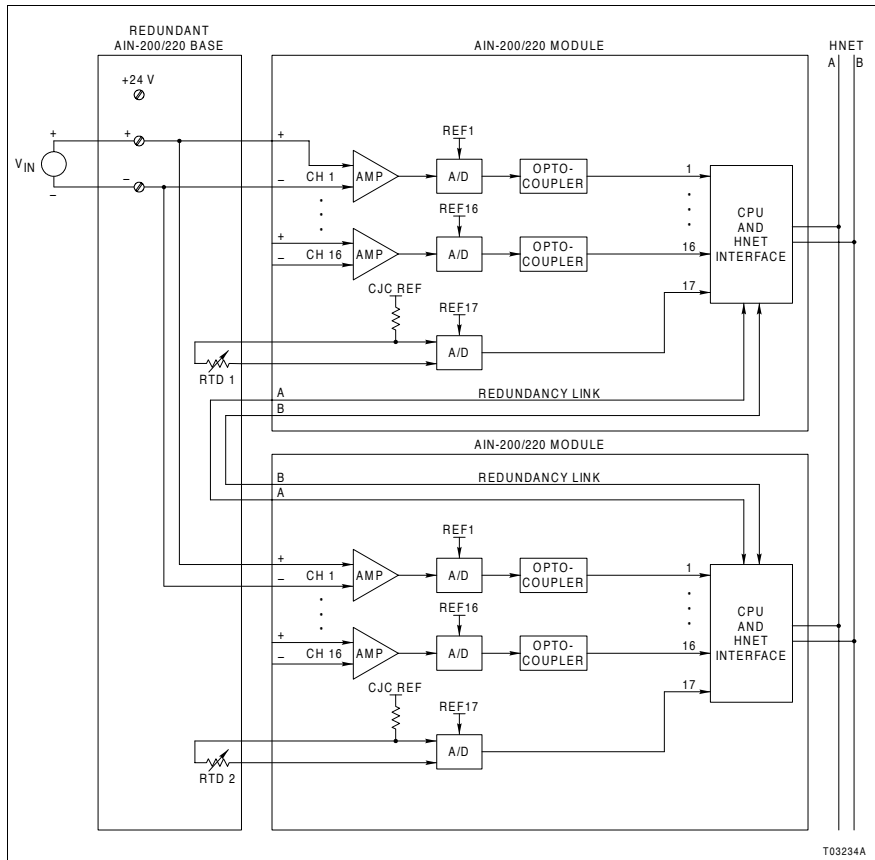


Figure 4-4. AIN-200/220 Block - Voltage and Thermocouple Mode

- A-to-D converter failure.
- Bad voltage reference.
- Failed D-to-A converter (one for all channels).

Digital Input

For digital input capable blocks, channels are directly wired in parallel to both I/O modules (Figs. 4-9 and 4-10). A short

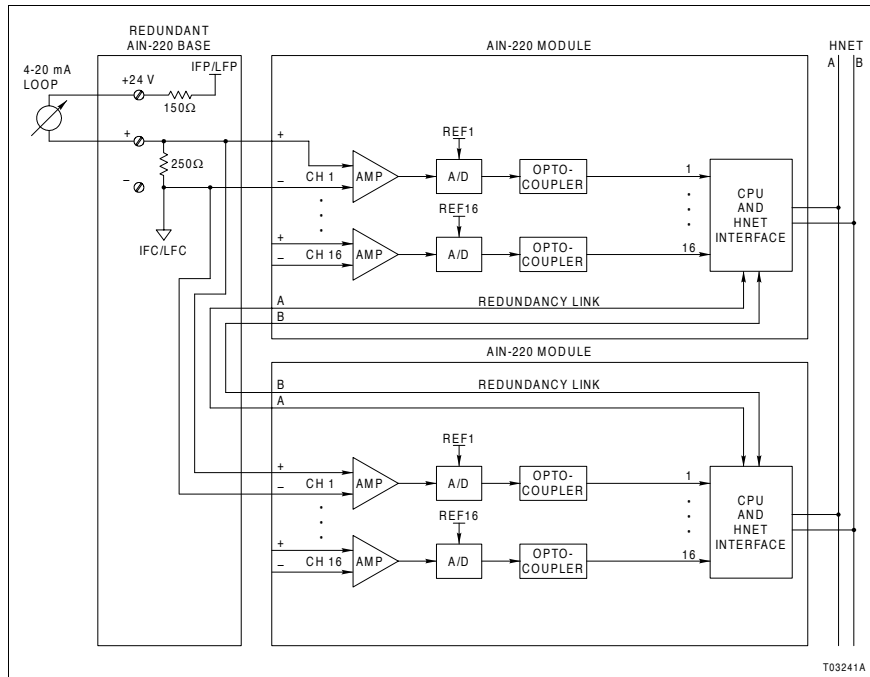


Figure 4-5. AIN-220 Block - Current Mode (IFP or LFP Powered)

across an input of one I/O module due to an I/O block fault will result in a false, unchanging zero state input. An open in an input channel circuit of the base will not allow either I/O module to read the input.

An input state change error for a digital input will cause a fail-over to the backup I/O module. This error occurs when one of the digital inputs is changing state faster than the module can handle. It is typically caused by a problem with the input source. All digital channel LEDs will flash steadily and at the same rate to indicate this type of error.

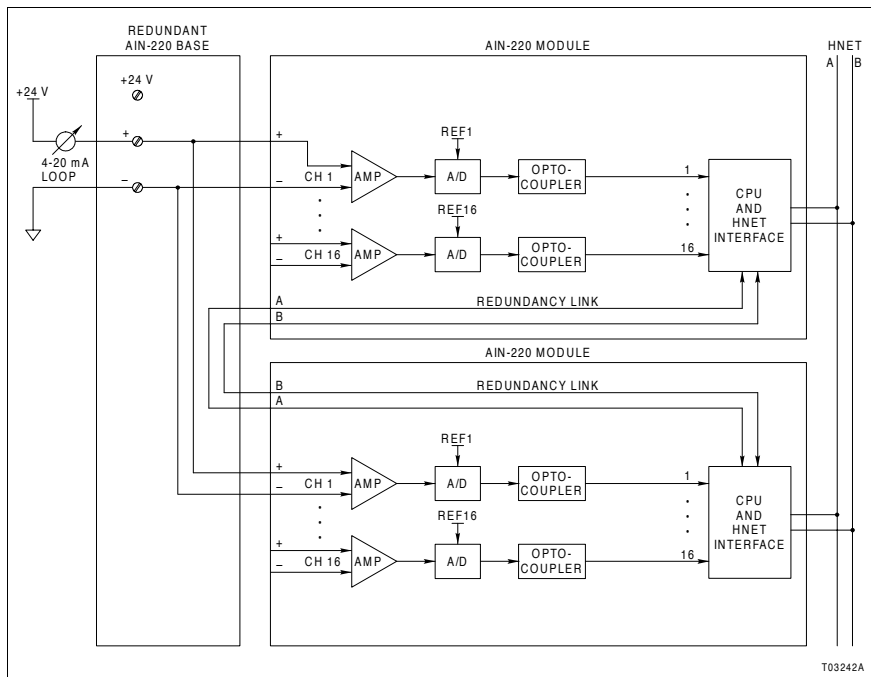


Figure 4-6. AIN-220 Block - Current Mode (RFP Powered)

Digital Output

For digital output capable blocks, channels are directly wired in parallel to both I/O modules (Figs. 4-9 through 4-12). A short across an output of one I/O module due to an I/O block fault will not allow the output to switch off. There are no detectable channel failures for the digital outputs of DIO-400 and DOT-100 blocks.

The DOT-120 block has readback circuitry to monitor actual outputs. If there is a difference between the actual output and the read back output, the channel will be marked as suspect. For the DOT-120 block, failover will occur if the primary I/O module has an output stuck closed, but the backup will be unable to correct this condition.

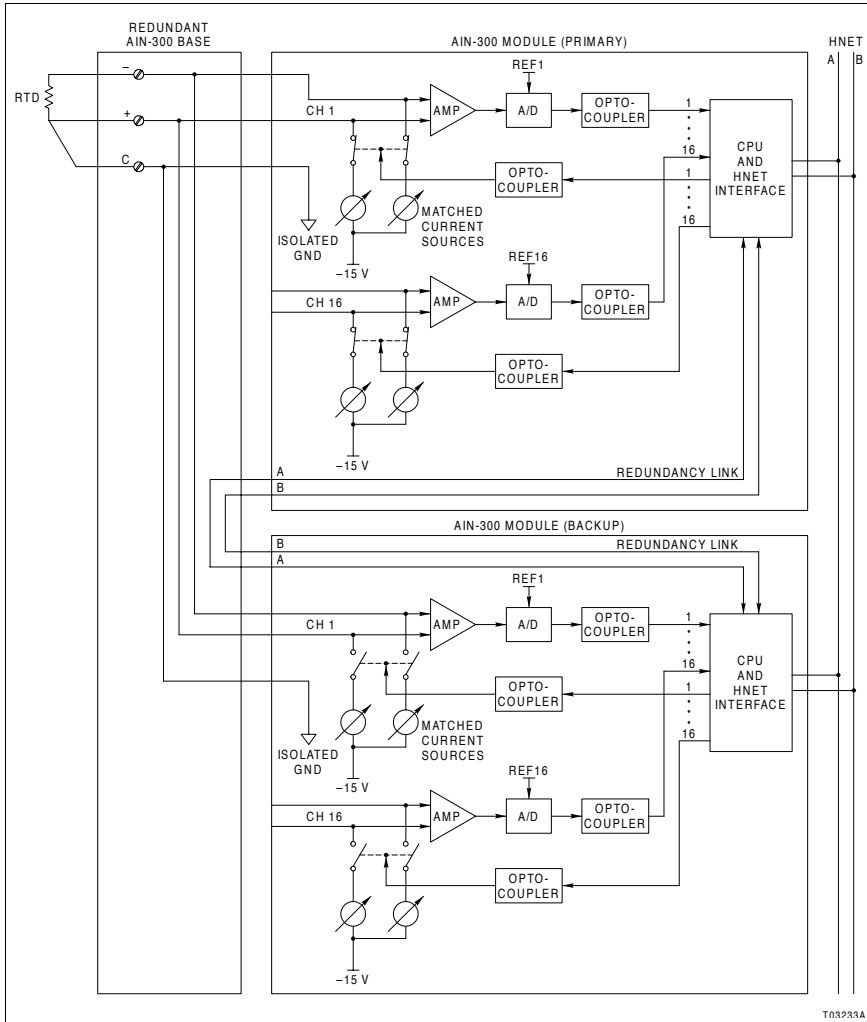


Figure 4-7. AIN-300 Block

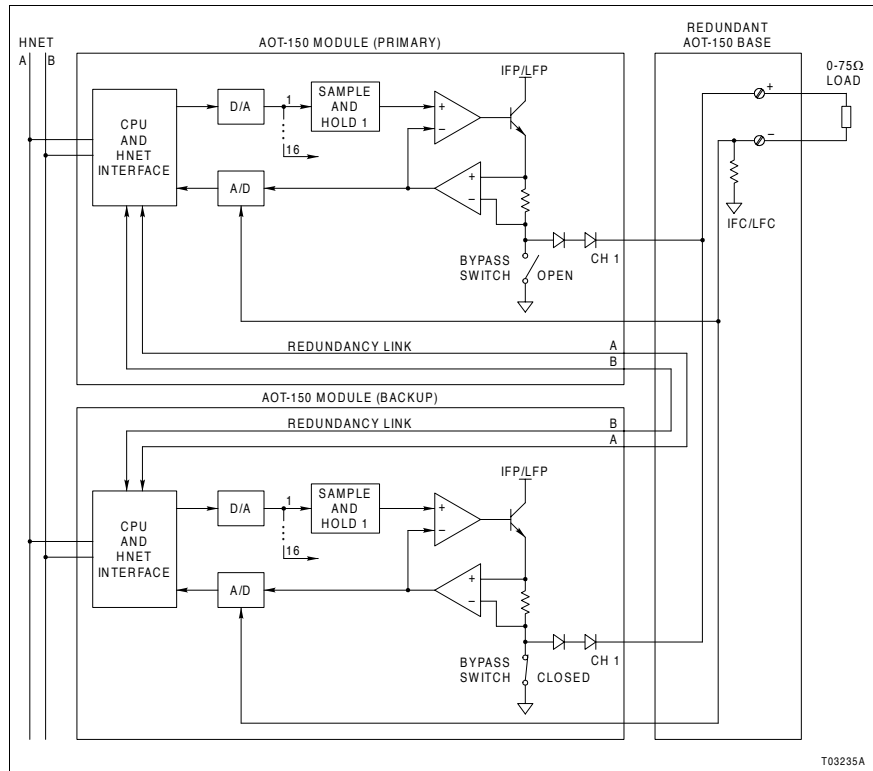


Figure 4-8. AOT-150 Block

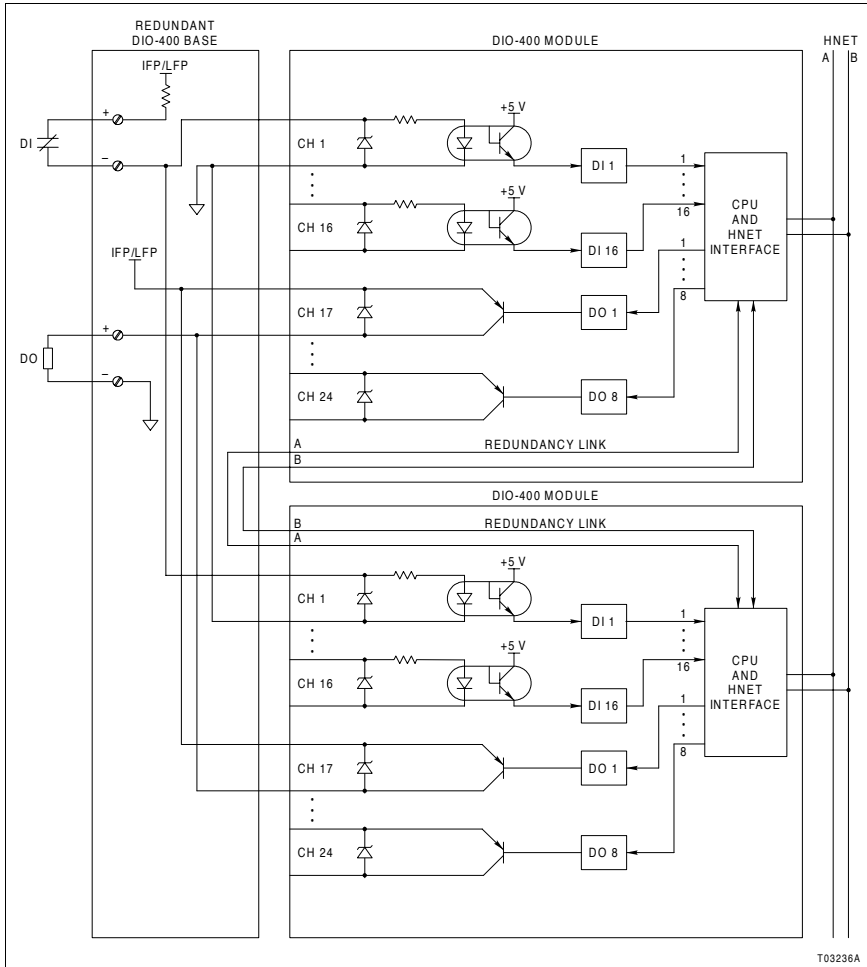
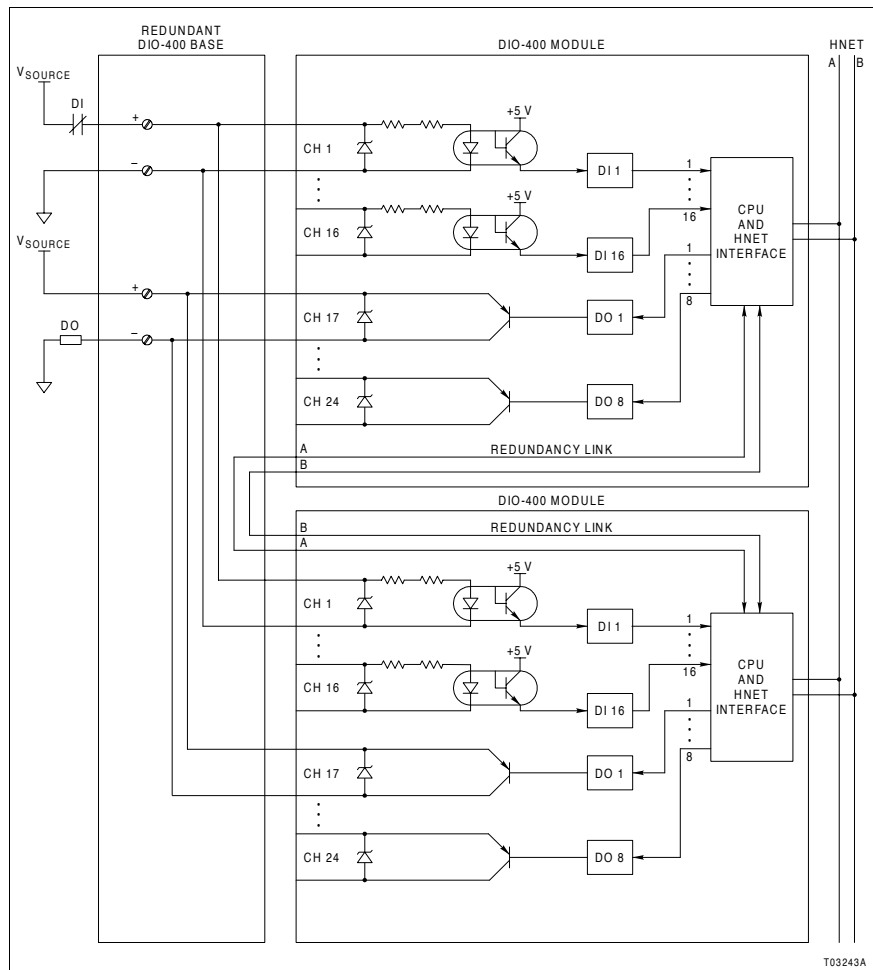


Figure 4-9. DIO-400 Block (IFP or LFP Powered)



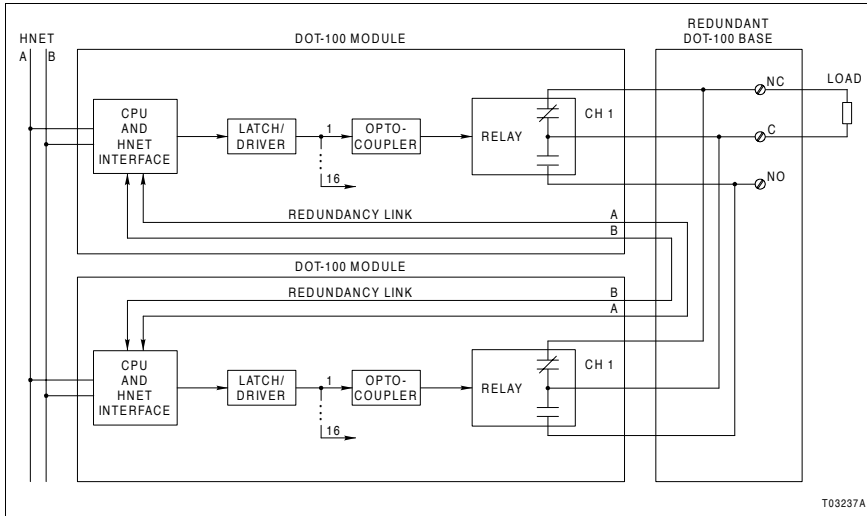


Figure 4-11. DOT-100 Block

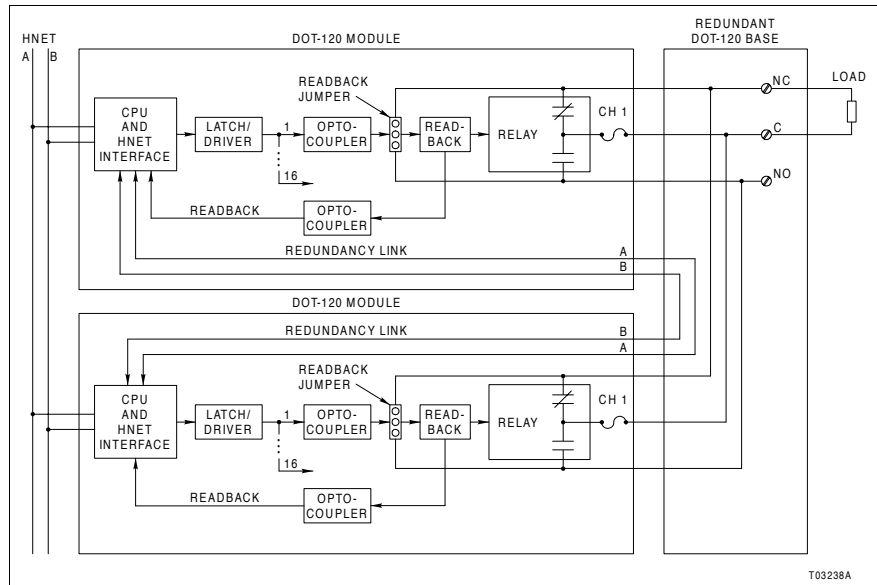


Figure 4-12. DOT-120 Block





Introduction

This section describes I/O and auxiliary block installation and connection for the Harmony I/O system. This instruction discusses only I/O system installation requirements. The instruction does not provide any I/O system planning information and assumes all components have already been purchased and are ready to be installed.

Special Handling

Observe these steps when handling electronic circuitry:

1. **Use Static Shielding Bag.** Keep an assembly in its static shielding bag until ready to install it in the system. Save the bag for future use.
2. **Ground Bags before Opening.** Before opening a bag containing an assembly with static sensitive devices, touch it to the equipment housing or ground to equalize charges.
3. **Avoid Touching Circuitry.** Handle assemblies by the plastic outer packaging; avoid touching the circuitry.
4. **Ground Test Equipment.**
5. **Use an Antistatic Field Service Vacuum.** Remove dust from assemblies if necessary.
6. **Use a Grounded Wrist Strap.** Use the ABB Automation field static kit (part number 1948385A1 - consisting of two wrist straps, ground cord assembly, alligator clip, and static dissipative work surface) when working with modules. The kit grounds a technician and the static dissipative work surface to the same ground point to prevent damage to the circuitry by electrostatic discharge. Connect the wrist strap to the appropriate grounding plug on the power supply or to an unpainted portion of the enclosure with the alligator clip. The wrist strap must be effectively connected to the earth grounding electrode system through the AC safety ground.



7. **Do Not Use Lead Pencils to Set Switches.** To avoid contamination of switch contacts that can result in unnecessary circuit board malfunction, do not use a lead pencil to set a switch.

Unpacking and Inspection

1. Examine the hardware immediately to verify that it has not been damaged in transit.
2. Notify the nearest ABB sales office of any damage.
3. File a claim for any damage with the transportation company that handled the shipment.
4. Use the original packing material and container to store the hardware.
5. Store the hardware in an environment of good air quality, free from temperature and moisture extremes and corrosives.

Installation Procedures

Table 5-1 lists all of the I/O and auxiliary block installation procedures. Refer to **Installation and Connection Sequence** in this section for an explanation of how to use the procedure sections.

Table 5-1. Installation Procedures

Procedure	Description
PR1	Installation preparation
PR2	I/O block base installation
PR3	I/O module installation
PR4	Auxiliary block installation
PR5	BLK-100 installation
PR6	AIN-120 setup
PR7	AIN-200 setup
PR8	AIN-220 setup
PR9	AIN-300 setup
PR10	AOT-150 setup
PR11	CIO-100 setup

Table 5-1. Installation Procedures *(continued)*

Procedure	Description
PR12	DIO-400 setup
PR13	DOT-100 setup
PR14	DOT-120 setup
PR15	CIO-110 setup
PR16	RLY-200 setup
PR17	CIO-100/110 cable connection
PR18	RLY-100/200 cable connection
PR19	Field wiring (S type base)
PR20	Field wiring (C type base)
PR21	Field wiring (cable connection)
PR22	CIO-110 wiring
PR23	RLY-100/200 wiring
PR24	Offline diagnostics
PR25	Device label definition
PR26	I/O system configuration

Installation and Connection Sequence

NOTE: Always follow the instructions given in **Special Handling** in this section when handling an I/O module.

Figures 5-1 through 5-6 comprise the I/O and auxiliary block installation and connection flowchart. This flowchart applies whether installing blocks in a new system or in an existing system.

In the flowchart, each flowchart block represents a single task. The PR code in the flowchart block identifies the procedure section that describes the steps to complete the indicated task. For example, turn to section PR4 to read about auxiliary block installation. Some steps are self-explanatory and have no related procedure section. Complete all steps given in a procedure section before continuing to the next flowchart block. The procedure sections are located towards the back of the instruction.

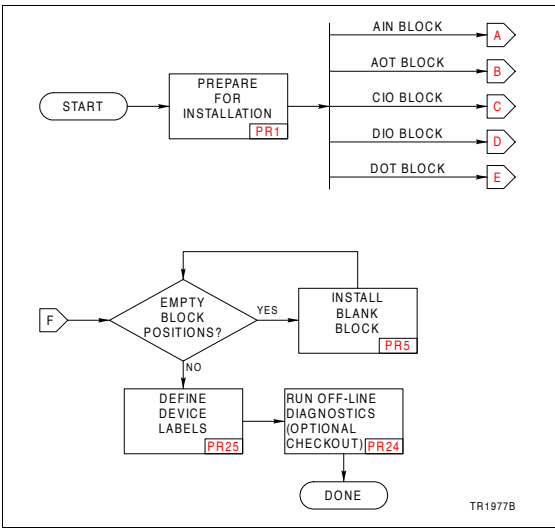


Figure 5-1. I/O and Auxiliary Block Installation and Connection Flowchart

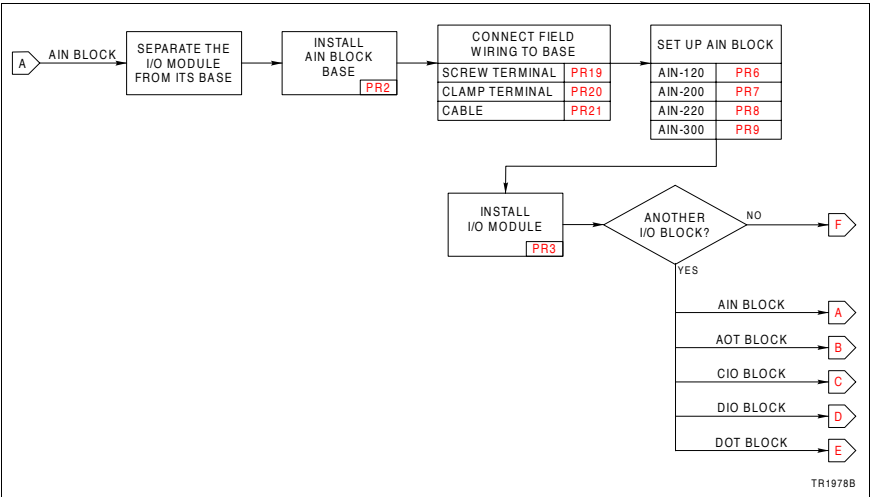


Figure 5-2. AIN Block Flowchart

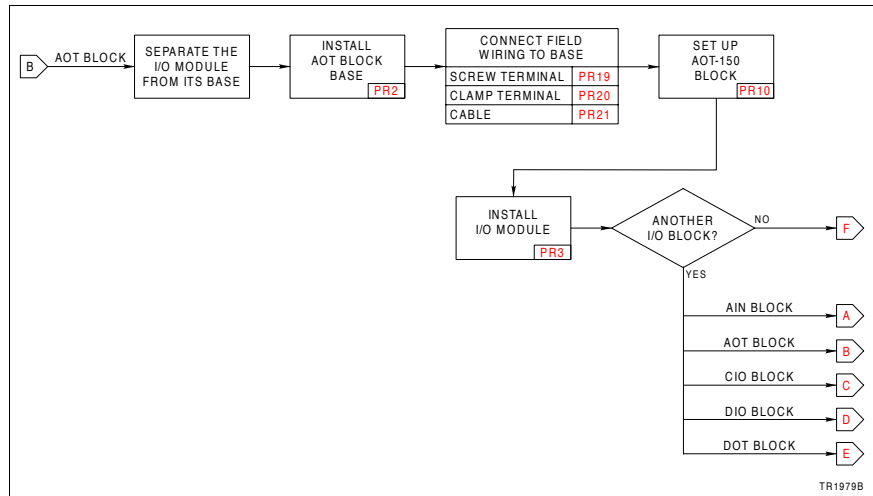


Figure 5-3. AOT Block Flowchart

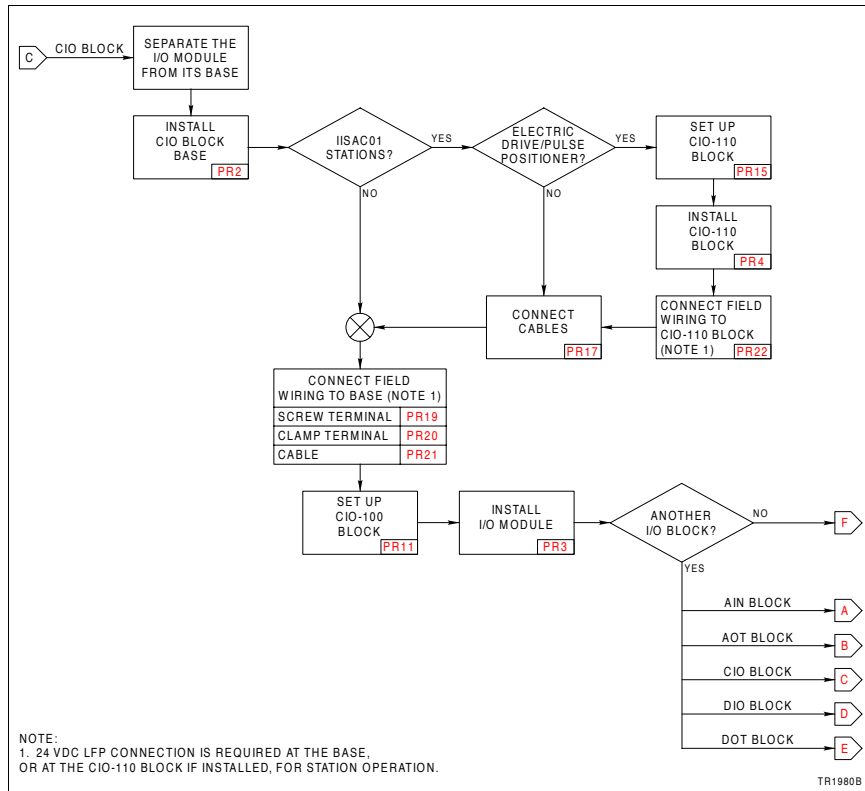


Figure 5-4. CIO Block Flowchart

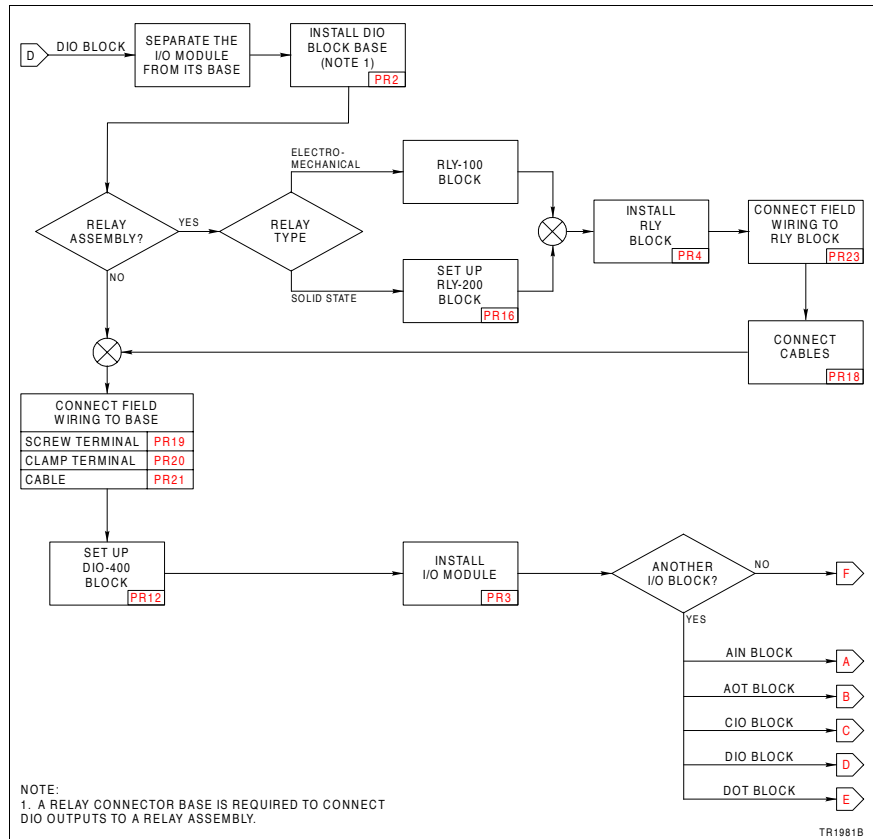


Figure 5-5. DIO and RLY Blocks Flowchart

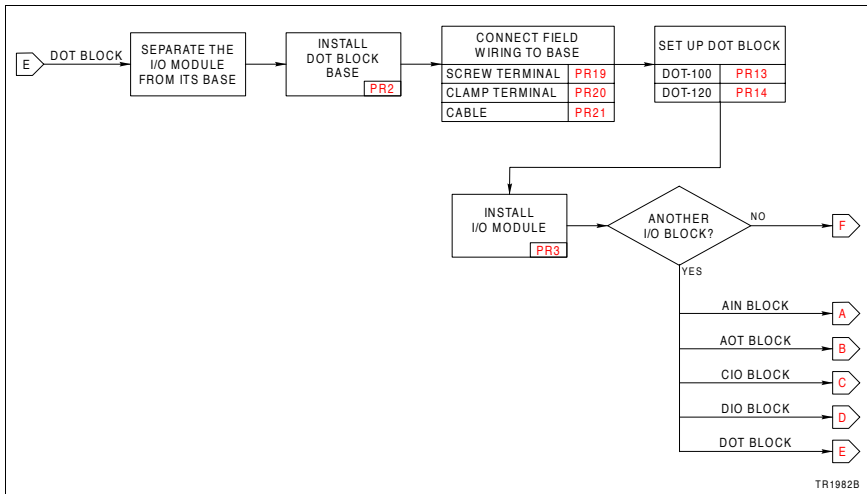


Figure 5-6. DOT Block Flowchart



Introduction

This section details I/O block configuration. All configuration is performed through a Harmony controller.

NOTE: The *Function Code Application Manual* contains I/O block configuration examples.

Configuration Tools

The Harmony I/O system can be configured and tuned using any configuration tools that support the I/O block function codes. This includes, for example:

- Composer (1.0 and later).
- Conductor NT (2.0 and later).
- Conductor VMS (1.0 and later).

NOTE: Only Composer has utilities to define device labels.

Harmony Controller

The Harmony controller is responsible for downloading and verifying the process configuration executed by an I/O block. An I/O block performs its input and output processing based on this process configuration.

Download

When an I/O block is first installed, it contains only a base configuration. This base configuration allows the block to participate in the device labeling process. During the actual labeling process, an I/O device definition function code (FC 221) with a device label is added to the base configuration. Once the label has been established, the Harmony controller can then communicate with and download the appropriate configuration to the block. Refer to *Labels* in this section for more information.



The complete control configuration resides and is retained in the Harmony controller at all times. The controller only off loads a portion of the configuration to be executed by the I/O blocks.

The controller automatically downloads the configuration during startup or after any configuration changes. For this to automatically occur, however, a device label must already have been established in each I/O block. Also, the device label in the block must match a device label in the control configuration of the Harmony controller (i.e., I/O device definition function code).

Verification

The Harmony controller is responsible for verifying I/O block configuration. After losing then regaining communication with an I/O block, the controller will issue commands to read, compare, then download if necessary the configuration. A download will occur if the controller detects any of the following conditions:

- Excluded function code.
- Extra function code.
- Difference in Harmony controller and I/O block specifications.

Changes

All control configuration changes made by the process engineer, technician, or operator affect the control configuration that resides in the Harmony controller. The changes can include adding new or deleting existing function codes, and modifying and tuning specifications of existing function codes. When a change is made to the control configuration that affects I/O blocks, the controller automatically downloads the changes to the appropriate blocks.

For a nonredundant controller, all changes except tuning require the controller to be placed in configure mode. The controller and I/O blocks do not execute the control configuration while in configure mode. For redundant controllers, online configuration enables making configuration changes without affecting the primary controller or interrupting the control

process. Refer to the **Primary Interface** instruction for an explanation of online configuration.

Tuning is the process of making changes to function code specifications while the controller and I/O blocks are executing. Not all specifications can be tuned. Only those specifically designated as tunable can be tuned. Refer to the **Function Code Application Manual** to identify tunable function code specifications.

Time Synchronization

All I/O blocks are time synchronized to insure accurate time stamping of process data. The Harmony controller maintains the time synchronization. The I/O block time-stamps data (input and output values) to a resolution of one millisecond. It applies the time-stamp to a value at the time the value is acquired.

Firmware Download

The I/O block firmware includes a real-time operating system, Hnet support, redundancy link support, and the function code environment. The I/O system supports firmware downloads, which allows I/O block firmware to be updated without having to replace physical components. All firmware downloads are performed using Composer tools and are managed by the Harmony controller. Refer to the **Primary Interface** instruction for firmware download procedures.

The controller takes an I/O block offline to download new firmware. The block's status LEDs will indicate a 0x19 (25 decimal) code when a firmware download is in process (refer to Table 8-3).

Labels

A label is simply a name assigned to a device or an I/O point. In this case, device refers to an I/O block. The Harmony I/O system uses two types of labels: device and channel. The device and channel labels are character strings saved in memory. Labels can be up to 32 characters.

NOTE: A device label is required. Channel labels are optional.



Device Label

All I/O blocks must have a device label assigned to communicate on Hnet. The Harmony controller uses the device labels to direct messages to specific I/O blocks and to identify the source of any received messages. In the control configuration, device labels map function codes to specific I/O blocks.

Electronic ID

Each I/O block has a unique electronic ID. This ID is fixed in memory and cannot be modified. This method of identification:

- Eliminates the need for a physical address switch that must be uniquely set and subsequently recorded for identification and configuration purposes.
- Removes any hardware address management requirements necessary to insure each I/O block has a unique identifier.
- Simplifies configuration.

The identification label, which is physically adhered to the front panel of the I/O module, gives the electronic ID of the I/O block; refer to *I/O Module Front Panel* in Section 7 for further description. The electronic ID does **not** need to be remembered or recorded for use in configuration. User-defined device labels are used instead. The Harmony controller automatically associates device labels with electronic IDs during the device labeling process.

Establishing a Device Label

When an I/O block is first removed from its packaging or after it has been initialized, it does not contain a device label. The device labeling procedure explained in the *Primary Interface* instruction must be performed to establish the label. Once established, the label is retained by the block. The block can be removed and reinstalled without requiring a new label to be assigned.

NOTES:

1. An I/O block needs to be relabeled after performing a firmware download. After copying firmware from one block to another, both the source block and the destination block must be relabeled.

2. Redundant I/O modules share the same device label. The primary I/O module will define or update the backup I/O module's device label automatically. This occurs even if the backup I/O module does not currently have a device label defined or if it has a device label that is different than the primary I/O module's.

The device label for an I/O block can be any unique, meaningful label desired. Labels can be assigned using any labeling scheme desired. The labels should include enough detail, however, to easily identify and differentiate between devices and should be defined consistently from block to block.

The Harmony controller performs all device label management, meaning that any changes, updates, and additions are directed to the controller which then communicates the changes, updates, and additions to the appropriate, individual I/O blocks.

NOTE: For compatibility reasons, the label for a Harmony controller is derived from its hardware address. This label cannot be modified.

Predefining a Device Label

Typically the device label is defined for an I/O block as the last step of block installation or I/O module replacement as described in [Section 5](#) and [Section 10](#) respectively. This is not a requirement however. In some cases, it may be easier and less time consuming to have the label assigned before beginning installation or replacement. Refer to procedure section [PR25](#) for the steps to predefine a device label.

Online Configuration

Specification one of FC 221 contains the device label. This specification is not tunable, which means it normally cannot be changed while the controller is operating in execute mode. The specification can be changed, however, using online configuration. If the device label is changed using online configuration, then the controller will automatically change the block's label to match this new label. Refer to the **Primary Interface** instruction for an explanation of online configuration.



Channel Label

A channel label identifies an I/O channel of an I/O block. A channel label can be any unique, meaningful label desired. The label assignment is optional and is not required for proper operation. It is strictly for ease of recognition during configuration and maintenance.

A human system interface such as a Conductor work station and other system nodes use a tag to acquire information from an exception reporting block and to perform process control. If desired, the channel label can be defined the same as a tag name in the system tag database. This allows easily identifying the relationship between an I/O block point and a tag in the system tag database.

NOTE: Currently, tag names are limited to 14 characters whereas channel labels can be up to 32 characters.

Duplicate Labels

Duplicate device labels on the same Hnet are not permitted. The Harmony controller checks for any duplicate device labels and will identify any occurrence as a configuration error. It does not check for duplicate channel labels however. The following paragraphs provide more detail about what occurs when a duplicate label is detected during configuration, startup, and normal operation.

NOTE: Both I/O modules of a redundant block share the same device label. These are not seen by the controller as duplicate labels.

Configuration	If the controller configuration contains two or more device definition function codes (FC 221) with identical device labels assigned, the controller will enter error mode and display a duplicate label error on its LEDs.
Initial I/O System Startup	The following occurs when duplicate device labels are detected on initial I/O system startup: 1. The offending I/O blocks will display a duplicate label error code (status LEDs 2, 4, and 5 on). 2. A status report indicating bad status is issued for each I/O block that has a duplicate label. This status indication can be seen in the controller status bytes.

3. A device problem report indicating duplicate device labels is issued for the I/O blocks that have the duplicate labels. This report can be seen on a human system interface.

This does not affect control configuration execution and the controller will continue to operate and communicate as normal with other I/O blocks.

Normal Operation If an I/O block that has a duplicate label is inserted into a system that has already established communication with another I/O block:

1. The controller automatically relabels the offending block with the device label "Duplicate Label Detected". The text string appears in the device label specification (S1) in FC 221.
2. The offending I/O block will display a duplicate label error code (status LEDs 2, 4, and 5 on).

This does not affect control configuration execution and the controller will continue to operate and communicate as normal with other I/O blocks.

Function Codes

The Harmony controller and I/O blocks execute a control configuration made up of function codes linked together and loaded in nonvolatile memory to perform the actual process control and process management. Function codes are pre-defined, fixed function algorithms. The controller supports numerous function codes for building the control configuration. The functions they perform range from computing (function generator, square root, etc.) to control (PID, pulse positioner, etc.) to I/O interface (analog input, digital output, etc.). Refer to the ***Automation Architect*** instruction for information on how to build a control configuration.

I/O blocks are configured using a series of I/O block specific function codes:

- I/O device definition (FC 221).
- Analog in/channel (FC 222).
- Analog out/channel (FC 223).
- Digital in/channel (FC 224).
- Digital out/channel (FC 225).
- Test status (FC 226).



The Harmony controller allows using both I/O block and rack I/O function codes concurrently to communicate with both Harmony I/O blocks and Harmony rack I/O devices simultaneously.

I/O Device Definition (FC 221)

The I/O device definition function code (FC 221) is mainly used to group the various I/O channel function codes of an I/O block. The function code supports up to 24 input or output channels (i.e., I/O channel function codes). Besides grouping the I/O channels, the function code is also responsible for:

- I/O block and channel summary status reporting.
- Duplicate device label checking.
- Configuration verification.
- Redundancy checking and failover.
- Generating problem reports.
- Override, simulation, and status error inhibit permit.

Refer to [Section 8](#) for I/O block status reporting details.

Function code specifications:

- Contain an I/O block device label. This associates the function code with a specific I/O block.
- Link I/O channel function codes. These function codes interface the I/O block inputs and outputs.
- Permit override, simulation, and status error inhibit modes for all linked I/O channels (i.e., master switch).
- Control I/O block status reporting. A status error inhibit condition prevents I/O channel errors from being included in the I/O block device status report made to the controller.
- Enable redundant I/O module checking.
- Identify an external cold junction reference for thermocouple inputs.

These are just some of the function code capabilities. Refer to the **Function Code Application Manual** for detailed function code descriptions, specifications, outputs, and capabilities.

I/O Channel (FC 222, 223, 224, 225)

The I/O channel function codes allow for single channel modularity. In other words, one I/O channel function code reads the input value or drives the output of one channel. Specifications are set on a per channel basis rather than on an I/O group basis. The function codes provide addressing, startup, execute (i.e., run time), override, simulation, and failure mode operation specifications. The I/O channel function codes are exception reporting function codes.

Tables 6-1 and 6-2 summarize some of the I/O channel function code capabilities. Refer to the **Function Code Application Manual** for detailed function code descriptions, specifications, outputs, and capabilities.

Table 6-1. I/O Channel Function Code Summary

FC	I/O	Purpose	Normal Mode Output
222	Analog input	Reads analog input channel data.	Analog input value in engineering units and the channel status.
223	Analog output	Sets analog output demand value and acquires output channel readback data.	Readback analog output value in engineering units and the channel status.
224	Digital input	Reads digital input channel data.	Digital input state (0 or 1) and the channel status.
225	Digital output	Sets digital output state and acquires output channel readback data (if applicable). ¹	Readback digital output state (0 or 1) and the channel status.

NOTE:

1. Not all digital output channels support readback. This depends on the I/O block type (e.g., DOT-100 block does not support readback).

Table 6-2. I/O Channel Specifications Summary

Specification Description		Function Code			
		222 (AI)	223 (AO)	224 (DI)	225 (DO)
Alarming	Alarm state			•	•
	High alarm (EU)	•	•		
	Low alarm (EU)	•	•		

**Table 6-2. I/O Channel Specifications Summary** *(continued)*

Specification Description		Function Code			
		222 (AI)	223 (AO)	224 (DI)	225 (DO)
Identification	Channel label	•	•	•	•
I/O characteristics	Custom range high limit	•			
	Custom range low limit	•			
	Deviation limit ¹	•	•		
	EU Identifier	•	•		
	High value (EU)	•	•		
	Input type	•			
	Low value (EU)	•	•		
	Significant change (EU)	•	•		
	Value to output		•		•
I/O conditioning	A/D conversion accuracy	•	• ²		
	Debounce period			•	
	EU conversion or shaping algorithm precedence	•			
	Lead wire resistance	•			
	Shaping algorithm	•			
I/O source	Normal input or undefined	•	•	•	•
	Override enable	•	•	•	•
	Override value	•	•	•	•
	Simulation enable	•	•	•	•
	Simulation value	•	•	•	•
Operation	Default state on stall		•		•
	Readback enable				•
	Status error inhibit	•	•	•	•

NOTES:

1. In normal mode this is redundant I/O deviation limit. In override mode this is override deviation limit. In simulation mode this is simulation deviation limit.

2. Readback A/D conversion accuracy for analog outputs.

An I/O block prevents the use of any I/O channel function codes it does not support. For example, a DOT-100 block supports 16 digital output channels, and therefore will only allow using digital out/channel function codes (FC 225) and additionally only channels one through 16.

I/O Channel Data

An I/O channel function code reports channel data in automatically generated exception reports. Channel data includes quality, alarm status, channel status, analog value or digital state, and a time-stamp. The data can be read by an external device such as a human system interface. The information is also available at the I/O channel function code outputs, which can be accessed by other local function codes.

Quality	The quality reported by an I/O channel function code is either good or bad as determined by the function code.
Alarm Status	For an analog channel, the alarm status indicates that the value being reported is within normal limits or has reached or passed either a high alarm or low alarm limit. The alarm limits are defined in I/O channel function code specifications. For a digital channel, one of its two digital states can be selected as an alarm state. The alarm state is selected with an I/O channel function code specification. When the channel toggles to the selected alarm state, an alarm is reported.
Channel Status	Channel status is reported in the form of problem reports which appear on a human system interface. Refer to Section 8 for channel problem report details.
Value or State	The analog value is reported in IEEE real-4 format. The digital state is reported as either a boolean logic one or zero.
Time-Stamp	The time-stamp is the system time at which a value was read. The time is in milliseconds.

Suspect Condition

The function code tests redundant inputs and outputs to determine suspect condition, and it also tests actual value against an override or simulated value. Actual value refers to an input value for analog or digital inputs and a demanded output value for analog or digital outputs. For analog inputs and outputs, the suspect indication is controlled by the deviation limit specification set in the I/O channel function codes (refer to Table [6-2](#)).

NOTE: Only readback capable digital outputs can indicate suspect while in normal mode. The DOT-100 block does not support readback.



For **redundant** inputs and outputs, the function code reports a suspect condition when:

- Redundant digital input states are good quality but do not match.
- Redundant digital output states (readback) are good quality but do not match.
- Redundant analog input values are good quality but there is a difference between the redundant analog inputs and the difference is greater than the deviation limit specified in the function code.
- Redundant analog output values (readback) are good quality but there is a difference between the readback values for the redundant analog outputs and the difference is greater than the deviation limit specified in the function code.

In this case, suspect warns that if a failover from primary to backup should occur, the difference in redundant values may be significant enough to cause a process upset.

For **override and simulation** inputs and outputs, the function code reports a suspect condition when:

- While in override or simulation mode, the override or simulation digital input state does not match the actual digital input state.
- While in override mode, the override digital output state does not match the readback output demand state.
- While in override mode, there is a difference between the override analog input value and the actual input value and the difference is greater than the deviation limit specified in the function code.
- While in simulation mode, there is a difference between the simulation analog input value and the actual input value and the difference is greater than the deviation limit specified in the function code.
- While in override mode, there is a difference between the override analog output value and the readback output demand value and the difference is greater than the deviation limit specified in the function code.

- While in simulation mode, there is a difference between the simulation analog output value and the readback output demand value and the difference is greater than the deviation limit specified in the function code.

In this case, the suspect warns that if the mode is changed from either override to normal or simulation to normal, the difference between actual value and override value or between actual value and simulation value may be significant enough to cause a process upset.

NOTE: When an IISAC01 Analog Control Station is in manual/override/auto-bypass mode and is bypassing the analog output of the CIO block, the suspect status is not set while in override or simulation mode. The station itself is responsible for preventing the process upset. It accomplishes this by maintaining bypass control over the analog output until the control output of its station function block (FC 80) matches the demand output of the station.

Exception Reporting

Each I/O channel function code is an exception reporting function code. Exception reported data can appear as dynamic values, alarms, and state changes on displays and in reports generated by operator interfaces and other system nodes.

Exception reporting is automatic. An I/O channel function code will generate an exception report periodically to update data, after a process point reaches a defined alarm limit or changes state, or after a significant change in value occurs.

The segment control (FC 82) and analog I/O channel function codes (FC 222 and 224) have specifications that control exception reporting. Specifically, the segment control function code contains minimum and maximum exception reporting times and the I/O channel function codes contain a significant change specification used to trigger exception reporting.

Engineering Units (EU)

Analog I/O channel function codes automatically perform engineering unit conversions on analog input, output demand, and output readback values. Analog inputs and readback values are converted based on the engineering unit low value, high value, and EU identifier specifications. Also, input type and range selection for analog inputs factors into the engineering units conversion.



Example: A high level analog input signal has a range of 0 to 10 VDC. The actual input signal is at 5 VDC. The engineering unit associated with the input is percent (%); therefore, the high limit is 100 and the low limit is zero. For this signal, the I/O block will report the input value as 50 percent.

Alarm limits and significant change are expressed in engineering units.

I/O Source

There are three input or output source selections for each I/O channel: normal, override, and simulated. The source is selected by setting certain I/O channel function code specifications (refer to Table 6-2). A value or state is identified as either normal, simulated, or overridden when reported. Additionally, an I/O channel can be undefined. An undefined channel is ignored during control configuration execution.

NOTE: The override, simulation, and status error inhibit permit specification (S26) in the I/O device definition function code acts as the master switch for enabling or disabling the override and simulation I/O source options for individual channels.

Normal	The I/O source is normal as long as the override, simulation, or undefined options are not selected. Normal is the default.
Override	The override option allows the I/O channel value or state to be manually overridden (locally substituted) to support system checkout or field testing. An override enable specification controls the override function and an override value specification sets the substitute value. The value specification is tunable and can be changed from a human system interface or by another function code.
Simulation	The simulation option allows the I/O channel value or state to be simulated by some other function code. A simulation enable specification controls the simulation function and a simulation value specification selects the simulation value source.

NOTES:

1. An override value takes precedence over a simulated value, and both override and simulated values take precedence over a normal input value.
2. Override and simulation modes do not function when the I/O channel is set to undefined input.

3. The auto-bypass/manual override operation of the IISAC01 Analog Control Station takes precedence over the CIO block's simulation, override, normal, and undefined source modes.

Hnet Stall Mode (Default State)

A default state on stall specification in output channel function codes selects a failure mode output. An output channel will go to the configured default state when Hnet communication or communication with the Harmony controller is lost. For an analog output, the options are zero percent output, 100 percent output, and hold current output. For a digital output, the options are zero state output, one state output, and hold current output. An output will automatically return to normal (i.e., controlled output) after communication is reestablished. Refer to **Failure Mode (Outputs)** in Section 3 for further explanation.

Status Reporting

A status error inhibit specification in I/O channel function codes controls error status reporting. If status reporting is disabled, any channel errors will not be reflected in I/O block device status reports. Block device status reports are integrated into Harmony controller status reports. This permits disabling status reporting during testing and for an out of service point. It does not disable input or output value and alarm status reporting, however.

NOTE: The override, simulation, and status error inhibit permit specification (S26) in the I/O device definition function code acts as the master switch for enabling or disabling status error inhibiting for individual channels.

Alarming

Alarm status reports are used to trigger alarming features such as display changes (e.g., colors and dynamic symbols), alarm tones, external annunciators, and automatic logging features. System alarming starts at the controller and I/O block level. When an I/O channel function code reports an analog value or digital state, it also includes alarm status information.

Low and high alarm limit specifications in analog I/O channel function codes are used to set up alarming. A low alarm condition will be reported when an input value or output readback



value is at or below the low alarm limit. Likewise, a high alarm condition will be reported when the value is at or above the high alarm limit.

An alarm state specification in digital I/O channel function codes is used to set up alarming. One of the two digital channel states can be selected as an alarm state. When the input or output readback toggles to the designated alarm state, an alarm condition will be reported.

Shaping Algorithms

The following shaping algorithms (i.e., computing functions) can be used with the analog input channel function code:

- Function generator (FC 1).
- Square root (FC 7).
- Polynomial (FC 167).

An engineering unit conversion/shaping algorithm precedence specification in the analog input channel function code determines when the shaping will be applied, either before or after engineering unit conversion.

Test Status (FC 226)

The test status function code (FC 226) provides access to Harmony I/O status information. Any I/O block specific function code can be tested for status (i.e., I/O device definition and I/O channel function codes). Refer to the **Function Code Application Manual** for the statuses that can be accessed with this function code.

The test status function code checks the status of up to four status conditions from the same function code. It is a four input logical OR function that sets the output to a logic zero if all tested status conditions are false, and to a logic one if one or more tested status conditions are true.



Introduction

This section provides operating information for I/O blocks and auxiliary blocks, and describes termination base markings and color coding.

I/O Block

All I/O blocks share similar front and rear panel layouts. Figure 7-1 shows an example front panel.

I/O Module Front Panel

The front panel of an I/O block communicates a considerable amount of information including block type, operating mode, and operating status. At a glance the following information can easily be discerned:

- Block type and model.
- Operating mode.
- Operating status.
- Power status.
- I/O channel status (digital I/O only).

Block Type and Model

A block type identifier enables quickly and easily identifying general block type. I/O blocks are grouped into three major categories: analog (A), digital (D), and control (C). These categories further divide into subcategories of input only (IN), output only (OT), and both input and output (IO). A CIO block, for example, is a control block that has both input and output capabilities.

A model number distinguishes between the different I/O block versions within a given block category. Each I/O block model has different I/O capabilities.

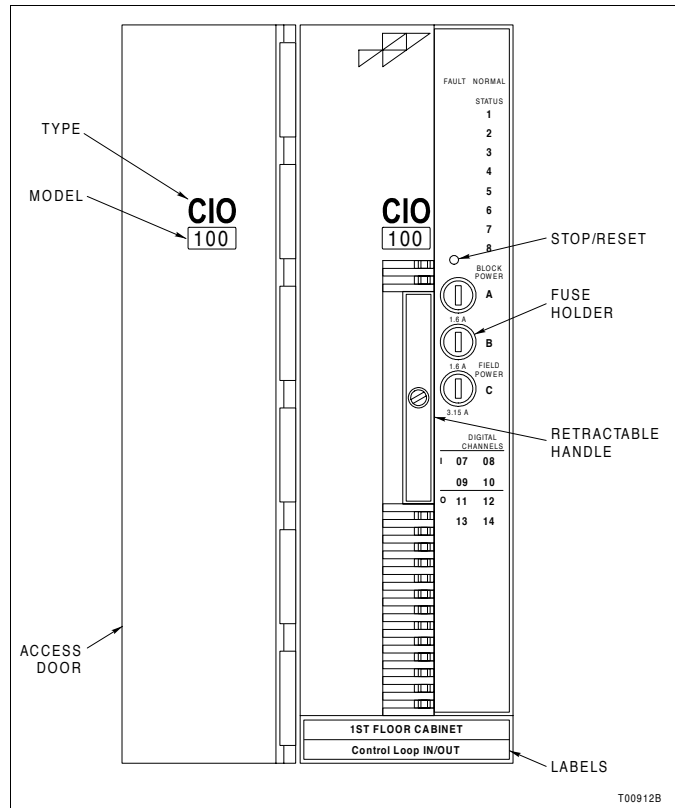


Figure 7-1. I/O Block Front Panel

Operating Mode - Normal and Fault

The NORMAL and FAULT indicate I/O block operating mode. Table 7-1 summarizes the indications.

Status

The eight status indicators show normal and error status codes. The status appears as an eight-bit binary status code, which can be deciphered using look-up tables provided. LED eight is the most significant bit. Refer to Table 7-2 for normal

Table 7-1. Operating Mode - Normal and Fault LEDs

Indicator	State	Description
Normal	On	Operational and online.
	Flashing	Established communication but not initialized or configured.
		Configured and operational but lost communication with the controller.
	Off	No power. If this condition exists, no front panel LEDs will be on.
		Communication not established with controller for the first time.
		Fault condition exists (with FAULT indicator on).
Fault	On	CPU halted (with status code given in eight status LEDs).
		Machine fault timer expired. Refer to Machine Fault Timer in Section 3 for a description.
		Stop/reset button activated.
	Off	No fault condition.

Table 7-2. Normal Operating Mode Status Codes

LED Status	Condition
– – – – – – – –	Initializing
1 2 3 4 5 6 – –	Normal stop
– – – – – – 7 –	Configuration downloaded
– – – – – – – 8	Normal operation (backup I/O module)
– – – – – – 7 8	Normal operation (primary I/O module)

NOTE: – = LED off.

operating mode status codes. Refer to Table 8-3 for additional status codes, both normal and error.

Block Power

The block power indicators (A and B) give a good or bad status indication for the redundant 24 VDC block logic power inputs to the block.

The status indicator on indicates a good power input. The inputs are tested after their front panel fuses, which means a bad input indication could be a blown fuse, bad connection, or



it could be a problem with the actual power source. A problem with the power source, however, will cause a bad status indication on other blocks.

Field Power

The field power indicator gives a good or bad status indication for the internal field power (IFP) or external local field power (LFP) input to the block. The indicator appears as C for all blocks except DIO blocks. A DIO block has two separate field power indicators to show digital input field power status (DI) and digital output field power status (DO). The type of power associated with the indicator depends on the field power option chosen for the block, either IFP or LFP.

The status indicator on indicates a good power input. The input is tested after its front panel fuse, which means a bad input indication could be a blown fuse, a bad connection, or it could be a problem with the actual power source. A problem with the power source, however, will cause a bad status indication on other blocks. This assumes there are other blocks using the same power source however.

Digital Channels

The channel status indicators show digital input and output channel states and status. Only digital I/O capable blocks have channel status indicators. The indicator is the channel number (e.g., 05, 10, 15, etc.). Refer to Table 7-3 for a description of possible indicator states.

Table 7-3. Digital Channel Status

Indicator	Channel Status
On	On state.
Single channel flashing at a steady rate	1. Readback open or short. 2. Configuration error.
All channels flashing at a steady and same rate	Input state change error. One of the digital inputs is changing state faster than the module can handle. Typically caused by a problem with the input source.
Off	Off state.

When the I/O block has both digital input and output capabilities, the channel indicators are segregated into input (I) and output (O) groups on the front panel.

ID Labels

The front panel contains two labels at the bottom of the I/O module: inner label and outer label. The labels are located in a small recess covered by a removable clear plastic lens.

Inner Label Permanently adhered to the block. It gives device identification information which includes the device ID number and a device description. The device ID is both a serial number and the unique electronic ID assigned at the factory. The following is an example inner label:

Device ID: 123456789ABC
High Level Voltage, Current IN

Outer Label For customer use. Provides an area for customer identification of the particular block. It also contains a brief I/O block application description. The following is an example outer label:

1ST STAGE - ACID DRUM
High Level Voltage, Current IN

I/O Module Rear Panel

Figure 7-2 shows the typical rear panel of an I/O module. The switches, jumpers, and connectors are recessed to allow resting the assembly face up on a table.

For a CIO-100 block, P4 is a station link connector rather than redundancy link and is labeled as such. For DIO blocks, the field power select jumpers are for digital output field power and are labeled as such.

Table 7-4 summarizes the SW2 special operations switch settings.

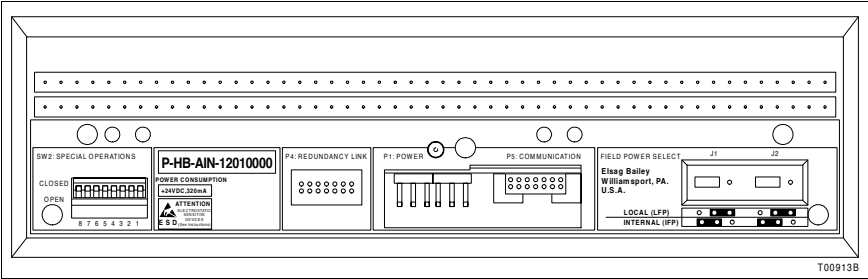


Figure 7-2. I/O Module Rear Panel

Table 7-4. Special Operations Switch (SW2) Settings

Switch Position (SW2)								Condition
8	7	6	5	4	3	2	1	
1	1	1	1	1	1	1	1	Normal operation
1	0	1	1	1	1	1	0	Initialize
0	x	x	x	x	x	x	x	Diagnostic mode (refer to Diagnos- tics in Section 8)

NOTE: 0 = off or open; 1 = on or closed. The on position is the switch up position when looking at the I/O module as shown in Figure 7-2.

Termination Base Color Coding and Markings

Field wiring attaches to the terminal strips located behind the front access door on a termination base (Fig. 7-1). To simplify installation, field wiring terminals are clearly marked to identify positive (+) and negative (–) polarity; and three-wire RTD, normally open relay contact, and normally closed relay contact wiring connections. Additionally, input and output channel terminals are color coded for easier recognition. The markings and color coding together allow wiring the input and output channels without requiring any additional documentation. Table 7-5 summarizes the markings and color code meanings.

Table 7-5. Terminal Strip Markings and Color Coding

Marking/Color	Description
+24 V	Current loop power
+	Positive terminal
–	Negative terminal

Table 7-5. Terminal Strip Markings and Color Coding (continued)

Marking/Color	Description
	Normally closed relay contact
	Normally open relay contact
	Three-wire RTD
Black letter on blue background	Analog input channel
Blue letter on black background	Analog output channel
Black letter on orange background	Digital input channel
Orange letter on black background	Digital output channel

Channels are numbered consecutively whether they are input or output channels. For example, the input channels of a DIO-400 block are numbered 01 to 16, and the output channels are numbered 17 to 24.

Operation

This section details the I/O block startup sequence, stop/reset pushbutton operation, and initialization.

Startup

A startup sequence occurs after a power on or manual reset of an I/O block. Plugging an I/O module into its base connects power and begins the start up. Table 7-6 describes a successful startup sequence.

The I/O block performs a series of online diagnostics tests during startup. Refer to **Diagnostics** in Section 8 for a description.

Stop/Reset Button

The stop/reset button (Fig. 7-1) is used to interrupt configuration execution and to initiate a hardware reset. The button is accessed through the small opening on the front panel. Some type of thin rod, preferably nonmetallic, is required to press the button.



Table 7-6. Startup Sequence

Sequence	LEDs				
	Normal	Fault	Status 1 to 8	Block and Field Power	Digital Channel
1	Off	On	All On	On	All On
2	On	Off	All On	On	All Off
3	On	Off	All Off	On	All Off
4	On	Off	On/Off ¹	On	On/Off ²

NOTE:

1. Refer to Table 7-2.

2. Refer to Table 7-3.

First Press Stop Press the button once to halt operation. The electronics conducts an orderly shutdown after stop is initiated to prevent any inadvertent process upsets:

1. Save process configuration.
2. Complete any nonvolatile memory write operations.
3. Deactivate all communication links.
4. Transfer control from the primary electronics assembly to the secondary assembly in redundant configurations.
5. Force any output channels to their powered off states.
6. Illuminate FAULT.

Second Press Reset Press the button a second time to initiate a hardware reset. A hardware reset is required to recover from a module time-out or a manual stop (single press). After the hardware reset completes, the block then begins its startup sequence. Refer to **Startup** in this section.

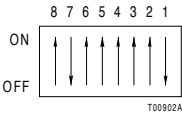
NOTE: If the module has already stopped due to an error (i.e., FAULT lit), a single press resets the module.

Initialization

Initialization clears block memory and restores a known default configuration. An initialization first clears nonvolatile memory, then restores a base set of function codes. An I/O block can be initialized in two ways: software command or hardware switch. The Harmony controller will automatically generate an initialize command when necessary. The special

operations switch (SW2) on the back of the I/O module allows manually initializing a block:

- 1. Halt operation by depressing the stop/reset button once.
- 2. Remove the I/O module.
- 3. Set switch SW2 to initialize (refer to Fig. 7-2 for its location).

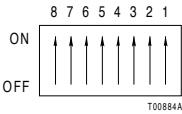


- 4. Insert the I/O module. The block is initialized after the front panel status indicators appear as follows and FAULT turns on.

Status Indicators (On)							
1	2	3	4	5	6	-	-

NOTE: - = LED off.

- 5. Remove the I/O module.
- 6. Set switch SW2 for normal operation.



- 7. Insert the I/O module.
- 8. Redefine the device label or insert the I/O module as a backup module. If inserted as a backup, the primary will automatically define the device label.

Auxiliary Block

There are no startup or initialization procedures for auxiliary blocks. The front panel of an auxiliary block contains a block type and model number, and a label covered by a removable clear plastic lens for customer use (Fig. 7-3).

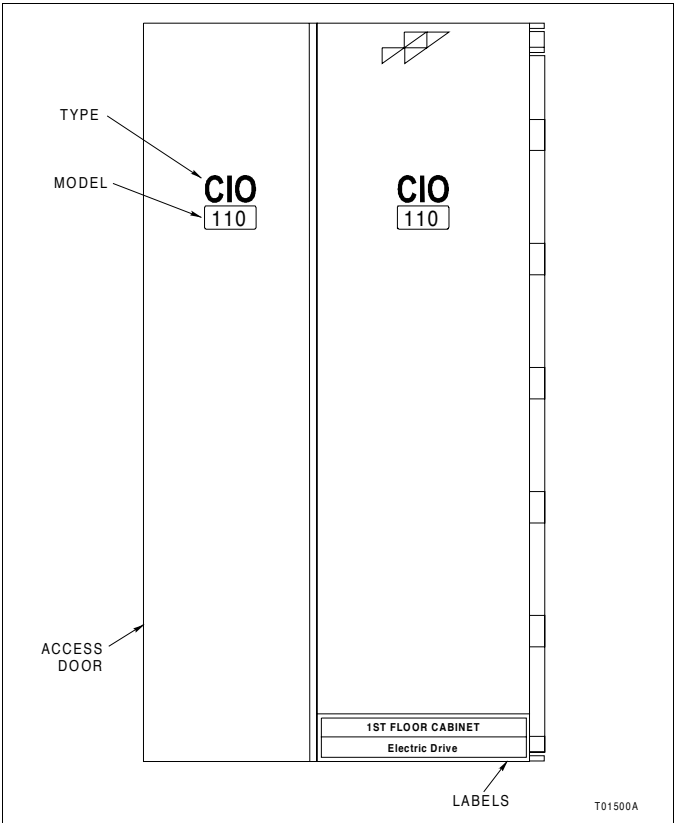


Figure 7-3. Auxiliary Block Front Panel



Introduction

This section provides troubleshooting information necessary to isolate Harmony I/O system errors. It is not meant to be all inclusive. If a problem exists that cannot be corrected using the information provided in this instruction, contact a local ABB service office for assistance.

Troubleshooting Procedures

Troubleshooting of the Harmony I/O system is performed mainly by observing the block front panel LEDs. Problems are also identified in problem reports made to the system, which are viewable on a human system interface such as a work station running Conductor software. If the initial indication of a problem was from a problem report, observe block front panel indications to help further isolate the problem.

NOTE: All tables in this section give corrective actions for single block indications. If the same indication is given for more than one block, consider a power system or communications system problem.

The operation of the front panel LEDs is described in [Section 7](#) and in tables that follow in this section. Refer to [I/O Block Problem Reports](#) and [I/O Block Status](#) in this section for a description of the reports made to the system.

Refer to [Diagnostics](#) in this section for a description of both online and offline diagnostics. The offline diagnostics can be run to verify operation of a suspect I/O block.

Operating Mode - Normal and Fault LEDs

Table [8-1](#) summarizes the normal and fault LED indications and gives corrective actions.



Table 8-1. Operating Mode - Normal and Fault LEDs

Indicator	State	Description	Corrective Action
Normal	On	Operational and online.	No action required.
	Flashing	Established communication but not initialized or configured.	Normal indication until the controller downloads and verifies the I/O block configuration. If the problem persists, check the controller.
		Configured and operational but lost communications with the controller.	1. Check the controller status. 2. Reset the I/O module.
	Off	No power. If this condition exists, no front panel LEDs will be on.	Refer to Table 8-2 for power problem corrective actions.
		Communication not established with controller for the first time.	Normal condition while waiting for controller to establish communication. Check the controller status.
		Fault condition exists (with FAULT indicator on).	Refer to FAULT LED description.
Fault	On	CPU halted (with status code given in eight status LEDs).	Refer to Table 8-3 in this section for status code descriptions and corrective actions.
		Machine fault timer expired. Refer to Machine Fault Timer in Section 3 for a description.	Reset the I/O module. If problem persists, replace the I/O module.
		Stop/reset button activated.	Normal indication after manual hardware stop and during a reset.
	Off	No fault condition.	No action required.

Power LEDs

Table 8-2 summarizes the block power and field power LED indications and gives corrective actions.

Status Code LEDs

The eight status indicators on the front of the I/O module show both normal and error status codes. The status codes appear in binary format. LED eight is the most significant bit. Refer to Table 8-3 to decipher status codes and determine possible corrective actions if necessary.

Table 8-2. Block and Field Power LEDs

Indicator	State	Description	Corrective Action
Block power A or B	On	Good power input.	No action required.
	Off	BLP power problem for the indicated power input. BLP power problem for the indicated power input.	1. Verify front panel block power A or B fuse on the I/O module is present and good. If not, replace the fuse. 2. Check the condition of the power connector (P1) on the I/O module. If bad, replace the I/O module. 3. Check the condition of the mounting column connector. If bad, replace the mounting column. 4. If problem persists, replace the I/O module.
Field power C, DI, or DO	On	Good power input.	No action required.
	Off	IFP power problem (if jumper selected).	1. Verify front panel field power fuse on I/O module is present and good. If not, replace the fuse. 2. Verify the field power select jumpers are set to IFP power. 3. Check the condition of the power connector (P1) on the I/O module. If bad, replace the I/O module. 4. Check the condition of the mounting column connector. If bad, replace the mounting column. 5. If problem persists, replace the I/O module.
		LFP power problem (if jumper selected).	1. Verify front panel field power fuse on I/O module is present and good. If not, replace the fuse. 2. Verify the field power select jumpers are set to LFP power. 3. Check the LFP power connection. 4. If problem persists, replace the I/O module.



Table 8-3. Status Codes

Code	LED On	Condition	Corrective Action
0	0x00	— — — — —	Initializing
1	0x01	1 — — — — —	Nonvolatile memory checksum error
3	0x03	1 2 — — — — —	Block halt due to failover
5	0x05	1 — 3 — — — —	Configuration error: undefined block
6	0x06	— 2 3 — — — —	Configuration error: data type conflict
10	0x0A	— 2 — 4 — — —	Software error

Table 8-3. Status Codes (continued)

Code	LED On	Condition	Corrective Action
13	0x0D	1 – 3 4 – – –	Redundancy link communications error Problem in redundancy link connection between primary and backup, or redundancy link hardware failure. 1. Reset the I/O modules. 2. Check redundancy link connector pins (P4) on primary and backup I/O modules. If bad, replace the I/O module. 3. Replace the backup I/O module. 4. Stop primary by pressing the stop/reset button once. Backup should take over. Replace the primary I/O module. 5. Replace the base. NOTE: The controller should be online with a valid configuration while replacing the I/O modules to manage the failover.
14	0x0E	– 2 3 4 – – –	Redundancy IDs same Redundant I/O modules unable to determine whether primary or backup. Same corrective actions as error code 13.
17	0x11	1 – – – 5 – –	Nonvolatile memory write error Same corrective actions as error code 1.
19	0x13	1 2 – – 5 – –	Read-only memory checksum error Program image in read-only memory is corrupt. 1. Perform a firmware download. 2. If error persists, replace the I/O module.
22	0x16	– 2 3 – 5 – –	Block type code mismatch between primary and backup Redundant I/O modules are of different types. Hardware keying is not correct. Front panel label on base and I/O module should match. Replace incompatible I/O module with compatible type.
23	0x17	1 2 3 – 5 – –	Duplicate Hnet address Each I/O block is manufactured with its own unique device ID (serial number). Should not occur. Replace I/O module.
24	0x18	– – – 4 5 – –	Invalid block type Internal error. Replace the I/O module.
25	0x19	1 – – 4 5 – –	Firmware download in progress No action required.

**Table 8-3. Status Codes** *(continued)*

Code	LED On	Condition	Corrective Action	
26	0x1A	– 2 – 4 5 – –	Duplicate device label detected	Device label assigned to the block is already in use by another I/O block. Define a unique device label.
27	0x1B	1 2 – 4 5 – –	Incorrect Hnet connection	I/O block is connected to a peer-to-peer network instead of Hnet.
35	0x23	1 2 – – – 6 – –	Write violation	Reset the I/O module. If error persists, replace the I/O module.
49	0x31	1 – – – 5 6 – –	Memory or CPU fault	
50	0x32	– 2 – – 5 6 – –	Bus error	
51	0x33	1 2 – – 5 6 – –	Illegal instruction	
52	0x34	– – 3 – 5 6 – –	Internal error - trace or privilege error	
53	0x35	1 – 3 – 5 6 – –	Internal error - spurious or unassigned exception	
54	0x36	– 2 3 – 5 6 – –	Internal error - divide by 0 or CHK instruction	
55	0x37	1 2 3 – 5 6 – –	Internal error - unde-fined TRAP instruction	
56	0x38	– – – 4 5 6 – –	Board level hardware error	Replace the I/O module.
63	0x3F	1 2 3 4 5 6 – –	Normal stop	Reset the I/O module.
64	0x40	– – – – – 7 – –	Configuration downloaded	Normal operation. No action required.
128	0x80	– – – – – 8 – –	Normal operation (backup I/O module)	
192	0xC0	– – – – – 7 8 –	Normal operation (primary I/O module)	

NOTE: – = off.

I/O Block Problem Reports

Problem reports are used to identify device and I/O channel problems (Table 8-4). These reports can be seen on a human system interface. The I/O device definition function code is responsible for problem reporting. The Harmony controller performs the actual reporting.

Table 8-4. I/O Block Problem Reports

Error	Type	Description	Corrective Action
Backup I/O module error	Device	Problem with the backup I/O module. Backup will not be able to take over if there is a problem with the primary.	1. Reset the backup I/O module. 2. Check the condition of the communications connector (P5) on the I/O module. If bad, replace the I/O module. 3. Check redundancy link connector pins (P4) on the backup I/O module. If bad, replace the I/O module. 4. Replace the backup I/O module. 5. Replace the base.
Bad field power status	Device	IFP or LFP power problem.	Refer to Table 8-2 for power problem corrective actions.
Bad Hnet channel A or B	Device	No communication on the indicated Hnet channel.	1. Reset the I/O module. 2. Check the condition of the communications connector (P5) on the I/O module. If bad, replace the I/O module. 3. Check the condition of the mounting column connector. If bad, replace the mounting column. 4. If problem persists, replace the I/O module.
Bad power input A or B	Device	BLP power problem for the indicated power input.	Refer to Table 8-2 for power problem corrective actions.
Bad readback status	Channel	Expected output and actual output are different.	1. Check DOT-120 block readback fuses. 2. Failure in the readback circuitry. Replace the I/O module. 3. Failure in the I/O channel circuitry. Replace the I/O module.
Bad redundancy link channel A or B	Device	Problem in redundancy link connection between primary and backup I/O modules or redundancy link hardware failure.	1. Reset the I/O modules. 2. Check redundancy link connector pins (P4) on primary and backup I/O modules. If bad, replace the I/O module.



Table 8-4. I/O Block Problem Reports (continued)

Error	Type	Description	Corrective Action
Bad redundancy link channel A or B (continued)	Device	Problem in redundancy link connection between primary and backup I/O modules or redundancy link hardware failure.	3. Replace the backup I/O module. 4. Stop primary by pressing the stop/reset button once. Backup should take over. Replace the primary I/O module. 5. Replace the base. NOTE: The controller should be online with a valid configuration while replacing the I/O modules to manage the failover.
Bad reference status	Device	Input from onboard reference circuitry used for drift correction is invalid.	Replace the I/O module.
Block nonvolatile memory failure	Device	Nonvolatile memory checksum or write error.	Initialize I/O block using special operations switch (SW2). Refer to Initialization in Section 7 for procedures. If error persists, replace the I/O module.
Calibration	Channel	I/O block is out of calibration. I/O blocks are factory calibrated.	Replace the I/O module.
Channel failure/out of range	Channel	Overvoltage or undervoltage condition exists for the indicated channel.	1. Check configuration to verify proper range selection. 2. Check channel jumpers to verify proper configuration. 3. Check field wiring connections.
Cold junction reference	Device	Input from internal or external cold junction reference used for temperature compensation is invalid.	1. Cold junction reference input from RTD onboard I/O block failed. Replace the I/O module. 2. External cold junction reference input failed. Check external CJR, field wiring, and connections.
Configuration mismatch	Device	Some type of error exists in the I/O block configuration in the controller.	Check the controller status. Correct any invalid input references, data type conflicts, range errors, etc.

Table 8-4. I/O Block Problem Reports (continued)

Error	Type	Description	Corrective Action
Duplicate label	Device	Controller detected a device label defined the same on more than one I/O block; duplicate device labels are not permitted.	Redefine the device label for one of the blocks. Refer to Duplicate Labels in Section 6 for further explanation.
Hnet channel A or B relay fault	Device	One of the relays that isolates the I/O block from Hnet has failed.	Replace the I/O module.
No response (offline)	Device	I/O module missing, not inserted properly, or no power.	1. Verify I/O module is present and inserted properly. 2. Verify the I/O block is powered up. If not, refer to Table 8-2 for power problem corrective actions. 3. Reset the I/O module.
Suspect condition	Channel	Refer to Suspect Condition in Section 6 for an explanation.	
System output alarm	Device	Refer to Block Power in Section 3 for an explanation.	

To allow tracing I/O block related problems, the device problem report includes:

- I/O device definition function block number (FC 221).
- Device label.
- Error type (Table 8-4).

The I/O channel problem report includes:

- Channel function block number (FC 222, 223, 224, or 225).
- Channel label.
- I/O device definition function block number (FC 221).
- Device label.
- Error type (Table 8-4).

Station Problem Reports

An IISAC01 Analog Control Station connected through a CIO-100 block is considered a remote station. To allow tracing



remote station problems, FC 80 (control station) will generate problem reports that include:

- Station function block number (FC 80).
- Station address.
- I/O device definition function block number.
- Device label.
- Error type (Table 8-5).

Table 8-5. Station Problem Reports

Error	Description	Corrective Action
Invalid block type	Controller is trying to communicate station information to an I/O block that does not support station link communication.	Verify FC 221 (I/O device definition) matches device label of CIO-100 block.
Missing device definition	Controller cannot communicate with IISAC01 station because FC 221 (I/O device definition) does not exist. Occurs when S28 in FC 80 (control station) references a FC 223 (analog output/channel) that is not referenced by a FC 221.	1. Add FC 221 function block. 2. Redefine S28 of FC 80 to point to a referenced, valid FC 223 function block.
Missing or misconfigured CIO	Controller cannot communicate with the CIO-100 block that is addressed by FC 221 (I/O device definition).	1. Verify the CIO-100 block is properly configured on Hnet. 2. Verify the CIO-100 block is properly labeled. 3. Verify the device label in function code 221 matches the device label of the CIO-100 block. 4. Verify Hnet cabling between the controller and CIO-100 block. 5. Replace the CIO-100 module. 6. Replace the controller.

Table 8-5. Station Problem Reports (continued)

Error	Description	Corrective Action
Missing or misconfigured IISAC01	Controller is communicating with the CIO-100 block, but the CIO-100 block is not communicating with the IISAC01 station.	1. Insure IISAC01 station is configured for 40 kilobaud. 2. Insure IISAC01 station address matches S16 in FC 80 (control station). 3. Check station link connectors and cabling between CIO-100 block and IISAC01 station (or between CIO-100, CIO-110, and IISCA01 station). 4. Check LFP power to the IISAC01 station. Verify a minimum of 3.3 square millimeters stranded (12 AWG stranded wire is used to connect power). 5. Replace IISAC01 station. 6. Replace CIO-100 module.
Null device definition label	Controller cannot communicate with IISAC01 station because FC 221 (I/O device definition) device label is undefined.	Set S1 of FC 221 to correspond to the CIO-100 block device label.
Too many IISAC01s configured for this CIO	There are too many FC 80 (control station) function blocks for a single CIO-100 block. The maximum is eight (two bypass and six indicating).	1. Configure some of the IISAC01 stations to operate from a different CIO-100 station link. 2. Verify multiple controllers are not attempting to utilize the same CIO-100 block station communications.

I/O Block Status

I/O block status information is reported to the Harmony controller where it is integrated into the controller's status report. Refer to the **Harmony Area Controller** or **Harmony Bridge Controller** instruction for module status report details. The I/O block includes the following types of status information in its report to the controller:

- Hnet communications (channel A and B).
- Configuration.



- Power.
- Redundancy.
- Local I/O.
- Station.

Also, status information can be acquired directly from the I/O device definition function code and the I/O channel function codes using FC 226 (test status). Refer to **Test Status (FC 226)** in Section 6 for further description.

Diagnostics

The I/O block firmware contains various diagnostic routines used to verify proper operation of components and circuitry. Some are run automatically during startup (online) and others can be invoked manually (offline).

Online

An I/O block runs the following online diagnostic checks during startup:

- Hnet.
- Data converters (D-to-A and A-to-D).
- I/O channel bus.
- Memory.
- Power status.
- Voltage references.

If any of these checks detect a hardware problem, the I/O block will provide error status code indications (if possible) and the block will halt. Refer to Table 8-3 to decipher the status codes.

Offline

The offline tests can be run to verify operation of a suspect I/O block or to check block integrity after installation. The offline diagnostics should only be run during installation or when the system is down. Refer to procedure section PR24 for the steps to run offline diagnostics.

I/O Block Connectors

The following sections provide the pin assignments for I/O block connectors.

I/O Module (P1, P4, P5)

An I/O module has three connection points for external signals and power: P1 power, P4 redundancy link, and P5 communication. Tables 8-6, 8-7, and 8-8 list the pin assignments for P1, P4, and P5.

Table 8-6. P1 Power Pins

Pin		Connection
A	1	BLP A (+)
	2	BLP B (+)
	3	IFP (+)
B	1	BLC A (–)
	2	BLC B (–)
	3	IFC (–)

Table 8-7. P4 Redundancy Link Pins

Pin	Connection	Pin	Connection
1	Transmit data A (+)	2	Receive data A (+)
3	Ground	4	Transmit data A (–)
5	Receive data A (–)	6	Handshake OUT
7	Primary/backup	8	Ground
9	Handshake IN	10	Transmit data B (+)
11	Receive data B (+)	12	Ground
13	Transmit data B (–)	14	Receive data B (–)

**Table 8-8. P5 Communication Pins**

Pin	Connection	Pin	Connection
1	Ground	2	Clock A
3	Ground	4	Data A
5	Ground	6	SOA 1
7	+V1	8	+V2
9	SOA 2	10	Ground
11	Data B	12	Ground
13	Clock B	14	Ground

CIO-100 (P7, P8)

Table 8-9 lists the pin assignments for the P7 station one connector and the P8 station two connector of the CIO-100 block.

Table 8-9. CIO-100 P7 and P8 Connector Pins

Pin	P7	P8
1	LFP (–)	LFP (–)
2	Serial link (–)	Serial link (–)
3	Not connected	Not connected
4	Analog output 1 (–)	Analog output 2 (–)
5	Analog input 2 (–)	Analog input 4 (–)
6	Analog input 1 (–)	Analog input 3 (–)
7	Ground	Ground
8	LFP ¹ (+)	LFP ¹ (+)
9	Serial link (+)	Serial link (+)
10	Not connected	Not connected
11	Analog output 1 (+)	Analog output 2 (+)
12	Analog output 1 (bypass)	Analog output 2 (bypass)
13	Analog input 2 (+)	Analog input 4 (+)
14	Analog input 1 (+)	Analog input 3 (+)

NOTE:

1. Fused +24 VDC; one fuse for both connectors P7 and P8.

DIO (P17)

Table 8-10 lists the pin assignments for the P17 connector of the DIO blocks.

Table 8-10. DIO P17 Connector Pins

Pin	Connection	Pin	Connection
1	Common	2	DO 22 (+)
3	DO 21 (+)	4	DO 20 (+)
5	DO 19 (+)	6	DO 18 (+)
7	DO 17 (+)	8	DO 23/24 (–)
9	DO 24 (+)	10	DO 23 (+)
11	DO 21/22 (–)	12	Not connected
13	DO 19/20 (–)	14	DO 17/18 (–)





Introduction

The reliability of any stand-alone product or control system is affected by the maintenance of the equipment. ABB Automation recommends that all equipment users practice a preventive maintenance program that will keep the equipment operating at an optimum level.

This section presents procedures that can be performed on-site. These preventive maintenance procedures should be used as guidelines to assist in establishing good preventive maintenance practices. Select the minimum steps required to meet the cleaning needs of your system.

Personnel responsible for maintenance should be familiar with the Harmony I/O system, have experience working with process control systems, and know what precautions to take when working on live AC systems.

Preventive Maintenance Schedule

Table 9-1 is the preventive maintenance schedule for the Harmony I/O system. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 9-1 are intuitive or self explanatory. Instructions for tasks that require further explanation are covered in the indicated procedure section.

NOTE: The preventive maintenance schedule is for general purposes only. Your application may require special attention.

**Table 9-1. Preventive Maintenance Schedule**

Task	Procedure	Frequency
General cleaning. Use a lint-free cloth and mild, all-purpose, non-flammable, commercial spray cleaner to remove dirt, fingerprints, and grease from the equipment (e.g., LCD screen, keypad, housing assembly). Spray the cleaner on the cloth and not directly on the equipment.	N/A	As required
Check cabinet air filters. Clean or replace them as necessary. Check the air filter more frequently in excessively dirty environments.	N/A	3 months
Check block faceplate and housing and the cooling fan assembly for dust. Clean as necessary using an antistatic vacuum. Insure air vents are free of dust and lint.	N/A	
Check all signal, power, ground, and cable connections associated with the I/O system; verify they are secure.	PR27	
Complete all tasks in this table.	N/A	Shutdown



Introduction

This section explains repair and replacement procedures for I/O and auxiliary blocks.

Repair

Harmony I/O system repair is limited to assembly replacement. If a block component such as an I/O module fails, remove and replace it with another. Do **not** attempt to replace discrete components in any I/O system assembly.

Replacement

NOTE: Always follow the instructions given in *Special Handling* in Section 5 when handling an I/O module.

The replacement procedures for most parts and assemblies are intuitive. Figures 10-1 through 10-4 comprise the replacement flowchart, which contains replacement procedures for those parts and assemblies that need explanation.

In the flowchart, each flowchart block represents a single task. The PR code in the flowchart block identifies the procedure section that describes the steps to complete the indicated task. Some steps are self-explanatory and have no related procedure section. Complete all steps given in a procedure section before continuing to the next flowchart block. The procedure sections are located towards the back of the instruction.

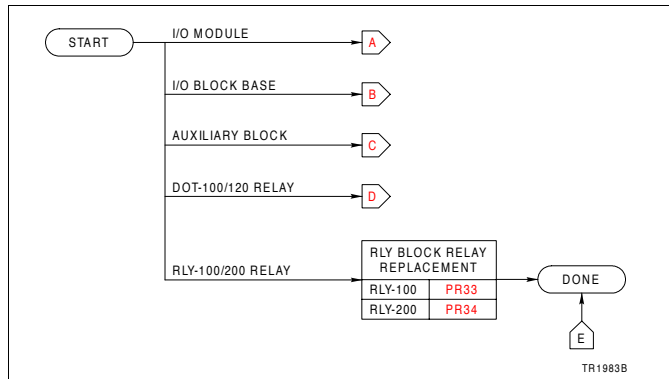


Figure 10-1. Replacement Flowchart (1 of 4)

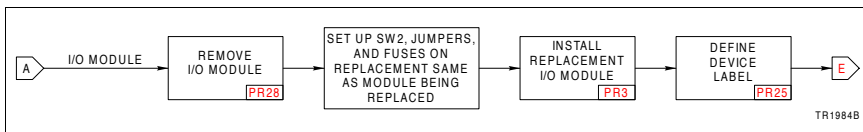


Figure 10-2. I/O Module Replacement Flowchart (2 of 4)

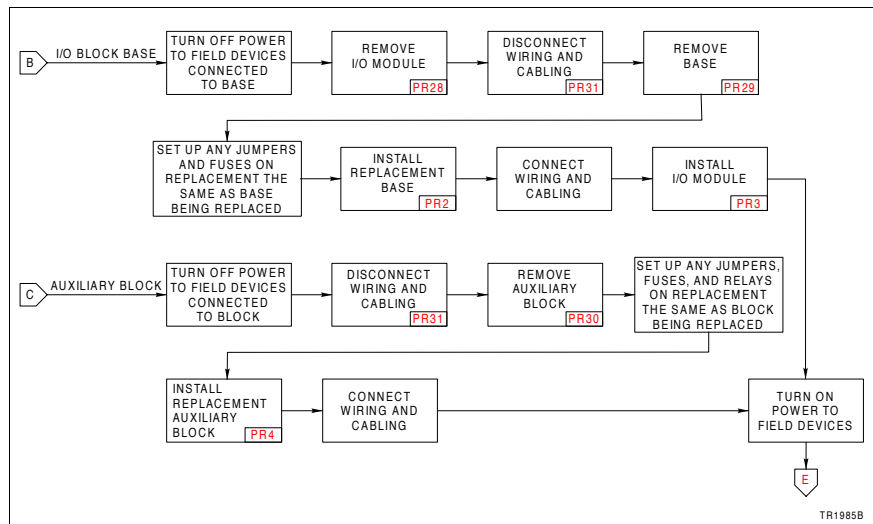


Figure 10-3. I/O Block and Auxiliary Block Replacement Flowchart (3 of 4)

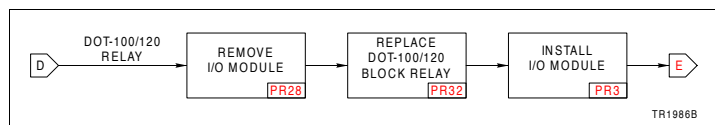


Figure 10-4. Relay Replacement Flowchart (4 of 4)





Introduction

This section provides installation, replacement, and spare part nomenclature and part numbers. Contact ABB for help determining the quantity of spare parts to keep on hand for your particular system.

I/O and Auxiliary Block Nomenclature

Tables 11-1 through 11-7 list I/O and auxiliary block nomenclature.

Table 11-1. Analog Input Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	A	I	N	-	-	-	-	-	-	-	-	-	Block Nomenclature
																	Block Type
										1	2	0	-	-	-	-	Current, high level voltage in
										2	0	0	-	-	-	-	Isolated high level voltage, low level voltage, TC in
										2	2	0	-	-	-	-	Isolated current, high level voltage, low level voltage, TC in
										3	0	0	-	-	-	-	Isolated RTD in
																	Module/Base Option
												0	C	1	-	-	Nonredundant cable/clamp terminal base
												0	C	2	-	-	Redundant cable/clamp terminal base
												0	S	1	-	-	Nonredundant screw terminal base
												0	S	2	-	-	Redundant screw terminal base
												1	0	0	-	-	I/O module
																	Reserved for Future Use
															0	0	Must be zeros



Table 11-2. Analog Output Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	A	O	T	-	1	5	0	-	-	-	-	-	Block Nomenclature - Current Out
																	Module/Base Option
												0	C	1	-	-	Nonredundant cable/clamp terminal base
												0	C	2	-	-	Redundant cable/clamp terminal base
												0	S	1	-	-	Nonredundant screw terminal base
												0	S	2	-	-	Redundant screw terminal base
												1	0	0	-	-	I/O module
																	Reserved for Future Use
												0	0				Must be zeros

Table 11-3. Control Input/Output Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	C	I	O	-	1	0	0	-	-	-	-	-	Block Nomenclature - Control Loop In/Out
																	Module/Base Option¹
												0	C	1	-	-	Nonredundant cable/clamp terminal base
												0	S	1	-	-	Nonredundant screw terminal base
												1	0	0	-	-	I/O module
																	Reserved for Future Use
												0	0				Must be zeros
P	-	H	B	-	C	I	O	-	1	1	0	0	0	0	0	0	Electric Drive/Pulse Positioner Termination²

NOTES:

1. Available in nonredundant configuration only. (AO bypass provided by optional manual/auto station (IISAC01).

2. Supports control stations that operate as electric drive/pulse positioner bypass stations. Ribbon cable NKCS04 is required to connect CIO-110 to CIO-100.

Table 11-4. Digital Input/Output Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	D	I	O	-	4	0	0	-	-	-	-	-	Block Nomenclature - Universal Digital In, 24/48 VDC Digital Out
																	Module/Base Option
												0	C	1	-	-	Nonredundant cable/clamp terminal base
												0	C	2	-	-	Redundant cable/clamp terminal base
												0	R	1	-	-	Nonredundant relay connector base - DI screw terminals, DO cable ¹
												0	R	2	-	-	Redundant relay connector base - DI screw terminals, DO cable ¹
												0	R	3	-	-	Nonredundant relay connector base - DI cable/clamp terminals, DO cable ¹
												0	R	4	-	-	Redundant relay connector base - DI cable/clamp terminals, DO cable ¹
												0	S	1	-	-	Nonredundant screw terminal base
												0	S	2	-	-	Redundant screw terminal base
												1	0	0	-	-	I/O module
																	Reserved for Future Use
															0	0	Must be zeros

NOTE:

1. Used in combination with RLY-100 and RLY-200. Provides screw/clamp terminals for DI and cable connection to the DO located on RLY block.

Table 11-5. Digital Output Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	D	O	T	-	-	-	-	-	-	-	-	-	Block Nomenclature
																	Block Type
											1	0	0	-	-	-	Onboard electromechanical relay out
											1	2	0	-	-	-	Onboard monitored electromechanical relay out (with fusing)
																	Module/Base Option
												0	C	1	-	-	Nonredundant cable/clamp terminal base
												0	C	2	-	-	Redundant cable/clamp terminal base
												0	S	1	-	-	Nonredundant screw terminal base
												0	S	2	-	-	Redundant screw terminal base
												1	0	0	-	-	I/O module
																	Reserved for Future Use
															0	0	Must be zeros



Table 11-6. Auxiliary Relay Assembly Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	R	L	Y	-	-	-	-	-	-	-	-	-	Block Nomenclature
																	Block Type
									1	0	0	-	-	-	-	-	Electromechanical relay assembly ^{1,2}
									2	0	0	-	-	-	-	-	Solid state relay assembly ^{1,3}
																	Reserved for Future Use
												0	0	0	0	0	Must be zeros

- NOTES:
1. Available in screw termination base style only.
 2. RLY-100 is packaged with eight DPDT (form C) electromechanical relays.
 3. RLY-200 is packaged unpopulated. Solid state relays are ordered separately. Refer to Table 11-12 for part numbers.

Table 11-7. Blank Block Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	H	B	-	B	L	K	-	1	0	0	-	-	-	-	-	Block Nomenclature ¹
																	Module/Base Option
												0	0	1	-	-	Nonredundant base
												0	0	2	-	-	Redundant base
												1	0	0	-	-	Blank module
																	Reserved for Future Use
														0	0		Must be zeros

- NOTES:
1. Blank blocks maintain column air flow. They are only required in the middle of a column where air flow would be disrupted with an empty column position. They are not required at the bottom of a column of blocks.

Cable Nomenclature

Tables 11-8 through 11-10 list cable nomenclature.

Table 11-8. DIO to RLY Cable Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	M	K	-	H	R	M	-	R	L	Y	1	2	-	-	-	Cable Nomenclature
																	Cable Type
														H	-	-	PLTC rated for use in hazardous areas
														S	-	-	For use in nonhazardous areas
																	Cable Length
														0	B		0.6 m (2 ft) - connects side-by-side DIO and RLY
														x	x		01 to 60 for 1.0 to 60 m (3.3 to 200 ft)

Table 11-9. I/O Block to Remote Termination Cable Nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
P	-	M	K	-	H	R	M	-	R	T	S	-	-	-	-	-	Cable Nomenclature
																	Conductors¹
											1	2					12 conductors
											1	6					16 conductors
											2	4					24 conductors
																	Cable Type
													H	-	-		PLTC rated for use in hazardous areas
													S	-	-		For use in nonhazardous areas
																	Cable Length
															x	x	01 to 60 for 1.0 to 60 m (3.3 to 200 ft)

NOTE:

1. Used with cable/clamp terminal base (C type) with the clamp terminals removed. Refer to Table PR21-1 to determine cable usage.

Table 11-10. CIO Cable Nomenclature

1	2	3	4	5	6	7	8	9	10	
N	K	C	S	0	3	-	0	0	-	CIO-100 to NKCS01/11/02/12 Adapter Cable
										Cable Length
									3	0.9 m (3 ft)
									5	1.5 m (5 ft)
N	K	C	S	0	4	-	-	-	-	CIO-100 to CIO-110 Cable - 0.6 m (2 ft)
										Not Used
										Leave blank
N	K	C	S	0	5	-	0	0	-	CIO-110 to NKCS01/11/02/12 Adapter Cable
										Cable Length
									3	0.9 m (3 ft)
									5	1.5 m (5 ft)



Miscellaneous Parts

Tables 11-11 through 11-13 list related, miscellaneous parts and their part numbers.

Table 11-11. Fuses

Number	Part	Note 1	CIO-100	CIO-110	DOT-120	RLY-200
1949438A1001	1.0 A, 250 V, 5 x 20 mm, fast-acting, low break capacity					•
1949438A1601	1.6 A, 250 V, 5 x 20 mm, fast-acting, low break capacity	•	•	•	•	
1949438A4001	4.0 A, 250 V, 5 x 20 mm, fast-acting, low break capacity			•		
1949532A3151	3.15 A, 250 V, 5 x 20 mm, time-lag, medium break capacity	•	•		•	
1949532A6301	6.3 A, 250 V, 5 x 20 mm, time-lag, medium break capacity		•			
1949697A3151	3.15 A, 250 V, 5 x 20 mm, time-lag, high break capacity					•
1949697A6301	6.3 A, 250 V, 5 x 20 mm, time-lag, high break capacity				•	

NOTES:

1. Used in all I/O blocks.
2. Refer to the individual block specification tables in Section 2 for fuse usage.

Table 11-12. Relays

Number	Part	DOT-100	DOT-120	RLY-100	RLY-200
1947684A32	Solid state relay 120/240 VAC				•
1947685A31	Solid state relay 24 VDC				•
1947685A32	Solid state relay 125 VDC				•
1949002A3	Magnacraft miniature epoxy sealed PC board EM relay (SPDT)	•	•		
1949562A1	Systems control output EM relay (DPDT)			•	

NOTE: Refer to the individual block specification tables in Section 2 for relay specifications.

Table 11-13. Miscellaneous

Number	Part
1946984A4	1 × 2 jumper block (0.1 mm center-to-center)
1946984A6	1 × 2 jumper
1946984A7	2 × 2 jumper block (0.2 mm center-to-center)
1946984A8	2 × 3 jumper block (0.2 mm center-to-center)
1948616A12	12-position terminal block (clamp terminal base)
1948616A16	16-position terminal block (clamp terminal base)
1949459A2	2-position terminal block (base)
200021A040S080	M4 × 8-mm screw
200021A040S100	M4 × 10-mm screw (with captive star washer)
6642146A1	Plastic lens - I/O block label cover
6642153A1	Plastic lens - auxiliary block label cover
6643676A1	Wire guide
P-HA-MSC-SCREW100	100 M4 × 10-mm screws for terminating field wiring shields (200021A040S100)





Purpose/Scope

15 min.

This procedure gives the steps required to set up the CIO-100 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

Prerequisites • Completed worksheet **WS6**.

Parts None.

Tools • Small-tipped, flat-blade screwdriver.
• Needlenose pliers (optional).

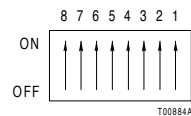
Safety Considerations

CAUTION

1. For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops.

Procedure

- ☐ 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- ☐ 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- ☐ 3. Set the field power select jumpers J1 and J2 located on the back of the I/O module as appropriate (Table **PR11-1**).

NOTE: J1 and J2 affect the I/O channels only. The fused LFP power to operate the stations is routed directly from the LFP terminals to the station connectors.



Table PR11-1. Field Power Select Jumpers

Field Power	J1	J2	Description
IFP	1 2 3	1 2 3	Field power from mounting column bus
LFP	1 2 3	1 2 3	Field power from LFP terminals on base



4. Set the analog input field power select jumpers J15 and J16 located on the CIO-100 base (Table PR11-2). These jumpers affect channels configured as IFP or LFP powered 4 to 20 milliampere analog inputs. Refer to Figure PR11-1 for jumper locations.

Table PR11-2. Analog Input Field Power Select Jumpers (Base)

Field Power	J15	J16	Description
Fused AI IFP/LFP ¹ (no station)	1 2 3	1 2 3	Routes IFP/LFP field power through the fuse in the I/O module.
Unfused AI LFP ^{2,3} (station)	1 2 3	1 2 3	Routes LFP power directly to the base terminals. Use this setting if stations are connected.

NOTES:

1. This option can be selected to provide fused IFP or LFP power to the analog input channels; however, removing the I/O module from the base will result in a loss of power to all input current loops.
2. Use this setting if current loop power must be maintained when the I/O module is removed from the base.
3. Use this setting if analog inputs are RFP powered.

Figure PR11-2 shows the field power connections made with jumpers J15 and J16.

- ☐ 5. Set the analog input channel jumpers located on the CIO-100 base as appropriate (Table PR11-3).
- ☐ 6. Remove the access cover from the left side of the I/O module (Fig. PR11-3).
- ☐ 7. Set the analog output channel jumpers as appropriate (Table PR11-4). Refer to Figure PR11-4 for jumper locations.

Table PR11-3. Analog Input Channel Jumpers

Input	Field Power	n ¹ -J1	n ¹ -J2	n ¹ -J3	n ¹ -J4
4 to 20 mA	IFP/LFP	1 2 3	1 2 3	1 2 3	1 2 3
	RFP	1 2 3	1 2 3	1 2 3	1 2 3
Differential 1 to 5 VDC	RFP	1 2 3	1 2 3	1 2 3	1 2 3
Single-ended 1 to 5 VDC	RFP	1 2 3	1 2 3	1 2 3	1 2 3

NOTE:

1. n corresponds to the channel number from 1 to 4. For example, 1-J1, 1-J2, 1-J3, and 1-J4 configure channel one.

Table PR11-4. Analog Output Channel Jumpers

Output	Field Power	n ¹ -J1									
4 to 20 mA ²	IFP/LFP	<table border="1"><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
1	2	3									
4	5	6									
7	8	9									
1 to 5 VDC	IFP/LFP	<table border="1"><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
1	2	3									
4	5	6									
7	8	9									

NOTE:

1. n corresponds to the channel number, either 5 or 6. For example, 5-J1 configures channel five.

2. A current output is required to support the IISAC01 output bypass feature.

- ☐ 8. Set the digital input channel jumpers as appropriate (Table PR11-5). All digital inputs must be RFP powered.



Table PR11-5. Digital Input Channel Jumpers

Input	Field Power	n ¹ -J1	n ¹ -J2																
24 VDC	RFP	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3		
1	2	3	4	5	6														
7	8	9	10	11	12														
2	3																		
48 VDC	RFP	<table><tr><td>1</td><td><table><tr><td>2</td><td>3</td></tr></table></td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td><table><tr><td>8</td><td>9</td></tr></table></td><td>10</td><td>11</td><td>12</td></tr></table>	1	<table><tr><td>2</td><td>3</td></tr></table>	2	3	4	5	6	7	<table><tr><td>8</td><td>9</td></tr></table>	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3
1	<table><tr><td>2</td><td>3</td></tr></table>	2	3	4	5	6													
2	3																		
7	<table><tr><td>8</td><td>9</td></tr></table>	8	9	10	11	12													
8	9																		
2	3																		
125 VDC	RFP	<table><tr><td>1</td><td>2</td><td>3</td><td><table><tr><td>4</td><td>5</td></tr></table></td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td><table><tr><td>10</td><td>11</td></tr></table></td><td>12</td></tr></table>	1	2	3	<table><tr><td>4</td><td>5</td></tr></table>	4	5	6	7	8	9	<table><tr><td>10</td><td>11</td></tr></table>	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3
1	2	3	<table><tr><td>4</td><td>5</td></tr></table>	4	5	6													
4	5																		
7	8	9	<table><tr><td>10</td><td>11</td></tr></table>	10	11	12													
10	11																		
2	3																		
120 VAC	RFP	<table><tr><td>1</td><td>2</td><td>3</td><td><table><tr><td>4</td><td>5</td></tr></table></td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td><table><tr><td>10</td><td>11</td></tr></table></td><td>12</td></tr></table>	1	2	3	<table><tr><td>4</td><td>5</td></tr></table>	4	5	6	7	8	9	<table><tr><td>10</td><td>11</td></tr></table>	10	11	12	<table><tr><td>1</td><td>2</td></tr></table> 3	1	2
1	2	3	<table><tr><td>4</td><td>5</td></tr></table>	4	5	6													
4	5																		
7	8	9	<table><tr><td>10</td><td>11</td></tr></table>	10	11	12													
10	11																		
1	2																		
240 VAC	RFP	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td><table><tr><td>5</td><td>6</td></tr></table></td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td><table><tr><td>11</td><td>12</td></tr></table></td></tr></table>	1	2	3	4	<table><tr><td>5</td><td>6</td></tr></table>	5	6	7	8	9	10	<table><tr><td>11</td><td>12</td></tr></table>	11	12	<table><tr><td>1</td><td>2</td></tr></table> 3	1	2
1	2	3	4	<table><tr><td>5</td><td>6</td></tr></table>	5	6													
5	6																		
7	8	9	10	<table><tr><td>11</td><td>12</td></tr></table>	11	12													
11	12																		
1	2																		

NOTE:

1. n corresponds to the channel number from 7 to 10. For example, 7-J1 and 7-J2 configure channel seven.

- ☐ 9. Set the digital output channel jumpers as appropriate (Table PR11-6).

Table PR11-6. Digital Output Channel Jumpers

Output	Field Power	n ¹ -J1									
24 VDC	IFP/LFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
	1	2	3								
4	5	6									
7	8	9									
	RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
1	2	3									
4	5	6									
7	8	9									

NOTE:

1. n corresponds to the channel number from 11 to 14. For example, 11-J1 configures channel 11.

- ☐ 10. Replace the access cover.
- ☐ 11. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.

- ☐ 12. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 13. Open the access door of the CIO-100 base and verify a 6.3 A, 250 V fuse is present in fuse holder F1. This fuse is for the +24 VDC LFP power that operates IISAC01 control stations. The fuse protects the power distributed to both station connectors.

NOTE: If connecting to a CIO-110 block for electric drive/pulse positioner termination, +24 VDC LFP power to operate the IISAC01 control stations attaches and is fuse protected at the CIO-110 block instead of at the CIO-100 block.

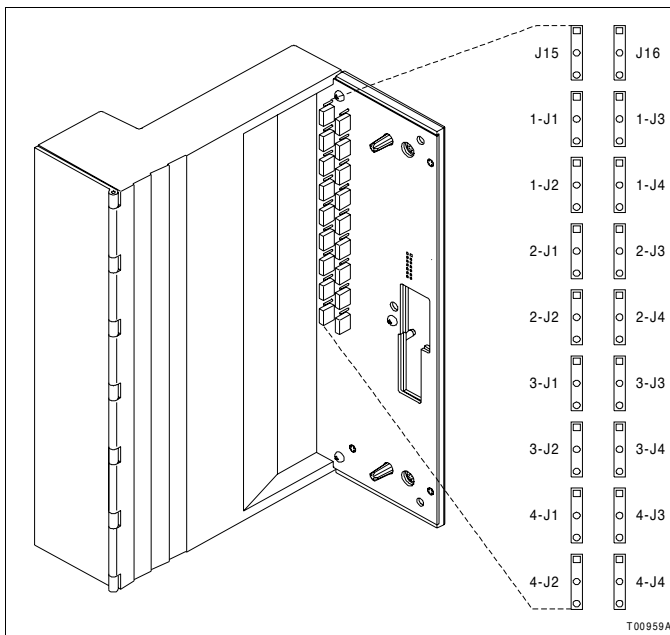


Figure PR11-1. User-Configurable Jumpers - Base

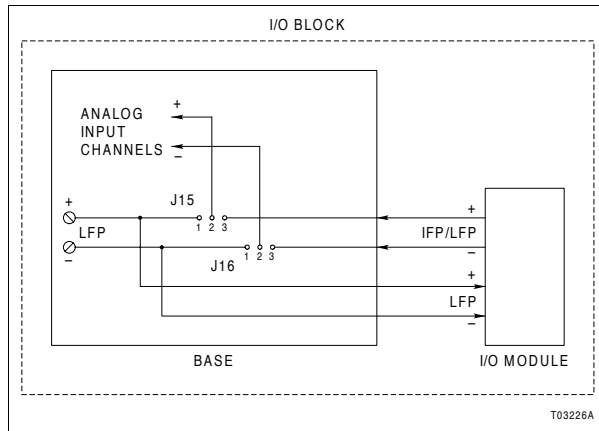


Figure PR11-2. Analog Input Field Power Selection (J15/J16)

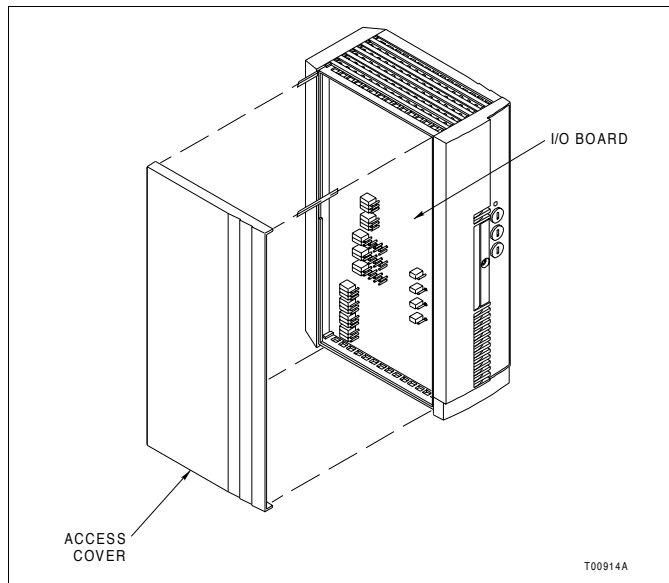


Figure PR11-3. Configuration Jumper Access

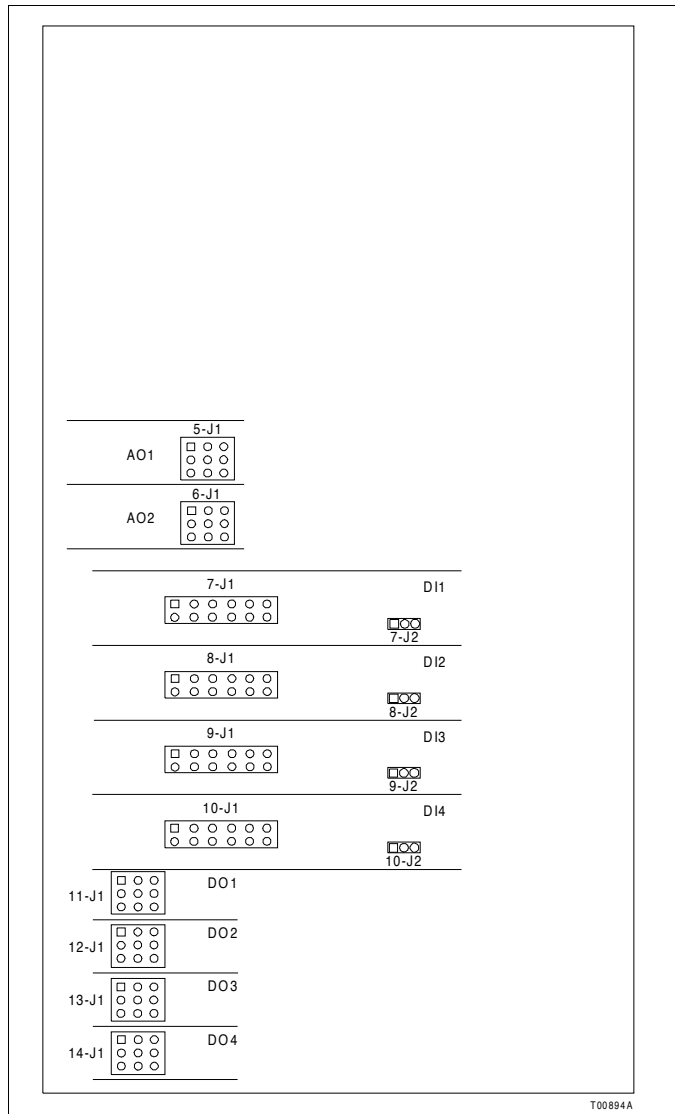


Figure PR11-4. User-Configurable Jumpers - I/O Board



Field Device Connection

Figures PR11-5, PR11-6, PR11-7, and PR11-8 show the circuit connections made after attaching field wiring and setting jumpers.

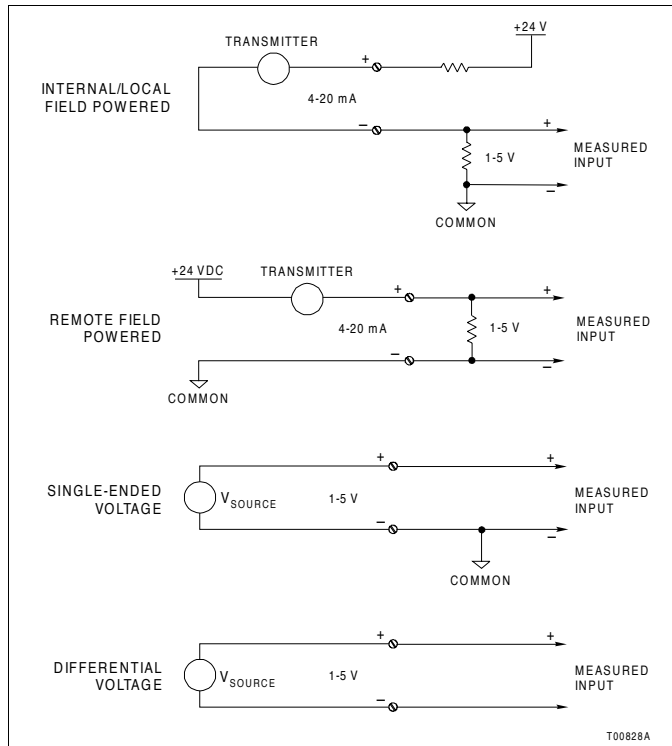
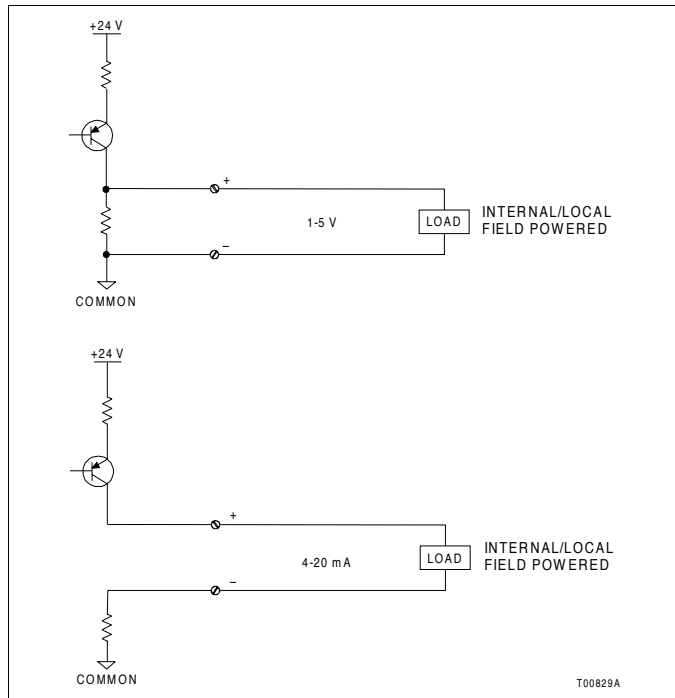
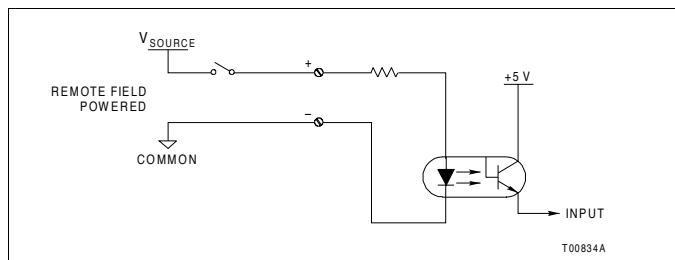


Figure PR11-5. Analog Input (Simplified)

**Figure PR11-6. Analog Output (Simplified)****Figure PR11-7. Digital Input (Simplified)**

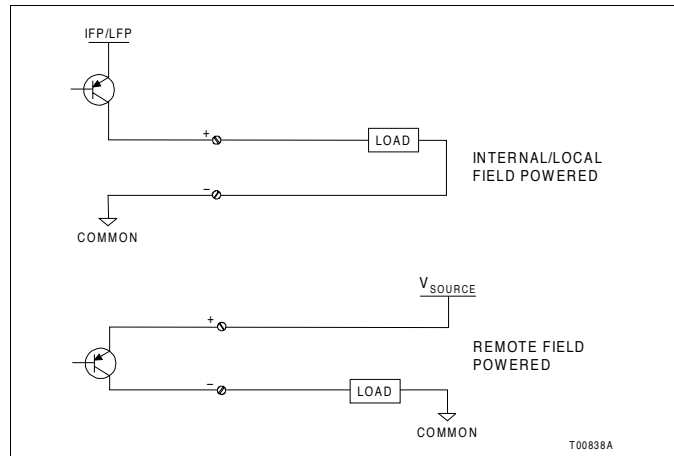


Figure PR11-8. Digital Output (Simplified)



Purpose/Scope

10 min.

This procedure gives the steps required to set up the DIO-400 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

- Prerequisites
- Completed worksheet **WS7**.
- Parts
- None.
- Tools
- Small-tipped, flat-blade screwdriver.
 - Needlenose pliers (optional).

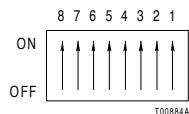
Safety Considerations

CAUTION

1. Insure the setting for the digital input field power monitor jumper DIFP-J2 matches the actual field power voltage (IFP or LFP). Circuit damage will occur if the LFP voltage is greater than the voltage setting of jumper DIFP-J2.

Procedure

- 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- 3. Set the digital output field power select jumpers J1 and J2 located on the back of the I/O module as appropriate (Table **PR12-1**).



Table PR12-1. Digital Output Field Power Select Jumpers

Field Power ¹	J1	J2	Description
IFP	1 2 3	1 2 3	Field power from mounting column bus
LFP	1 2 3	1 2 3	Field power from LFP terminals on base

NOTE:

1. 24 VDC IFP/LFP required when connecting to an RLY block.

- ☐ 4. Remove the access cover from the left side of the I/O module (Fig. PR12-1).
- ☐ 5. Set the digital input field power select jumper DIFP-J1 as appropriate (Table PR12-2). Refer to Figure PR12-2 for the jumper location.

Table PR12-2. Digital Input Field Power Select Jumper

Field Power	DIFP-J1
IFP (24 VDC only)	1 2 3 4 5 6
LFP	1 2 3 4 5 6

- ☐  6. Set the digital input field power monitor jumper DIFP-J2 as appropriate (Table PR12-3). This should correspond to the IFP/ LFP voltage being used for the digital input channels. Refer to Figure PR12-2 for the jumper location.

Table PR12-3. Digital Input Field Power Monitor Jumper

Input	DIFP-J2
24 VDC	1 2 3 4 5 6 7 8 9 10 11 12
48 VDC	1 2 3 4 5 6 7 8 9 10 11 12
125 VDC	1 2 3 4 5 6 7 8 9 10 11 12

Table PR12-3. Digital Input Field Power Monitor Jumper (continued)

Input	DIFP-J2												
120 VAC	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6								
7	8	9	10	11	12								
240 VAC	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6								
7	8	9	10	11	12								

- ☐ 7. Set the input channel jumpers as appropriate (Table PR12-4).

Table PR12-4. Digital Input Channel Jumpers

Input	Field Power	n ¹ -J1	n ¹ -J2	n ¹ -J3																								
24 VDC	IFP/LFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3	
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RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3		
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48 VDC	LFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3	
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RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3		
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RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	1 <table><tr><td>2</td><td>3</td></tr></table>	2	3		
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120 VAC	LFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	<table><tr><td>1</td><td>2</td><td>3</td></tr></table>	1	2	3
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7	8	9	10	11	12																							
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**Table PR12-4. Digital Input Channel Jumpers** *(continued)*

Input	Field Power	n ¹ -J1	n ¹ -J2	n ¹ -J3																								
120 VAC	RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	<table><tr><td>1</td><td>2</td><td>3</td></tr></table>	1	2	3
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1	2	3	4	5	6																							
7	8	9	10	11	12																							
1	2	3																										
240 VAC	LFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	<table><tr><td>1</td><td>2</td><td>3</td></tr></table>	1	2	3
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7	8	9	10	11	12																							
1	2	3																										
	RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>	1	2	3	4	5	6	7	8	9	10	11	12	<table><tr><td>1</td><td>2</td><td>3</td></tr></table>	1	2	3
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7	8	9	10	11	12																							
1	2	3																										

NOTE:

1. n corresponds to the channel number from 1 to 16. For example, 1-J1, 1-J2, and 1-J3 configure channel one.

- ☐ 8. Set the output channel jumpers as appropriate (Table PR12-5).

Table PR12-5. Digital Output Channel Jumpers

Output	Field Power	n ¹ -J1									
24 VDC	IFP/LFP ²	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
	1	2	3								
4	5	6									
7	8	9									
	RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
1	2	3									
4	5	6									
7	8	9									
48 VDC	LFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
	1	2	3								
4	5	6									
7	8	9									
	RFP	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr></table>	1	2	3	4	5	6	7	8	9
1	2	3									
4	5	6									
7	8	9									

NOTE:

1. n corresponds to the channel number from 17 to 24. For example, 17-J1 configures channel 17.
 2. 24 VDC IFP/LFP required when connecting to an RLY block.

- ☐ 9. Replace the access cover.

- ☐ 10. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.
- ☐ 11. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 12. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

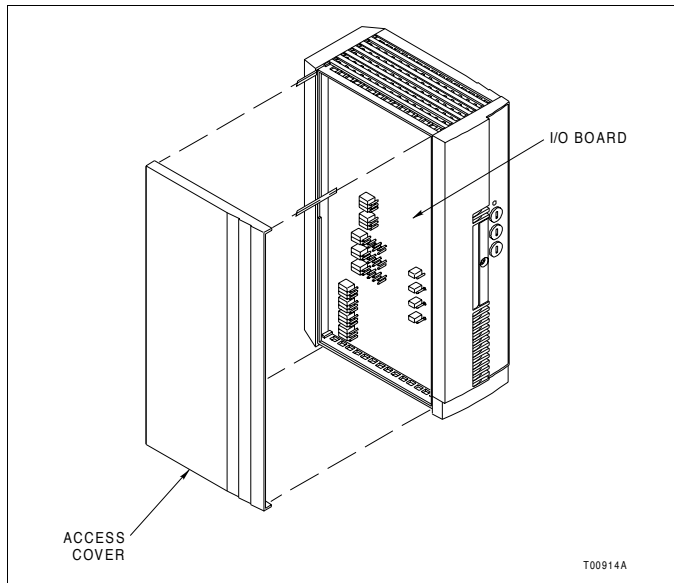


Figure PR12-1. Configuration Jumper Access

Field Device Connection

Figures **PR12-3** and **PR12-4** show the circuit connections made after attaching field wiring and setting jumpers. Figure **PR12-5** shows the circuit connections made when operating the DIO-400 block with an RLY-100 or RLY-200 block.

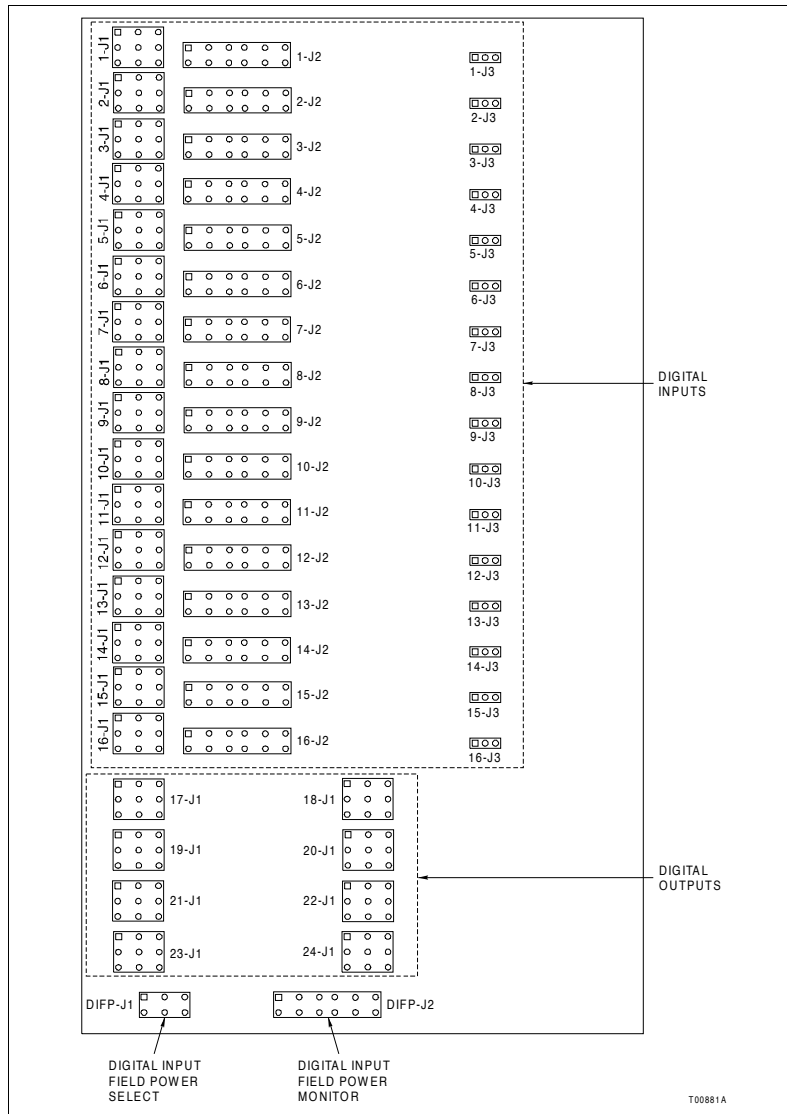


Figure PR12-2. User-Configurable Jumpers - I/O Board

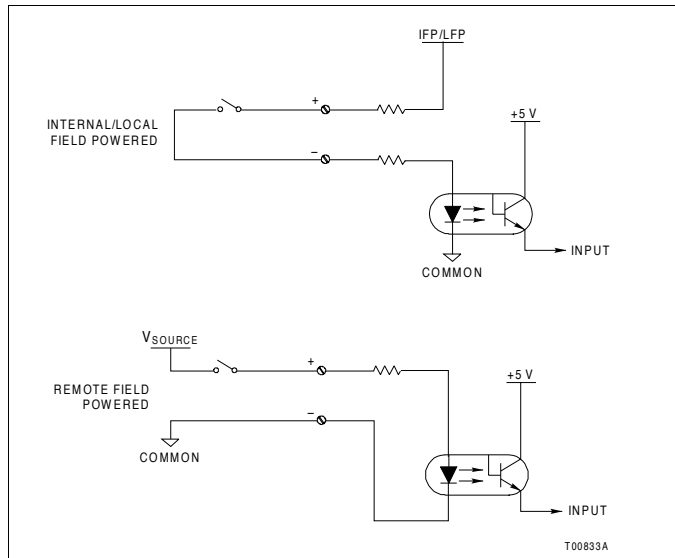


Figure PR12-3. Digital Input (Simplified)

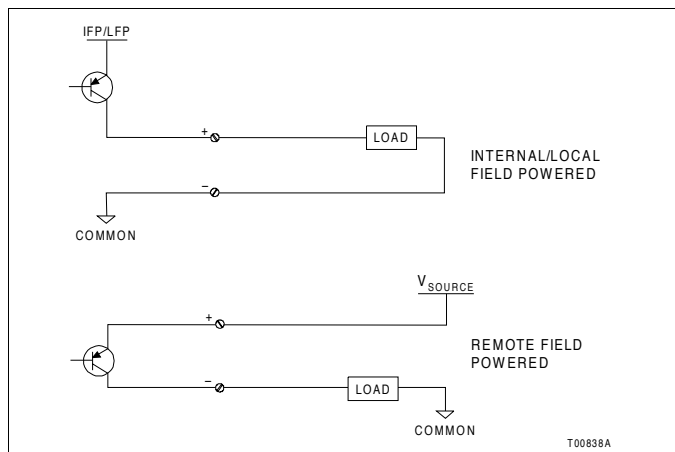


Figure PR12-4. Digital Output (Simplified)

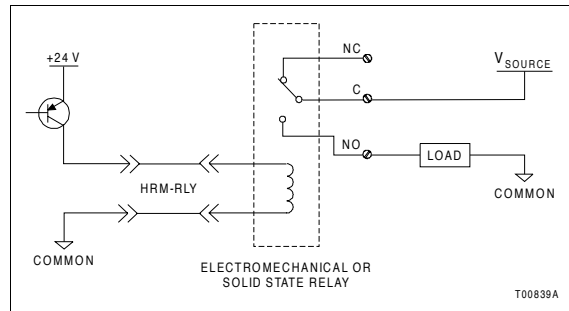


Figure PR12-5. DIO with RLY - Digital Output (Simplified)

DOT-100 Setup



PR13

Purpose/Scope

5 min.

This procedure gives the steps required to set up the DOT-100 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

Prerequisites • Completed worksheet **WS8**.

Parts None.

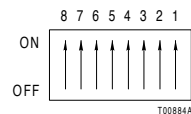
Tools • Small-tipped, flat-blade screwdriver.
• Needlenose pliers (optional).

Important Notice

Only wire field devices to the normally open relay contacts on a redundant DOT block. Both the normally open and normally closed relay contacts can be used on a nonredundant DOT block.

Procedure

- ☐ 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- ☐ 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- ☐ 3. Set the field power select jumpers J1 and J2 located on the back of the I/O module as appropriate (Table **PR13-1**).



Table PR13-1. Field Power Select Jumpers

Field Power ¹	J1	J2	Description
IFP	1 2 3	1 2 3	Field power from mounting column bus
LFP	1 2 3	1 2 3	Field power from LFP terminals on base

NOTE:

1. 24 VDC to power output relay coils.

- ☐ 4. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.
- ☐ 5. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 6. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

Field Device Connection

Figure PR13-1 shows the circuit connections made after attaching field wiring.

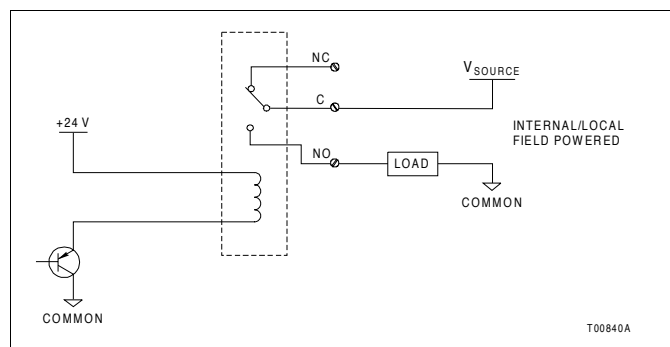


Figure PR13-1. Digital Output (Simplified)

DOT-120 Setup



PR14

Purpose/Scope

10 min.

This procedure gives the steps required to set up the DOT-120 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

Prerequisites • Completed worksheet **WS9**.

Parts None.

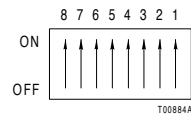
Tools • Small-tipped, flat-blade screwdriver.
• Needlenose pliers (optional).

Important Notice

Only wire field devices to the normally open relay contacts on a redundant DOT block. Both the normally open and normally closed relay contacts can be used on a nonredundant DOT block.

Procedure

- ☐ 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- ☐ 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- ☐ 3. Set the field power select jumpers J1 and J2 located on the back of the I/O module as appropriate (Table **PR14-1**).



Table PR14-1. Field Power Select Jumpers

Field Power ¹	J1	J2	Description
IFP			Field power from mounting column bus
LFP			Field power from LFP terminals on base

NOTE:

1. 24 VDC to power output relay coils.

- ☐ 4. Remove the access cover from the left side of the I/O module (Fig. PR14-1).
- ☐ 5. Set the readback/fusing select jumpers as appropriate (Table PR14-2). Refer to Figure PR14-2 for the jumper locations.

Table PR14-2. Readback/Fusing Select Jumpers

Output	n ¹ -J1	n ¹ -J2
Normally closed		
Normally open		

NOTE:

1. n corresponds to the channel number from 1 to 16. For example, 1-J1 and 1-J2 configure channel one.

The jumper settings determine which of the contact outputs are monitored. Both readback jumpers n-J1 and n-J2 **must** be set the same. For example, if the output is wired as a normally closed output, then both jumpers should be in the normally closed position. If both contact outputs are used, only one is monitored depending on the jumper settings.

- ☐ 6. Replace the access cover.
- ☐ 7. Verify 6.3 A, 250 V fuses are present in each of the DOT-120 block fuse holders XF1 through XF16 (Fig. PR14-2).
- ☐ 8. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.

- ☐ 9. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 10. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

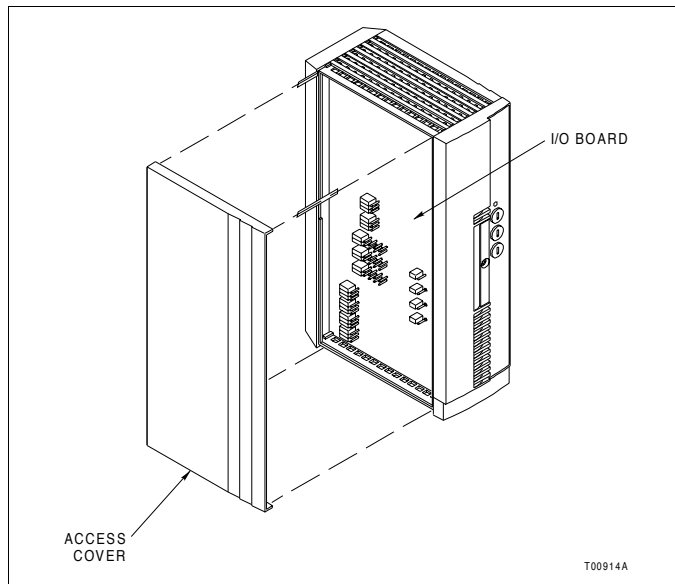


Figure PR14-1. Configuration Jumper Access

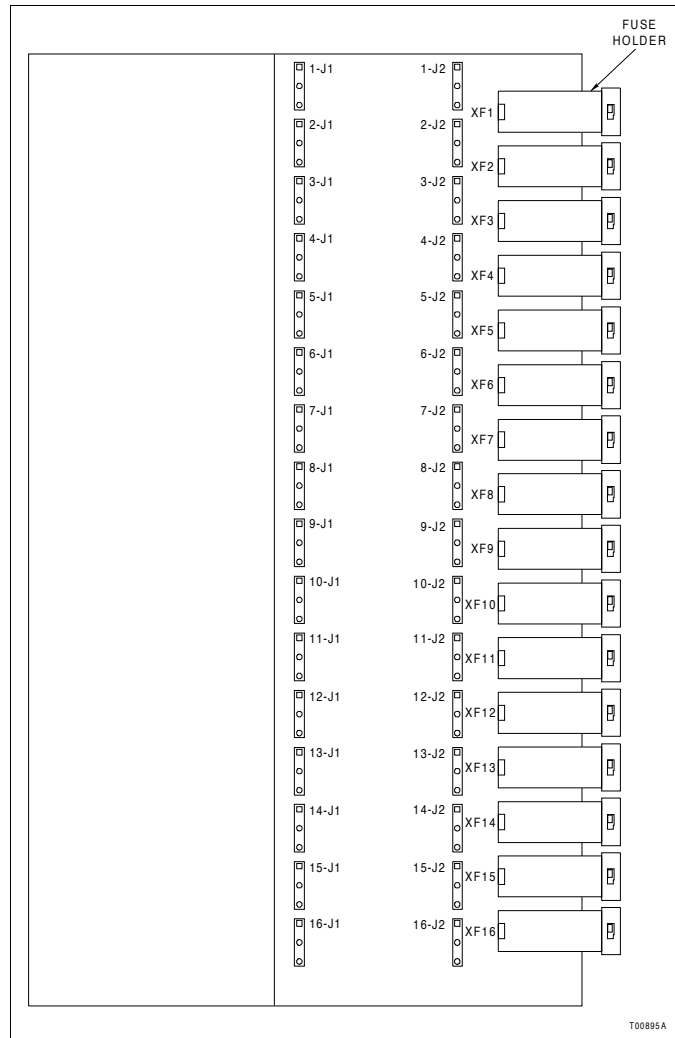


Figure PR14-2. User-Configurable Jumpers - I/O Board

Field Device Connection

Figure PR14-3 shows the circuit connections made after attaching field wiring.

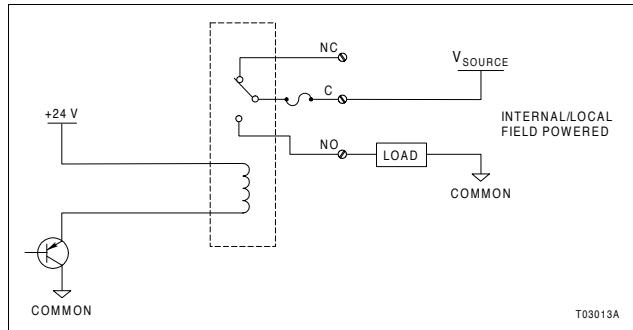


Figure PR14-3. Digital Output (Simplified)





Purpose/Scope

5 min.

This procedure gives the steps required to set up the C10-110 block for proper operation.

Parts None.

Tools

- Small-tipped, flat-blade screwdriver.
- Needlenose pliers (optional).
- IISAC01 Analog Control Station instruction.

Procedure

- ☐ 1. Set the M/A power select jumpers J1 and J2 as appropriate (Table PR15-1).

Table PR15-1. M/A Power Select Jumpers

Power Source	J1	J2												
External M/A power source connected at terminal block	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr></table>	1	2	3	4	5	6	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr></table>	1	2	3	4	5	6
1	2	3												
4	5	6												
1	2	3												
4	5	6												
LFP power used for M/A power; no external M/A power source connected	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr></table>	1	2	3	4	5	6	<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr></table>	1	2	3	4	5	6
1	2	3												
4	5	6												
1	2	3												
4	5	6												

Refer to Figure PR15-1 for jumper locations. Refer to the ***IISAC01 Analog Control Station*** instruction for an explanation of the M/A power.

- ☐ 2. Verify a 1.6 A, 250 V fuse is present in fuse holder XF3. This fuse is required when using LFP power for M/A power.
- ☐ 3. Verify 4.0 A, 250 V fuses are present in fuse holders XF1 and XF2. These fuses are for the +24 VDC LFP power that operates IISAC01 control stations connected at P2 and P4 respectively.

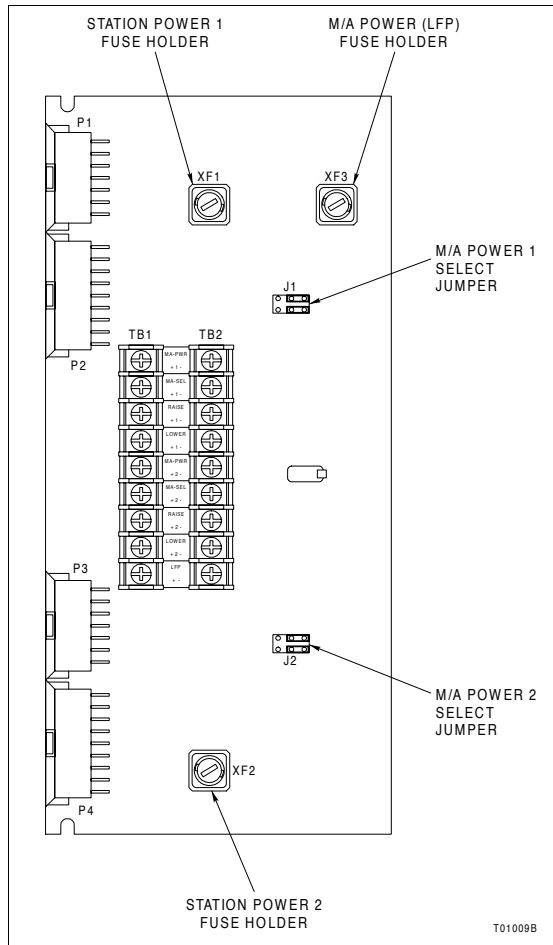


Figure PR15-1. I/O Board Layout



Purpose/Scope

15 min.

This procedure gives the steps required to set up the RLY-200 block for proper operation.

NOTE: NC on the terminal label means not connected.

Parts

Number	Qty	Description
1947684A32	1 - 8	120 VAC solid state relay
		240 VAC solid state relay
1947685A31		24 VDC solid state relay
1947685A32		125 VDC solid state relay
1949438A1001	1 - 8	125 VDC relay fuse
1949438A3151		24 VDC relay fuse
1949697A3151		120 VAC relay fuse
		240 VAC relay fuse

Tools • Small-tipped, flat-blade screwdriver.

Safety Considerations

CAUTION

1. Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used.

Procedure



1. Install the relays in sockets XK17 through XK24 (Fig. [PR16-1](#)). The block can be populated with relays of different ratings. They do not all have to be the same.
 - a. Verify the relay being installed is an approved relay (refer to [Section 11](#)).



- b. Align and insert the relay into the socket. Insure that it is seated flush with the socket.
 - c. Tighten the attachment screw.
- ☐ 2. Install the proper fuse in each fuse holder XF17 through XF24. The fuse is dependent on the type of relay installed (Table **PR16-1**).

Table PR16-1. Fuses

Relay	Fuse	Description
24 VDC	3.15 A, 250 V	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
125 VDC	1.0 A, 250 V	5 x 20 mm, fast-acting, low break capacity (IEC 127-2/II)
120 VAC	3.15 A, 250 V	5 x 20 mm, time-lag, high break capacity (IEC 127-2/IV)
240 VAC		

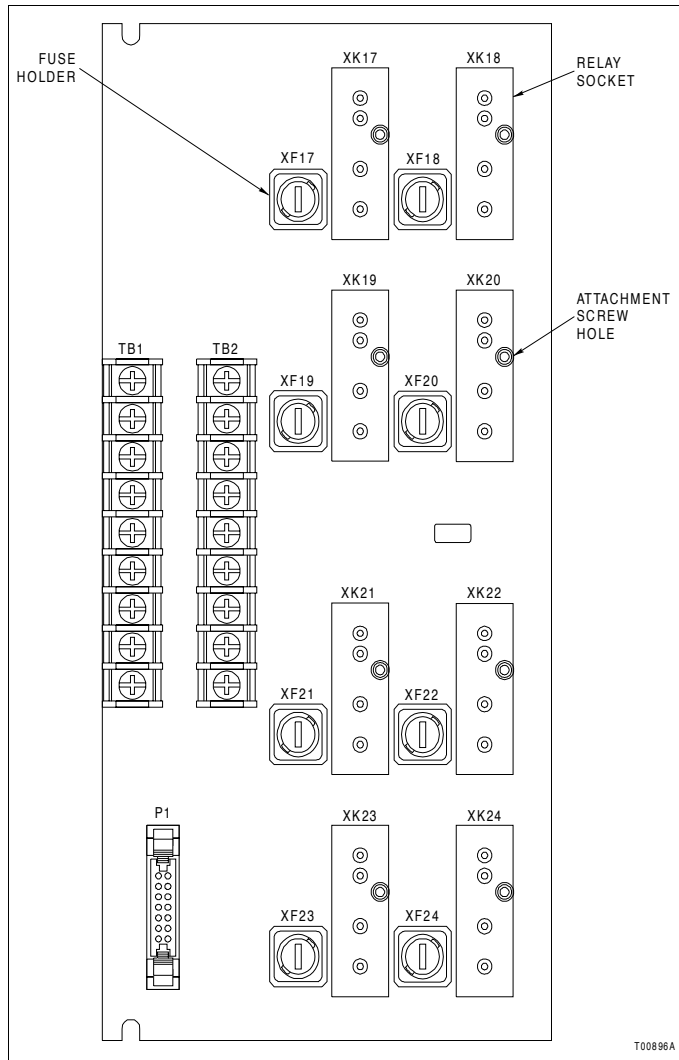


Figure PR16-1. I/O Board Layout (Shown Without Relays)





Purpose/Scope

10 min.

This procedure gives the steps required to cable connect an IISAC01 Analog Control Station to a CIO-100 block. A station can either connect directly to the CIO-100 block or connect through a CIO-110 block (Fig. **PR17-1**).

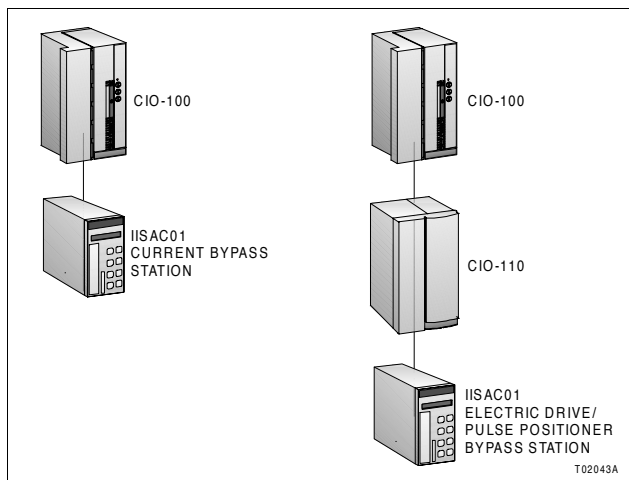


Figure PR17-1. CIO Connection

This procedure only covers CIO-100 and CIO-110 block cable requirements. Refer to the ***IISAC01 Analog Control Station*** instruction for station setup, installation, and cabling requirements.

Parts

Number	Qty	Description
NKCS03	1 per station connection	CIO-100 to IISAC01 translation cable
NKCS04	1 per station connection	CIO-100 to CIO-110 cable
NKCS05	1 per station connection	CIO-110 to IISAC01 translation cable



Tools • IISAC01 Analog Control Station instruction.

Procedure

Figure PR17-2 shows the cabling required to connect an IISAC01 station that supports current mode bypass operation. Figure PR17-3 shows the cabling required to connect an IISAC01 station that supports electric drive/pulse positioner bypass operation.

NOTE: The CIO-110 block must be located either directly above or directly below the CIO-100 block it is to connect to.

- ☐ Make the necessary cable connections as shown in Figure PR17-2 or PR17-3.

Table PR17-1. CIO-100 to CIO-110 Connector Relationship

Station	CIO-100	CIO-110
1	P7	P1, P2
2	P8	P3, P4

Table PR17-2. CIO-100 and IISAC01 Analog Input Relationship

Station	CIO-100		IISAC01	
	Connector	Analog Input		Analog Input
1	P7	CH1	AI1	AI1
		CH2	AI2	AI2
2	P8	CH3	AI3	AI1
		CH4	AI4	AI2

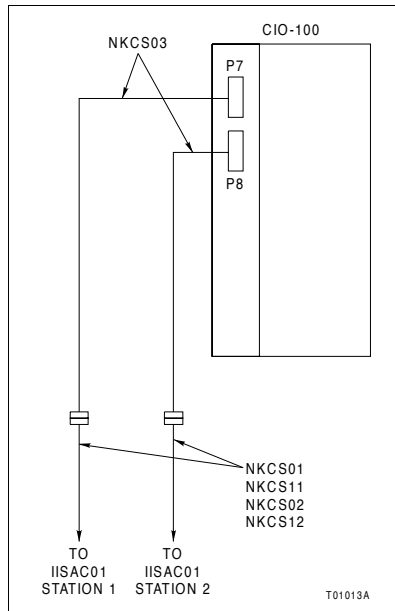


Figure PR17-2. Current Mode Bypass Cable Connection

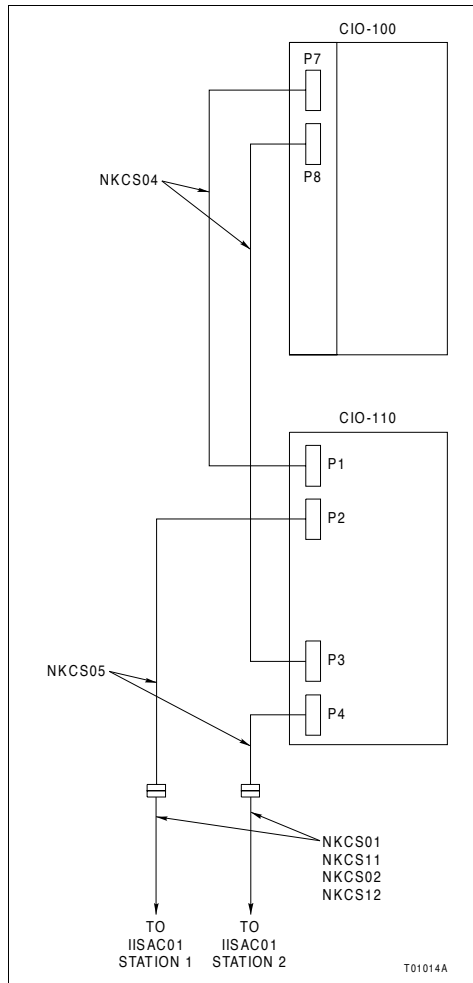


Figure PR17-3. Electric Drive/Pulse Positioner Bypass Cable Connection

RLY-100/200 Cable Connection



PR18

Purpose/Scope

5 min.

This procedure gives the steps required to cable connect a RLY-100 or RLY-200 block to a DIO-400 block (Fig. **PR18-1**).

NOTE: A DIO block must have a relay connector base (P-HB-DIO-4000R?00) to connect DIO outputs to an RLY block.

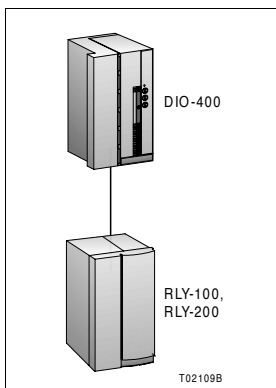


Figure PR18-1. DIO to RLY Connection

Parts

Number ^{1,2}	Qty	Description
P-MK-HRM-RLY12Hxx	1	DIO to RLY cable
P-MK-HRM-RLY12Sxx		DIO to RLY cable

NOTES:

1. H = PLTC rated for use in external enclosure applications; S = for use in internal enclosure applications.

2. Refer to **Section 11** for complete nomenclatures.

Tools None.



Procedure

- Make the necessary cable connections as shown in Figure PR18-2. This figure shows the cabling required to connect an RLY-100 or RLY-200 block to the DIO block.

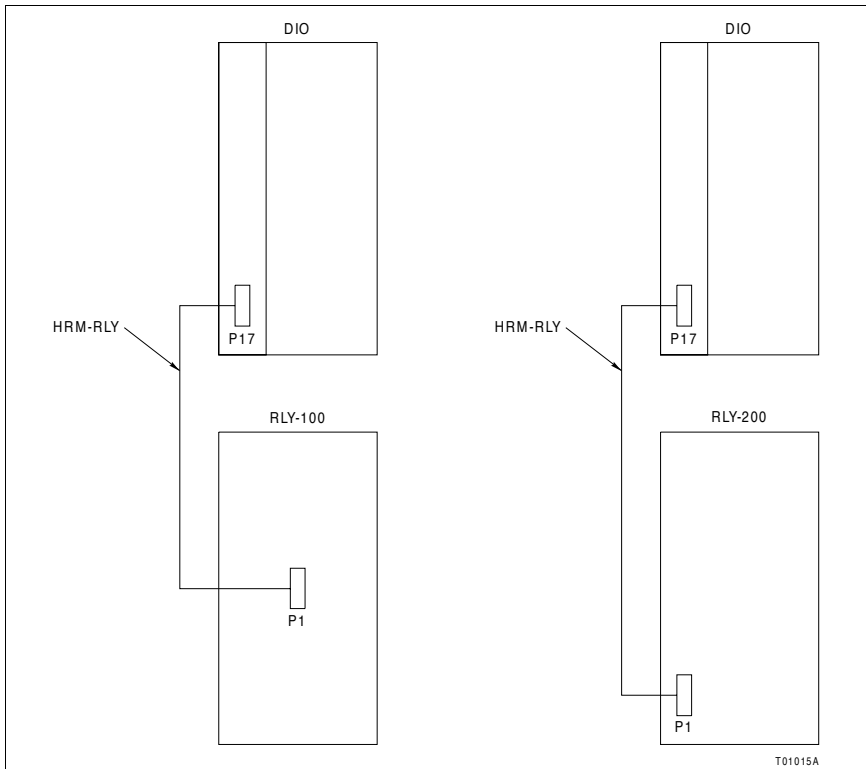


Figure PR18-2. DIO Block to RLY Block Cable Connection



Purpose/Scope

1 min.

This procedure gives the steps required to remove an I/O module from its base. The removal procedure is the same for all I/O modules. An I/O module can be removed with power on.

NOTE: Always follow the instructions given in **Special Handling** in Section 5 when handling an I/O module.

Parts None.

Tools

- Flat-blade or Phillips screwdriver.
- Thin rod for reset button, preferably nonmetallic.

Safety Considerations

WARNING

1. An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous.

CAUTION

1. For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliamper input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops.

Procedure

- ☐ 1. Depress the stop/reset button once to halt block operation if not already halted.
- ☐  2. Loosen the captive front panel fastening screw (Fig. PR28-1).
- ☐ 3. Grasp the I/O module by its handle and gently pull.

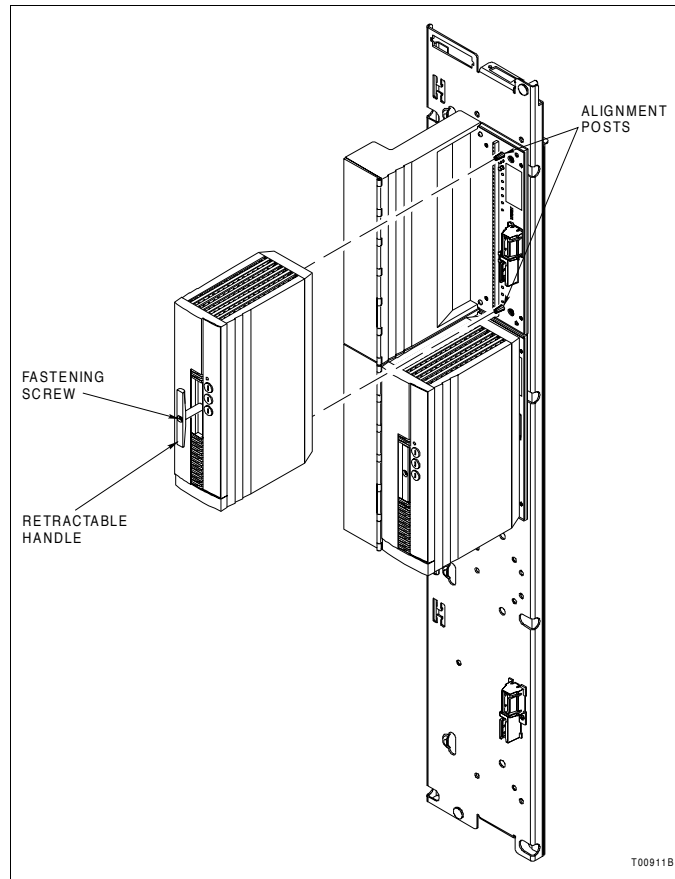


Figure PR28-1. I/O Module Removal



Purpose/Scope

5 min.

This procedure gives the steps required to remove a terminal (C, R, and S type) or connector base (K type). The procedure is the same whether removing a nonredundant or redundant base.

Parts None.

Tools • Phillips screwdriver.

Procedure

- ☐ 1. Loosen the two captive screws that attach the base to the column (Fig. [PR29-1](#)). A redundant base has four captive screws.
- ☐ 2. Slide the base to the right so the tabs on the back of the base clear the slots in the column as shown in Figure [PR29-1](#), then remove the base.

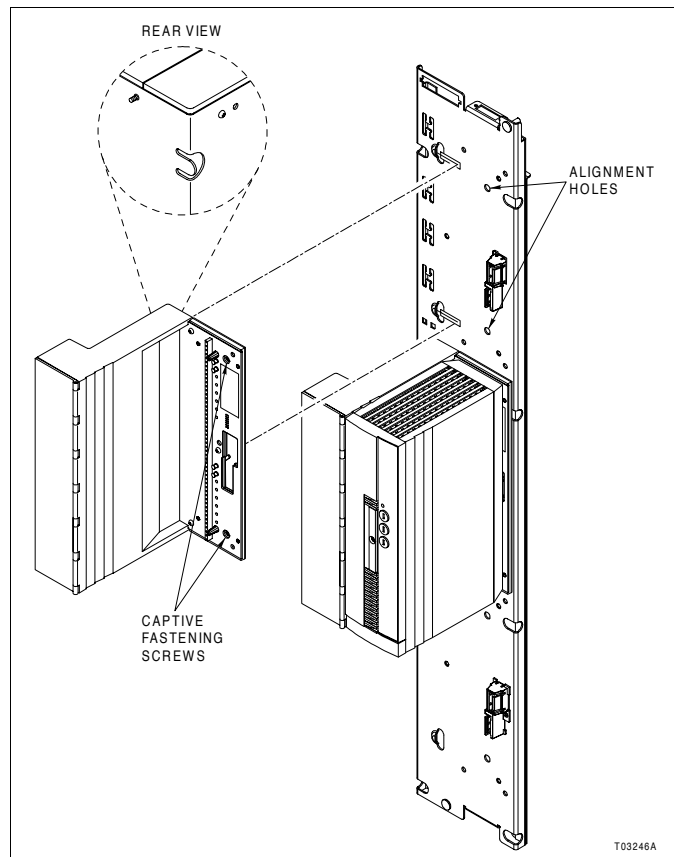


Figure PR29-1. Base Removal

Auxiliary Block Removal



PR30

Purpose/Scope

10 min.

This procedure gives the steps required to remove an auxiliary block. The procedure is the same for all auxiliary blocks.

Parts None.

Tools • Phillips screwdriver.

Procedure

- ☐ 1. Separate the auxiliary block housing from its mounting bracket by opening the front panel door and loosening the four captive screws that attach the housing to the bracket (Fig. [PR30-1](#)).
- ☐ 2. Remove the auxiliary housing bracket by removing the three screws attaching the bracket to the column.

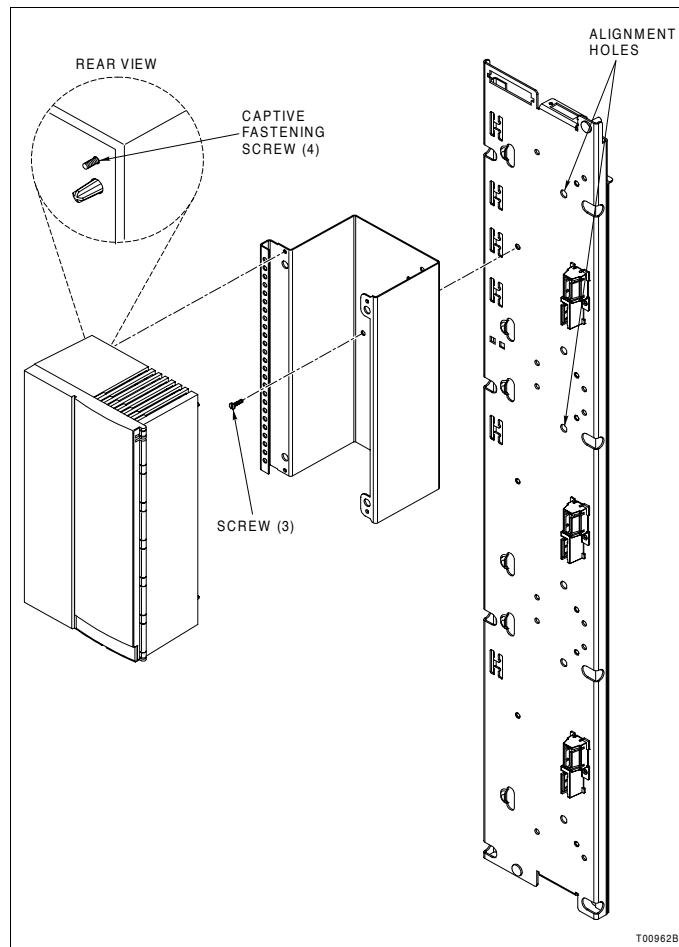


Figure PR30-1. Auxiliary Block Removal

Wiring and Cabling Disconnection



PR31

Purpose/Scope

15 min.

This procedure gives the steps to disconnect field wiring, power wiring, and cables prior to removing an I/O or auxiliary block.

Parts None.

Tools

- Flat-blade screwdriver.
- Phillips screwdriver.

Safety Considerations

WARNING

1. Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.

Procedure

- ☐ 1. Record any block, wiring, and cabling information necessary so the wiring and cabling can be easily reconnected. This step may not be required if the front door label contains the information, or this information is already recorded in some other form.
- ☐  2. Verify that power is off to the Harmony I/O system and field devices being disconnected.
- ☐ 3. Disconnect all field wiring from the block.

Screw Terminals If the wiring is attached using screw terminals, remove each wire attached.

Clamp Terminals If the field wiring is attached using clamp terminals, unplug the terminal strip from the connector on the base. Individual wires can remain connected to the terminals.



Cable Connector If the field wiring is attached using a cable connector, unplug the cable from the base.

- ☐ 4. Disconnect the LFP power wiring from the block.
- ☐ 5. Disconnect all cables.

DOT-100/120 Relay Replacement



PR32

Purpose/Scope

15 min.

This procedure gives the steps to replace a relay on a DOT-100 or DOT-120 block.

Parts

Number	Qty	Description
1949002A3	1 - 16	Electromechanical relay (SPDT)

Tools None.

Safety Considerations

CAUTION

1. Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used.

Procedure

- ☐ 1. Remove the access cover from the left side of the I/O module (Fig. PR32-1).
- ☐ 2. Pull the existing relay from its socket XK1 through XK16 (Fig. PR32-2). Rock the relay from side to side to loosen and remove it.
- ☐  3. Verify the replacement relay is an approved relay and of the same type.
- ☐ 4. Align and insert the new relay. Insure that it is seated flush with the socket.
- ☐ 5. Replace the access cover.

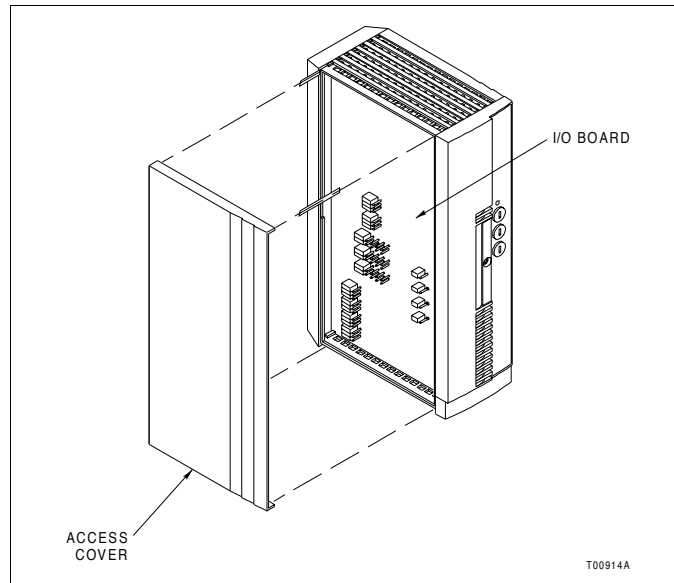


Figure PR32-1. Configuration Jumper Access

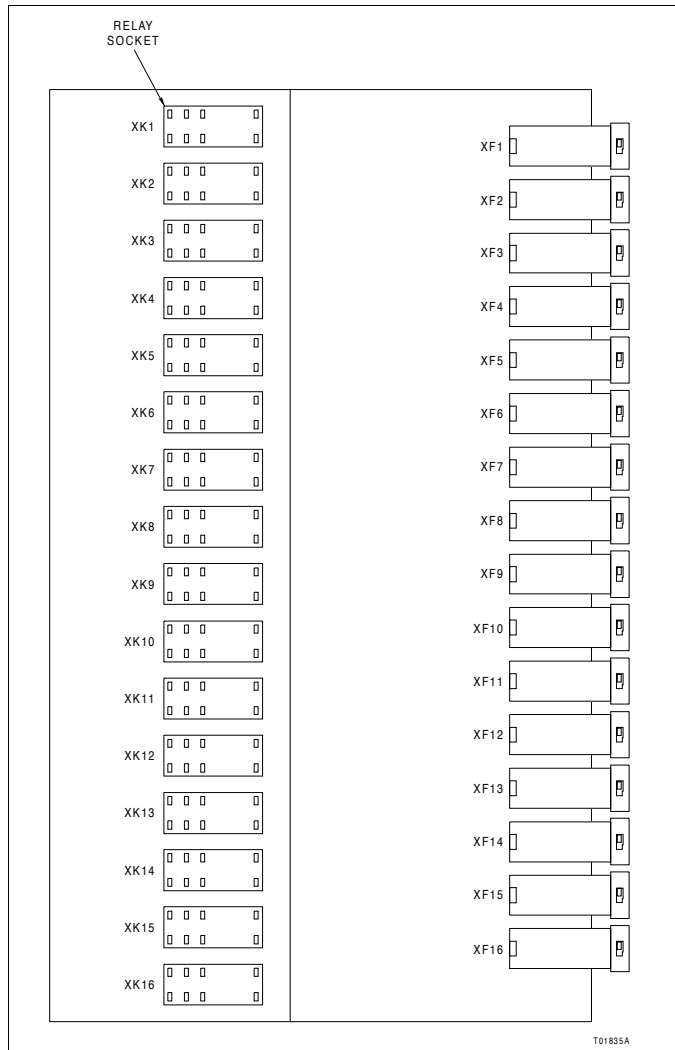


Figure PR32-2. I/O Board Layout (Shown Without Relays)



RLY-100 Relay Replacement



PR33

Purpose/Scope

5 min.

This procedure gives the steps to replace a relay on the RLY-100 block.

Parts

Number	Qty	Description
1949562A1	1 - 8	Electromechanical relay (DPDT)

Tools None.

Safety Considerations

WARNING

1. Verify field power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete.

CAUTION

1. Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used.

Procedure

- ☐  1. Turn off power to the field device controlled by the relay being replaced.
- ☐ 2. Open the access door, then pull the existing relay from its socket XK17 through XK24 (Fig. PR33-1). The sockets are very tight to insure the relays remain in place. Rock the relay up and down to loosen and remove it.
- ☐  3. Verify the replacement relay is an approved relay and of the same type.



- ☐ 4. Align and insert the new relay. Insure that it is seated flush with the socket.
- ☐ 5. Turn on power previously turned off in Step 1.

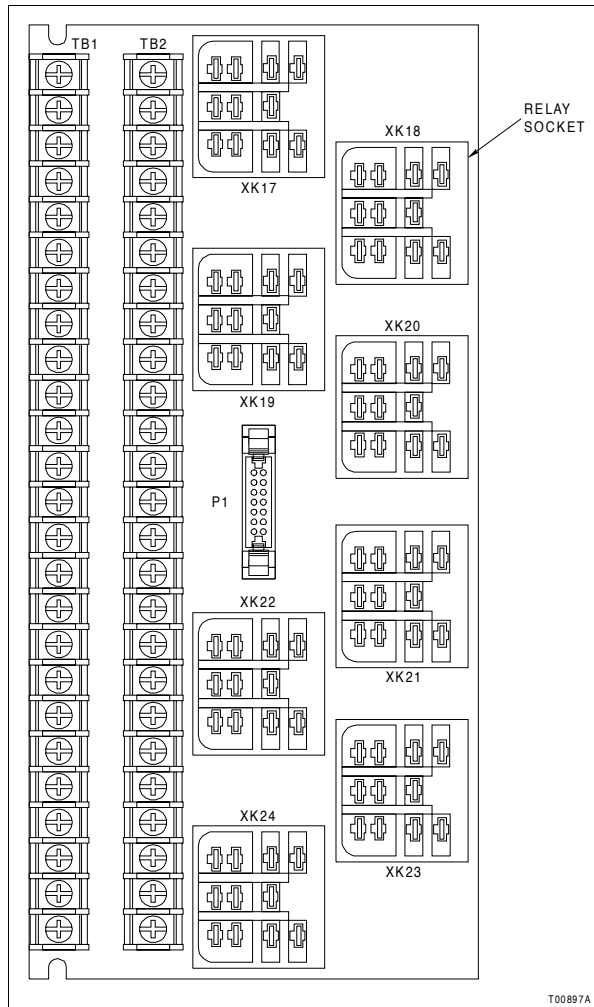


Figure PR33-1. RLY-100 Board Layout (Shown Without Relays)



RLY-200 Relay Replacement



PR34

Purpose/Scope

5 min.

This procedure gives the steps to replace a relay on the RLY-200 block.

NOTE: Check for a blown fuse before replacing a relay.

Parts

Number	Qty	Description
1947684A32	1 - 8	120 VAC solid state relay
1947685A31		24 VDC solid state relay
1947685A32		125 VDC solid state relay
1947803A1		240 VAC solid state relay

Tools • Small-tipped, flat-blade screwdriver.

Safety Considerations

WARNING

1. Verify field power is turned off before starting the replacement procedure. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete.

CAUTION

1. Use only ABB Automation approved relays on the relay assembly. Using unapproved relays could improperly route signals and damage equipment connected to the relay and the relay itself. CSA certification is voided when unapproved relays are used.

Procedure



1. Turn off power to the field device controlled by the relay being replaced.



2. Open the access door, then loosen the attachment screw of the relay to be replaced (Fig. [PR34-1](#)).



- ☐ 3. Pull the existing relay from its socket XK17 through XK24.
- ☐  4. Verify the replacement relay is an approved relay and of the same type.
- ☐ 5. Align and insert the new relay. Insure that it is seated flush with the socket.
- ☐ 6. Tighten the attachment screw.
- ☐ 7. Turn on power previously turned off in Step 1.

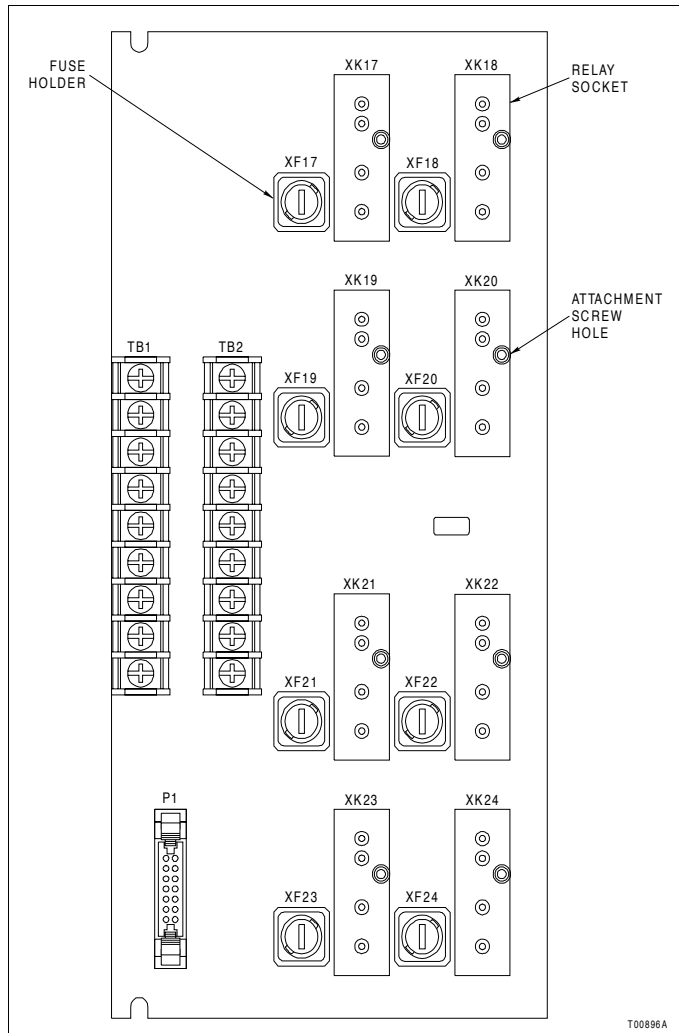


Figure PR34-1. RLY-200 Board Layout (Shown Without Relays)





Block ID: _____

Location: _____ Column: _____ Row: _____

Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ None

Field Power Selection: ☐ IFP ☐ LFP

Analog Inputs - FC 222

Input	Range
Current	4 to 20 mA
High Level Voltage	0 to 1 VDC 0 to 5 VDC 0 to 10 VDC 1 to 5 VDC -10 to +10 VDC
Custom voltage	-10 to +10 VDC



CH1 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH2 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH3 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH4 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ _____ to _____ VDC (RFP only)
☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH5 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ _____ to _____ VDC (RFP only)
☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH6 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ _____ to _____ VDC (RFP only)
☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH7 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH8 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH9 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH10 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ _____ to _____ VDC (RFP only)
☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH11 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ _____ to _____ VDC (RFP only)
☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH12 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ _____ to _____ VDC (RFP only)
☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH13 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH14 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH15 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____





Block ID: _____

Location: _____ Column: _____ Row: _____

Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Field Power Selection: ☒ IFP (only option)

Analog Inputs - FC 222

Input	Range/Type
High level voltage	0 to 1 VDC 0 to 5 VDC 0 to 10 VDC 1 to 5 VDC -10 to +10 VDC
Low level voltage	0 to 100 mV -100 to +100 mV
Custom voltage	-10 to +10 VDC
Thermocouple (TC)	B, E, J, K, L, N (14 AWG), N (28 AWG), R, S, T, U Chinese E, S



CH1 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH2 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH3 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH4 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH5 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH6 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH7 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH8 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH9 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH10 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ _____ to _____ VDC

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH11 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ _____ to _____ VDC

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH12 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ _____ to _____ VDC

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH13 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH14 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH15 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ _____ to _____ VDC
☐ Thermocouple
TC Type: _____
Lead Wire Ω : _____ (mV or TC input)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ _____ to _____ VDC

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____





Block ID: _____

Location: _____ Column: _____ Row: _____

Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ None

Field Power Selection: ☐ IFP ☐ LFP

Analog Inputs - FC 222

Input	Range/Type
Current	4 to 20 mA
High level voltage	0 to 1 VDC 0 to 5 VDC 0 to 10 VDC 1 to 5 VDC -10 to +10 VDC
Low level voltage	0 to 100 mV -100 to +100 mV
Custom voltage	-10 to +10 VDC
Thermocouple (TC)	B, E, J, K, L, N (14 AWG), N (28 AWG), R, S, T, U Chinese E, S



CH1 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH2 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH3 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH4 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH5 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH6 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH7 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH8 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH9 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH10 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH11 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH12 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH13 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH14 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH15 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ _____ to _____ VDC (RFP only)

☐ Single-ended ☐ Differential (voltage mode)

☐ Thermocouple

TC Type: _____

Lead Wire Ω : _____ (mV or TC input)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



AIN-300



WS4

Block ID: _____
Location: _____ Column: _____ Row: _____
Device Label: _____ (32 characters max.)

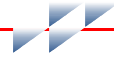
Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Field Power Selection: ☒ IFP (only option)

Analog Inputs - FC 222

CH1 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 10 Ω copper
☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.
☐ 120 Ω nickel
☐ Chinese 53 Ω copper
Lead Wire Ω : _____
Eng. Units: ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH2 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH3 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH4 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 10 Ω copper
☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.
☐ 120 Ω nickel
☐ Chinese 53 Ω copper
Lead Wire Ω : _____
Eng. Units: ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH5 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input: ☐ 10 Ω copper
☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.
☐ 120 Ω nickel
☐ Chinese 53 Ω copper
Lead Wire Ω : _____
Eng. Units: ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH6 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH7 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH8 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH9 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH10 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH11 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH12 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH13 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

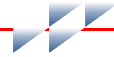
☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH14 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH15 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 10 Ω copper

☐ 100 Ω platinum ☐ U.S. Lab. Std. ☐ U.S. Ind. Std. ☐ Euro. Std.

☐ 120 Ω nickel

☐ Chinese 53 Ω copper

Lead Wire Ω : _____

Eng. Units: ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____





Block ID: _____
Location: _____ Column: _____ Row: _____
Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ None

Field Power Selection: ☐ IFP ☐ LFP

Analog Outputs - FC 223

CH1 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Stall State: ☐ 0% ☐ 100% ☐ Hold Output
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH2 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Stall State: ☐ 0% ☐ 100% ☐ Hold Output
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH3 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH4 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH5 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH6 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH7 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH8 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH9 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH10 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____



CH11 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH12 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH13 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH14 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH15 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Stall State: ☐ 0% ☐ 100% ☐ Hold Output
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH16 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Stall State: ☐ 0% ☐ 100% ☐ Hold Output
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____





Block ID: _____
Location: _____ Column: _____ Row: _____
Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ None

Field Power Selection: ☐ IFP ☐ LFP

Analog Inputs - FC 222

CH1 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ 1 to 5 VDC (RFP only) ☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

CH2 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP
☐ 1 to 5 VDC (RFP only) ☐ Single-ended ☐ Differential (voltage mode)
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____



CH3 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ 1 to 5 VDC (RFP only) ☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH4 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 4 to 20 mA ☐ IFP/LFP ☐ RFP

☐ 1 to 5 VDC (RFP only) ☐ Single-ended ☐ Differential (voltage mode)

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

Analog Outputs - FC 223

CH5 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output: ☐ 4 to 20 mA (IFP/LFP only)

☐ 1 to 5 VDC (IFP/LFP only)

Stall State: ☐ 0% ☐ 100% ☐ Hold Output

Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C

Low Value: _____ High Value: _____

CH6 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ 4 to 20 mA (IFP/LFP only)
☐ 1 to 5 VDC (IFP/LFP only)
Stall State: ☐ 0% ☐ 100% ☐ Hold Output
Eng. Units: ☐ _____ ☐ Percent (%) ☐ Deg F ☐ Deg C
Low Value: _____ High Value: _____

Digital Inputs - FC 224

CH7 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input (RFP only): ☐ 24 VDC
☐ 48 VDC
☐ 125 VDC
☐ 120 VAC
☐ 240 VAC

CH8 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Input (RFP only): ☐ 24 VDC
☐ 48 VDC
☐ 125 VDC
☐ 120 VAC
☐ 240 VAC



CH9 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input (RFP only): ☐ 24 VDC

☐ 48 VDC

☐ 125 VDC

☐ 120 VAC

☐ 240 VAC

CH10 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input (RFP only): ☐ 24 VDC

☐ 48 VDC

☐ 125 VDC

☐ 120 VAC

☐ 240 VAC

Digital Outputs - FC 225

CH11 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

24 VDC: ☐ IFP/LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH12 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

24 VDC: ☐ IFP/LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH13 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
24 VDC: ☐ IFP/LFP ☐ RFP
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH14 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
24 VDC: ☐ IFP/LFP ☐ RFP
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output





Block ID: _____

Location: _____ Column: _____ Row: _____

Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ 48 VDC ☐ 125 VDC
☐ 120 VAC ☐ 240 VAC
☐ None

Digital Input Field Power: ☐ IFP ☐ LFP

Digital Output Field Power: ☐ IFP ☐ LFP (24 or 48 VDC only)

NOTES:

1. Digital inputs can be 24 VDC IFP or 24 VDC, 48 VDC, 125 VDC, 120 VAC, or 240 VAC LFP powered. RFP is also supported.
2. Digital outputs can be either 24 VDC IFP or 48 VDC LFP powered only. RFP is not supported.
3. Digital outputs must be configured as 24 VDC IFP/LFP to operate with an RLY block.



Digital Inputs - FC 224

CH1 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH2 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH3 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH4 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

☐ 125 VDC ☐ LFP ☐ RFP

☐ 120 VAC ☐ LFP ☐ RFP

☐ 240 VAC ☐ LFP ☐ RFP

CH5 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

☐ 125 VDC ☐ LFP ☐ RFP

☐ 120 VAC ☐ LFP ☐ RFP

☐ 240 VAC ☐ LFP ☐ RFP

CH6 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

☐ 125 VDC ☐ LFP ☐ RFP

☐ 120 VAC ☐ LFP ☐ RFP

☐ 240 VAC ☐ LFP ☐ RFP



CH7 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH8 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH9 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH10 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

☐ 125 VDC ☐ LFP ☐ RFP

☐ 120 VAC ☐ LFP ☐ RFP

☐ 240 VAC ☐ LFP ☐ RFP

CH11 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

☐ 125 VDC ☐ LFP ☐ RFP

☐ 120 VAC ☐ LFP ☐ RFP

☐ 240 VAC ☐ LFP ☐ RFP

CH12 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

☐ 125 VDC ☐ LFP ☐ RFP

☐ 120 VAC ☐ LFP ☐ RFP

☐ 240 VAC ☐ LFP ☐ RFP



CH13 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH14 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH15 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input: ☐ 24 VDC ☐ IFP/LFP ☐ RFP
☐ 48 VDC ☐ LFP ☐ RFP
☐ 125 VDC ☐ LFP ☐ RFP
☐ 120 VAC ☐ LFP ☐ RFP
☐ 240 VAC ☐ LFP ☐ RFP

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Input:

☐ 24 VDC	☐ IFP/LFP	☐ RFP
☐ 48 VDC	☐ LFP	☐ RFP
☐ 125 VDC	☐ LFP	☐ RFP
☐ 120 VAC	☐ LFP	☐ RFP
☐ 240 VAC	☐ LFP	☐ RFP

Digital Outputs - FC 225

CH17 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output:

☐ 24 VDC	☐ IFP/LFP	☐ RFP
☐ 48 VDC	☐ LFP	☐ RFP

Stall State:

☐ On (0)	☐ Off (1)	☐ Hold Output

CH18 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output:

☐ 24 VDC	☐ IFP/LFP	☐ RFP
☐ 48 VDC	☐ LFP	☐ RFP

Stall State:

☐ On (0)	☐ Off (1)	☐ Hold Output

CH19 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output:

☐ 24 VDC	☐ IFP/LFP	☐ RFP
☐ 48 VDC	☐ LFP	☐ RFP

Stall State:

☐ On (0)	☐ Off (1)	☐ Hold Output



CH20 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Output: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH21 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Output: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH22 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Output: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH23 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)

Output: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH24 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output: ☐ 24 VDC ☐ IFP/LFP ☐ RFP

☐ 48 VDC ☐ LFP ☐ RFP

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output





Block ID: _____
Location: _____ Column: _____ Row: _____
Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ None

Field Power Selection: ☐ IFP ☐ LFP

NOTE: 24 VDC IFP or LFP is needed to power the output relay coils.

Digital Outputs - FC 225

CH1 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH2 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output



CH3 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH4 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH5 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH6 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH7 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH8 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH9 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH10 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH11 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH12 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH13 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH14 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output



CH15 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output: ☐ Normally open ☐ Normally closed

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output: ☐ Normally open ☐ Normally closed

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output



Block ID: _____
Location: _____ Column: _____ Row: _____
Device Label: _____ (32 characters max.)

Field Power Options

Internal Field Power (IFP): ☒ 24 VDC (always available)

Local Field Power (LFP): ☐ 24 VDC ☐ None

Field Power Selection: ☐ IFP ☐ LFP

NOTE: 24 VDC IFP or LFP is required to power the output relay coils.

Digital Outputs - FC 225

CH1 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH2 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output



CH3 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH4 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH5 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH6 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH7 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH8 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH9 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH10 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH11 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH12 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH13 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH14 Channel Info: _____
Channel Label: _____ (optional 32 characters max.)
Output: ☐ Normally open ☐ Normally closed
Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output



CH15 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output: ☐ Normally open ☐ Normally closed

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output

CH16 Channel Info: _____

Channel Label: _____ (optional 32 characters max.)

Output: ☐ Normally open ☐ Normally closed

Stall State: ☐ On (0) ☐ Off (1) ☐ Hold Output



Introduction

This section provides drawings showing dimensions for I/O and auxiliary blocks.

I/O Block

Figures A-1 through A-3 are I/O block components: I/O module, nonredundant base, and redundant base.

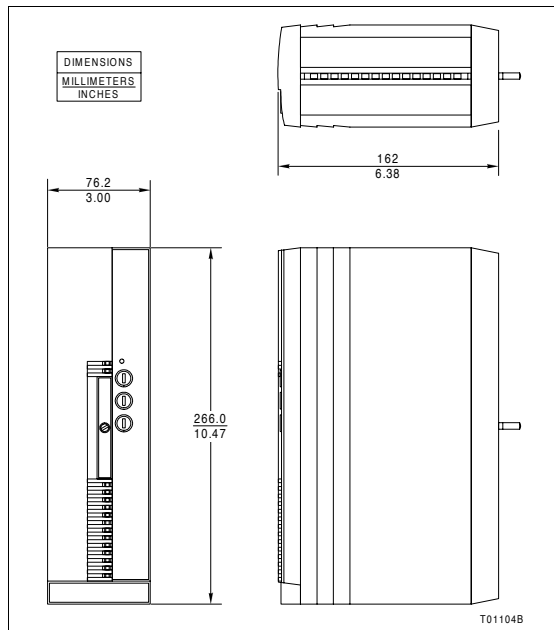


Figure A-1. I/O Module

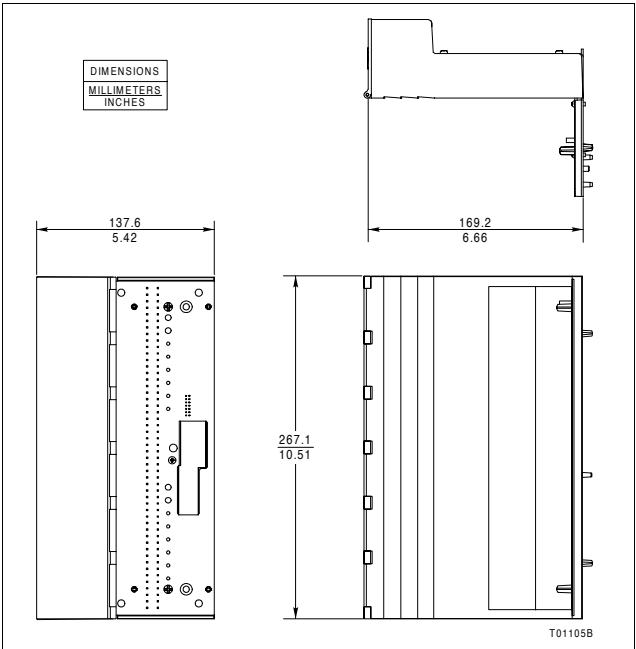


Figure A-2. Nonredundant Base

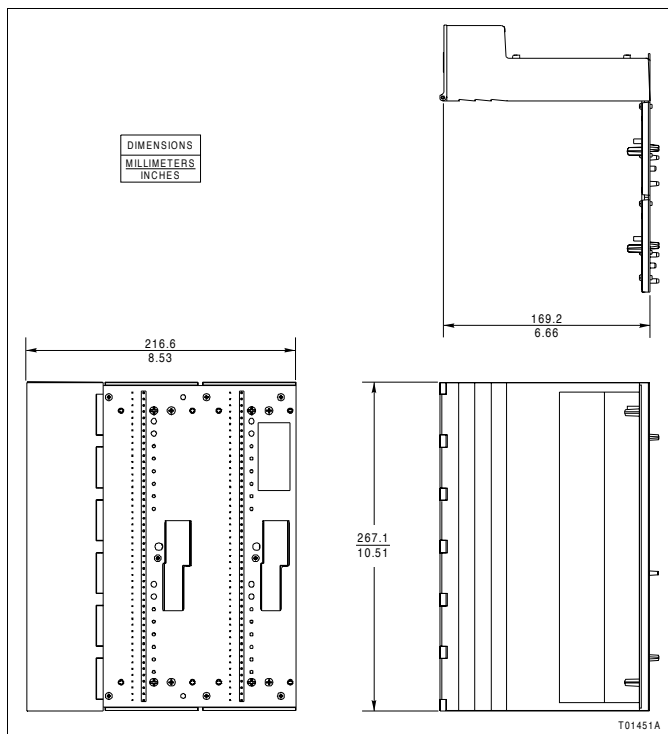


Figure A-3. Redundant Base



Auxiliary Block

Figure A-4 is the auxiliary block.

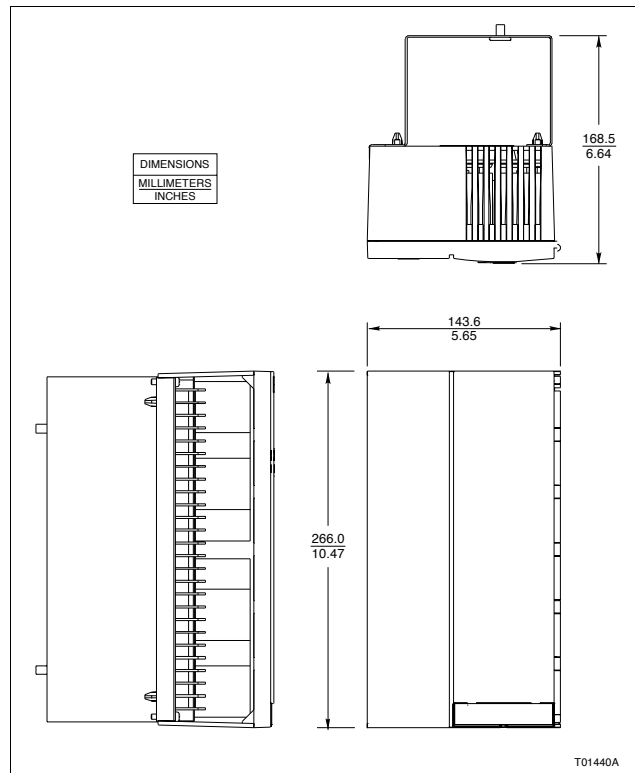


Figure A-4. Auxiliary Block



Purpose/Scope

Variable

This procedure gives steps that should be performed in preparation for I/O and auxiliary blocks installation.

- Prerequisites
- Block mounting hardware installed.
 - Block power connected.
 - Hnet components installed and connected.

Parts None.

- Tools
- Block Power and Mounting Hardware instruction.
 - Harmony Communications Network (Hnet) instruction.

Procedure

For each Harmony I/O system enclosure, perform the following steps:

- ☐ 1. Verify the enclosure is prepared and ready for I/O and auxiliary blocks installation.
 - Cooling fan assembly, column mounting bars, and block mounting columns installed in the enclosure.
 - 24 VDC BLP and IFP power connected from the power system to each block mounting column.
 - Hnet connected from the controller to a mounting column (primary enclosure only).
 - Hnet properly connected between the block mounting columns.
 - Hnet terminators properly installed or connected.
 - Repeater mounting units with Hnet repeaters installed and properly connected if required.

Refer to the **Block Power and Mounting Hardware** and **Harmony Communications Network (Hnet)** instructions if any of



the previously listed items have not been completed before beginning any I/O and auxiliary blocks installation.

- ☐ 2. Verify the internal enclosure locations for I/O and auxiliary blocks to be installed. Refer to ***I/O and Auxiliary Block Considerations*** in this section.
- ☐ 3. Fill out the appropriate I/O block worksheets as necessary. Information recorded on these worksheets is needed in the installation procedures that follow.

NOTE: The worksheets are only intended to aid in the installation process. In some cases, the information recorded on the worksheets may already be available or provided in some other form. In these cases, filling out the worksheets is not necessary.

Table **PR1-1** provides a listing of worksheets. The worksheets are located towards the back of the instruction in the WS sections. Refer to ***I/O Block Worksheets*** in this section for more information.

Table PR1-1. Worksheets

I/O Block	Worksheet	I/O Block	Worksheet
AIN-120	WS1	CIO-100	WS6
AIN-200	WS2	DIO-400	WS7
AIN-220	WS3	DOT-100	WS8
AIN-300	WS4	DOT-120	WS9
AOT-150	WS5		

NOTE: Make copies of worksheets and maintain the originals in this instruction.

I/O and Auxiliary Block Considerations

Keep the following considerations in mind when locating I/O and auxiliary blocks:

1. An enclosure can contain more than one repeater mounting unit. The units are typically located on the first column.
2. Position an auxiliary block directly above or below its I/O block.
3. Install blank blocks in any empty slots to maintain air flow through a block column. Blank blocks are not needed, however, to fill positions at the bottom of a column.

4. When installing any nonredundant I/O blocks or auxiliary blocks on a redundant column, locate the blocks at the bottom of the column so that air flow through the redundant I/O modules of blocks is not disrupted in midstream.

I/O Block Worksheets

The number of input and output signals a single Harmony I/O system will interface can be substantial. Worksheets for each I/O block type are provided in this instruction to record block related information to facilitate setup and installation (Table **PR1-1**). Table **PR1-2** describes the information recorded in these worksheets and where it is used.

Table PR1-2. Worksheet Information

Information	Description	Where Used
Location	Physical location including block column and row.	I/O block installation.
Device label	32-character label assigned to the I/O block.	I/O block installation and controller configuration.
Field power option selected for the I/O block	IFP or LFP	I/O block wiring and setup (i.e., jumper settings).
Field power option selected per channel	IFP/LFP or RFP	I/O block wiring and setup.
Channel label	Optional 32-character label assigned to each I/O channel.	Controller configuration.
Input and output type	1 to 5 VDC, 4 to 20 mA, 10 Ω copper RTD, etc.	I/O block wiring and setup.





Purpose/Scope

5 min.

This procedure gives the steps required to install a termination base for an I/O block. The procedure is the same whether installing a nonredundant or redundant base. A redundant base, however, requires a redundant mounting column.

Parts None.

Tools • Phillips screwdriver.

Procedure

- ☐ 1. Verify the block location. I/O blocks can be located anywhere within an enclosure in any available, empty mounting position.
- ☐ 2. Position the base on the mounting column. Insert the tabs at the back, left side of the base into the slots in the column as shown in Figure [PR2-1](#). Tilt the base slightly to properly insert the tabs. The base is properly positioned when the posts on the back of the base line up with the alignment holes in the column. The mounting column connectors should protrude through the base.
- ☐ 3. Tighten the two captive screws to attach the base to the column. A redundant base has four captive screws.
- ☐ 4. Verify the back of the base is flush with the mounting column.

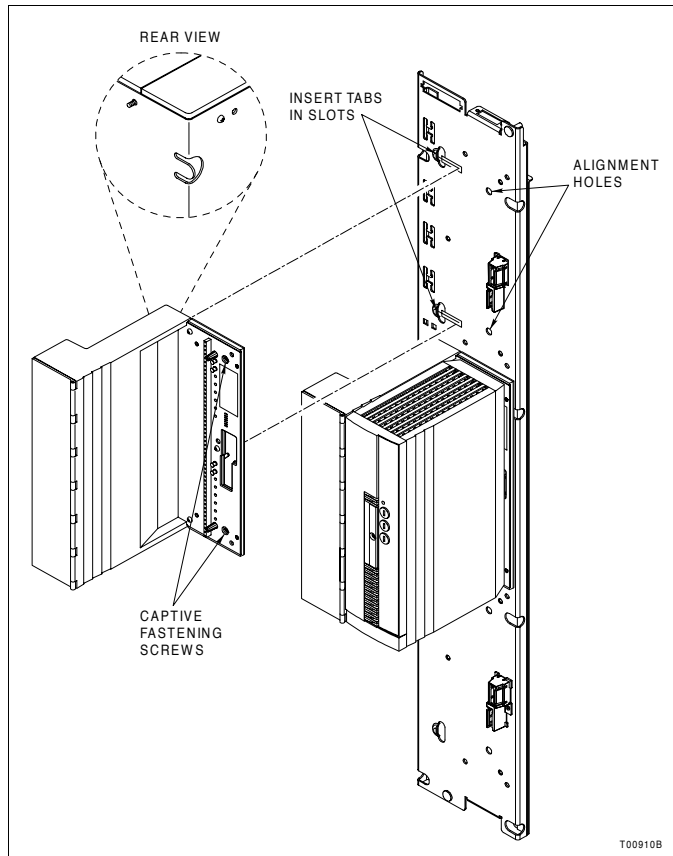


Figure PR2-1. Base Attachment



Purpose/Scope

1 min.

This procedure gives the steps required to install an I/O module. The installation procedure is the same for all I/O modules. Also, the procedure is the same whether installing modules on redundant or nonredundant bases.

NOTE: Always follow the instructions given in *Special Handling* in Section 5 when handling an I/O module.

Parts None.

Tools • Flat-blade or Phillips screwdriver.

Safety Considerations

WARNING

1. An I/O module should not be inserted or removed with power applied when located in a class I, division 2 hazardous location unless the area is known to be nonhazardous.

Procedure

- ☐ 1. Verify the block location. I/O modules are keyed to compatible bases to prevent a mismatch.
- ☐ 2. Grasp the retractable handle when inserting the I/O module. Insure the handle is extended completely so that the fastening screw does not stick out from the back of the module (Fig. PR3-1).
- ☐  3. Position the I/O module on the base. The I/O module is properly positioned when the posts protruding from the base line up with the alignment holes on the back of the I/O module.

NOTE: Do not use the fastening screw to align the I/O module.

- ☐ 4. Gently push the module in until the front of the base and the front of the I/O module are flush. This should not require



much pressure. If the I/O module cannot be pushed in flush with the base, then either it is not properly aligned or it is not compatible with the particular base.

- ☐ 5. Tighten the captive front panel fastening screw. The fastening screw actually threads into the mounting column and not into the base. Do not overtighten.

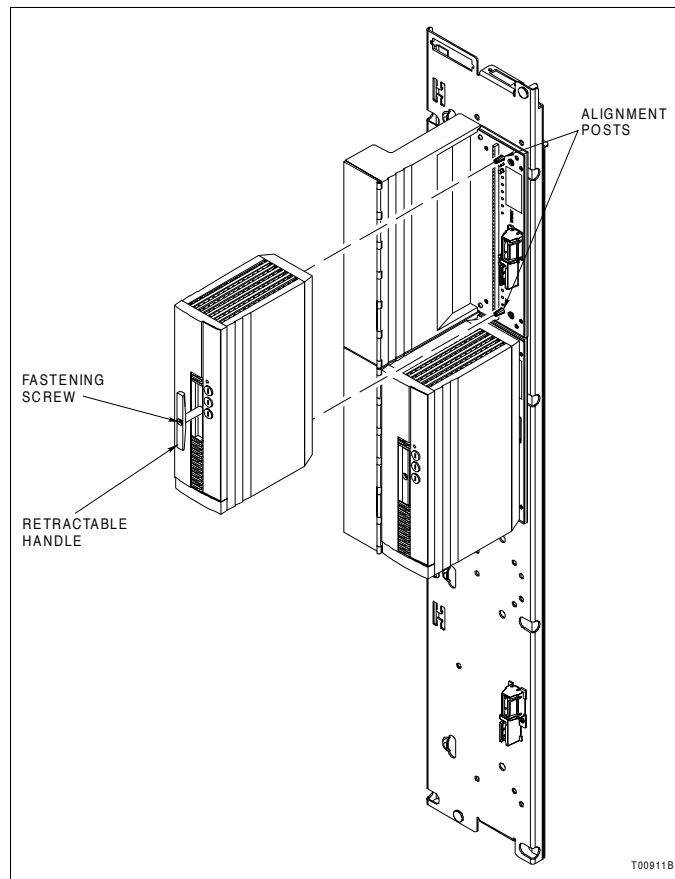


Figure PR3-1. I/O Module Attachment

Auxiliary Block Installation



PR4

Purpose/Scope

10 min.

This procedure gives the steps required to install an auxiliary block. The installation procedure is the same for all auxiliary blocks.

Parts

Number	Qty	Description
200021A040S080	3	M4 × 8-mm screw

Tools

- Phillips screwdriver.

Procedure

- ☐ 1. Separate the auxiliary block housing from its mounting bracket if required. Open the front panel door and loosen the four captive screws that attach the housing to the bracket (Fig. [PR4-1](#)).
- ☐ 2. Verify the block location. An auxiliary block can be located directly above or below its associated I/O block.
- ☐ 3. Install the auxiliary housing bracket.
 - a. Position the bracket on the column by aligning the posts on the back of the bracket with the alignment holes in the column. The backplane connectors should protrude through the back of the bracket when positioned properly.
 - b. Attach the bracket to the column using three M4 screws.
- ☐ 4. Attach the auxiliary housing.
 - a. Position the housing on the bracket by aligning the posts on the back of the housing with the alignment holes in the bracket.
 - b. Open the door and tighten the four captive screws to fasten the housing to the bracket.

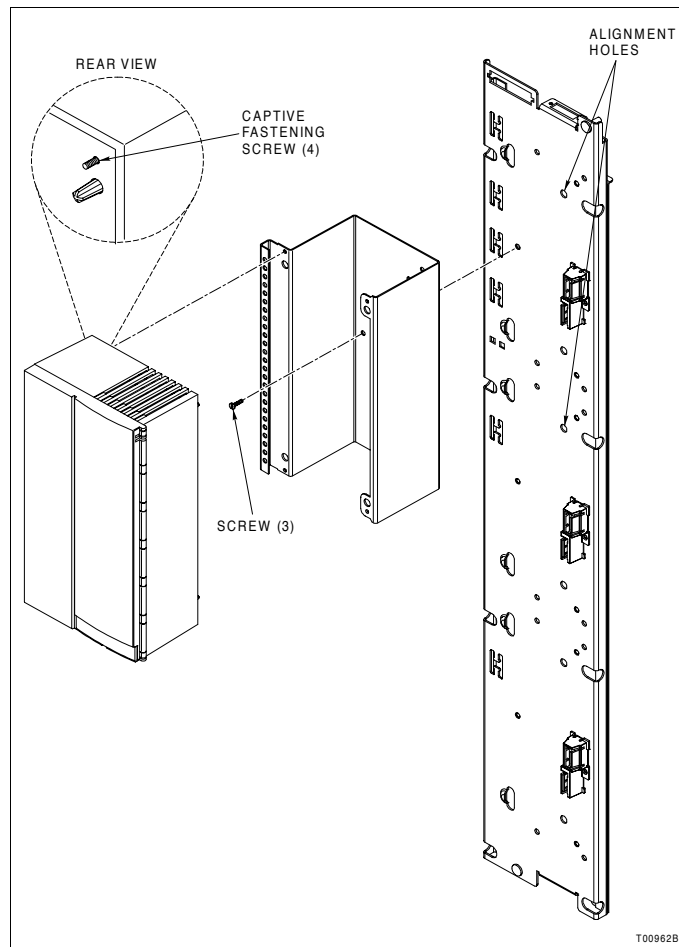


Figure PR4-1. Auxiliary Block Installation



Purpose/Scope

5 min.

This procedure gives the steps required to install a blank block (BLK-100) to fill empty block positions. Any empty positions within a column of blocks must be filled to maintain airflow. Blank blocks are not required, however, in empty positions at the bottom of a column.

The procedure is the same whether installing a nonredundant or redundant blank block. A redundant blank block, however, requires a redundant mounting column.

Parts None.

Tools • Flat-blade or Phillips screwdriver.

Procedure

- ☐ 1. Install the block base.
 - a. Position the base on the mounting column. Insert the tabs at the back, left side of the base into the slots in the column as shown in Figure PR5-1. The base is properly positioned when the posts on the back of the base line up with the alignment holes in the column. The mounting column connectors should protrude through the base.
 - b. Tighten the two captive screws to attach the base to the column. A redundant base has four captive screws.
 - c. Verify the back of the base is flush with the mounting column.
- ☐ 2. Install the blank module.
 - a. Grasp the retractable handle when inserting the blank module. Insure the handle is extended completely so that the fastening screw does not stick out from the back of the module (Fig. PR5-2).
 - b. Position the blank module on the base. The module is properly positioned when the posts protruding from the

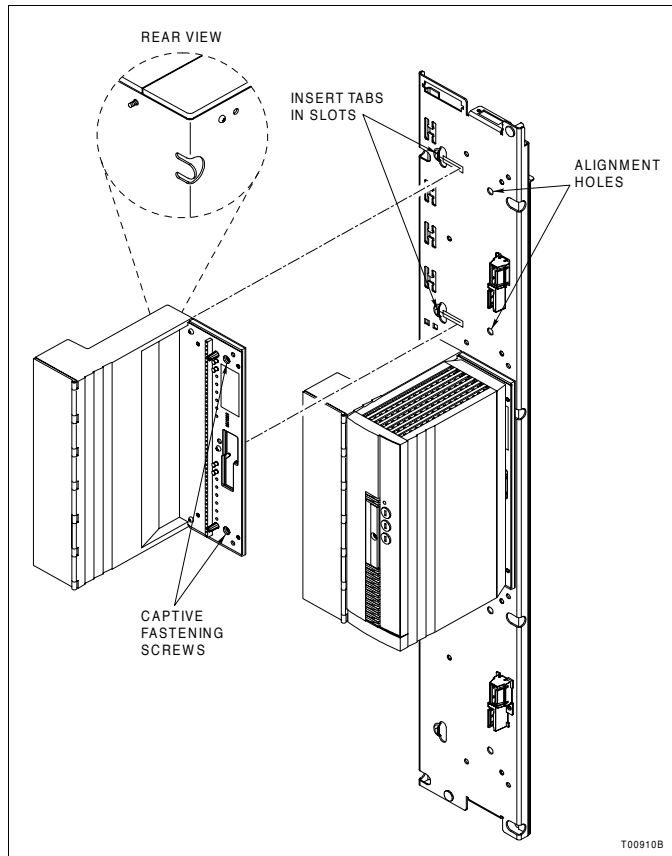


Figure PR5-1. Base Attachment

base line up with the alignment holes on the back of the module.

NOTE: Do not use the fastening screw to align the blank module.

c. Gently push the module in until the front of the base and the front of the module are flush. This should not require much pressure. If the module cannot be pushed in flush with the base, then it is not properly aligned.

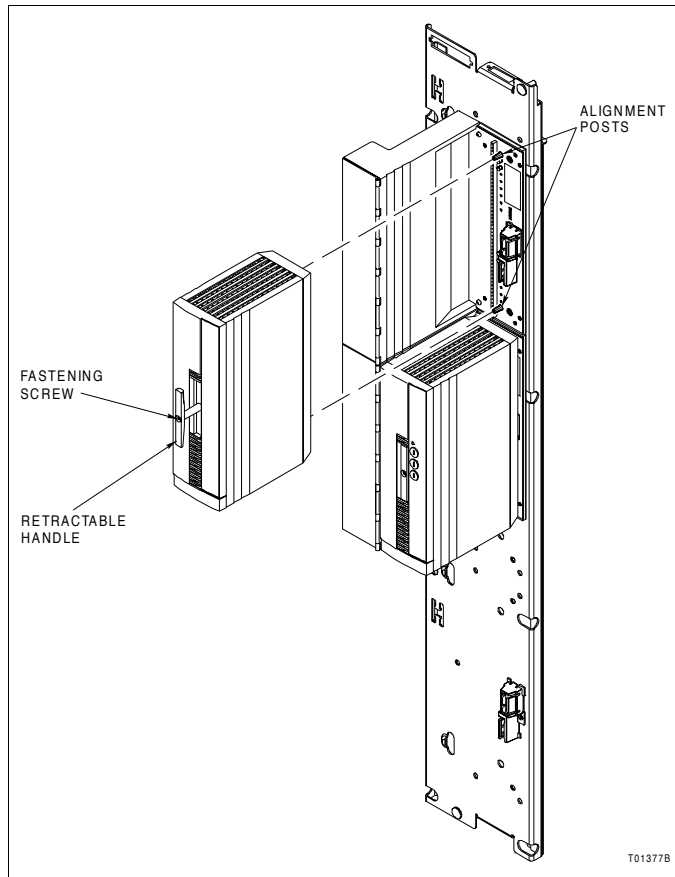


Figure PR5-2. Blank Module Attachment

- d. Tighten the captive front panel fastening screw. The fastening screw actually threads into the mounting column and not into the base. Do not overtighten.
- e. For a redundant block, repeat steps a through d for the second blank module.



AIN-120 Setup



PR6

Purpose/Scope

15 min.

This procedure gives the steps required to set up the AIN-120 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

Prerequisites • Completed worksheet **WS1**.

Parts None.

Tools • Small-tipped, flat-blade screwdriver.
• Needlenose pliers (optional).

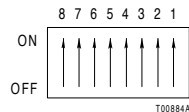
Safety Considerations

CAUTION

1. For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops.

Procedure

- ☐ 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- ☐ 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- ☐ 3. Set the field power select jumpers J1 and J2 located on the back of the I/O module (Table **PR6-1**).



Table PR6-1. Field Power Select Jumpers (Module)

Field Power	J1	J2	Description
IFP ¹	1 2 3	1 2 3	Field power from mounting column bus
LFP	1 2 3	1 2 3	Field power from LFP terminals on base

NOTE:

1. Use this setting if all channels are RFP powered.



4. Set the analog input field power select jumpers J17 and J18 located on the AIN-120 base (Table PR6-2). These jumpers affect channels configured as IFP or LFP powered 4 to 20 milli-ampere inputs. Refer to Figure PR6-1 for jumper locations.

Table PR6-2. Analog Input Field Power Select Jumpers (Base)

Field Power	J17	J18	Description
Fused AI IFP/LFP ¹	1 2 3	1 2 3	Routes IFP/LFP field power through the fuse in the I/O module.
Unfused AI LFP ^{2,3}	1 2 3	1 2 3	Routes LFP power directly to the base terminals.

NOTES:

1. This option can be selected to provide fused IFP or LFP power to the analog input channels; however, removing the I/O module from the base in a nonredundant application will result in a loss of power to all input current loops.
 2. Use this setting if current loop power must be maintained when the I/O module is removed from the base in nonredundant applications.
 3. Use this setting if analog inputs are RFP powered. Use this option if stations are connected.

Figure PR6-2 shows the field power connections made with jumpers J17 and J18.

- ☐
5. Set the input channel jumpers located on the AIN-120 base (Table PR6-3). Refer to Figure PR6-1 for jumper locations.

Table PR6-3. Input Channel Jumpers

Input	Field Power	n ¹ -J1	n ¹ -J2
4 to 20 mA	IFP/LFP	3 2 1	3 2 1
	RFP	3 2 1	3 2 1
Differential high level voltage	RFP	3 2 1	3 2 1

Table PR6-3. Input Channel Jumpers *(continued)*

Input	Field Power	n ¹ -J1	n ¹ -J2
Single-ended high level voltage	RFP	3 2 1	3 2 1

NOTE:

1. n corresponds to the channel number from 1 to 16. For example, 1-J1 and 1-J2 configure channel one.

- ☐ 6. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.
- ☐ 7. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 8. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

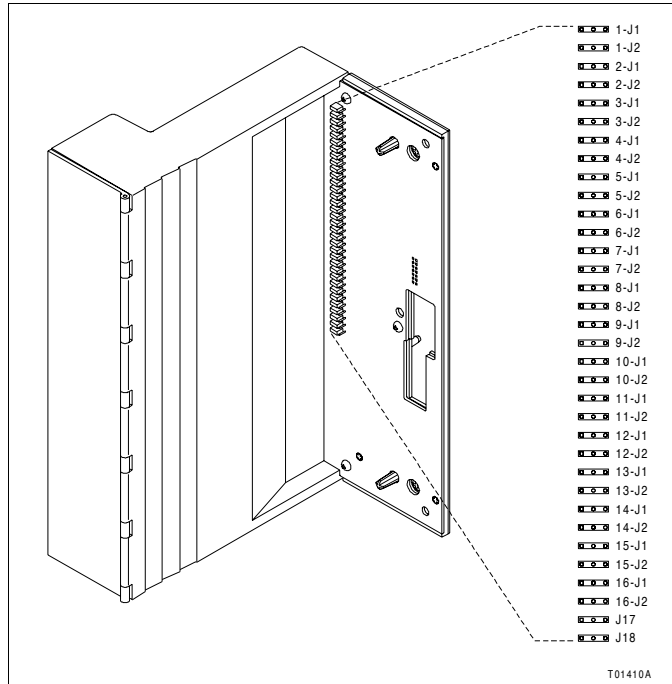


Figure PR6-1. User-Configurable Jumpers - Base

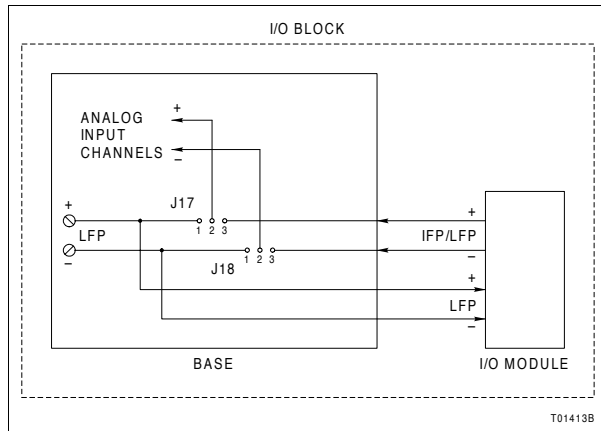


Figure PR6-2. Analog Input Field Power Selection (J17/J18)

Field Device Connection

Figure PR6-4 shows the circuit connections made after attaching field wiring and setting jumpers.

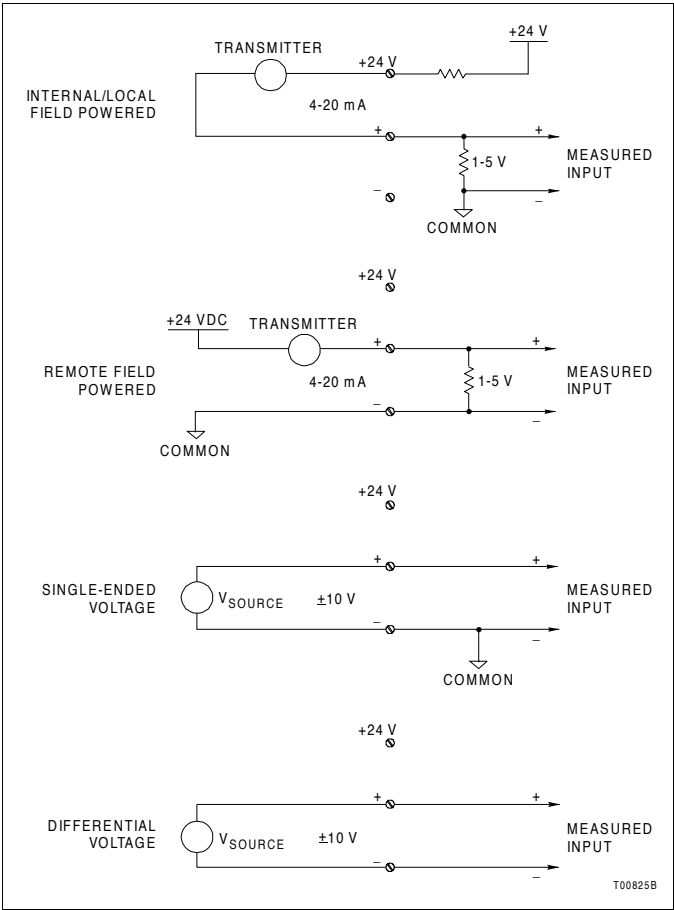


Table PR6-4. Analog Input (Simplified)



Purpose/Scope

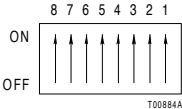
10 min.

This procedure gives the steps required to set up the AIN-200 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

- Prerequisites
- Completed worksheet **WS2**.
- Parts
- None.
- Tools
- Small-tipped, flat-blade screwdriver.
 - Needlenose pliers (optional).

Procedure

- 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- 3. Verify the field power select jumpers J1 and J2 located on the back of the I/O module are set as shown in Table **PR7-1**.

Table PR7-1. Field Power Select Jumpers

Field Power	J1	J2	Description
IFP	1 2 3	1 2 3	Field power from mounting column bus

- 4. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.
- 5. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.



- 6. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

Field Device Connection

Figure PR7-1 shows the circuit connections made after attaching field wiring.

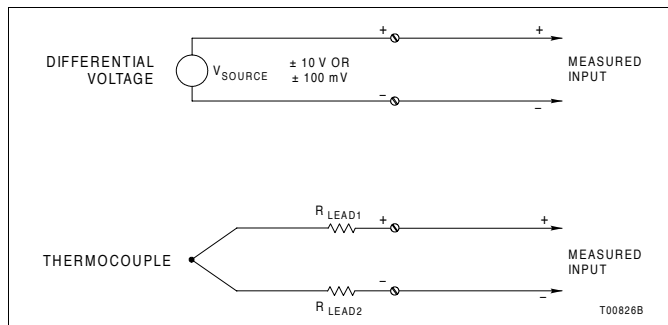


Figure PR7-1. Analog Input (Simplified)



Purpose/Scope

15 min.

This procedure gives the steps required to set up the AIN-220 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

- Prerequisites
- Completed worksheet **WS3**.
- Parts
- None.
- Tools
- Small-tipped, flat-blade screwdriver.
 - Needlenose pliers (optional).

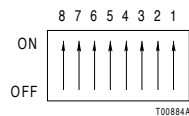
Safety Considerations

CAUTION

1. For analog input channels, if the fused AI IFP/LFP option is selected to power a 4 to 20 milliampere input, removing the I/O module from the base in nonredundant applications will result in a loss of power to all input current loops.

Procedure

- 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- 3. Set the field power select jumpers J1 and J2 located on the back of the I/O module (Table **PR8-1**).



Table PR8-1. Field Power Select Jumpers (Module)

Field Power	J1	J2	Description
IFP ¹	1 2 3	1 2 3	Field power from mounting column bus
LFP	1 2 3	1 2 3	Field power from LFP terminals on base

NOTE:

1. Use this setting if all channels are RFP powered.



4. Set the analog input field power select jumpers J17 and J18 located on the AIN-220 base (Table PR8-2). These jumpers affect channels configured as IFP or LFP powered 4 to 20 milli-ampere inputs. Refer to Figure PR8-1 for jumper locations.

Table PR8-2. Analog Input Field Power Select Jumpers (Base)

Field Power	J17	J18	Description
Fused AI IFP/LFP ¹	1 2 3	1 2 3	Routes IFP/LFP field power through the fuse in the I/O module.
Unfused AI LFP ^{2,3}	1 2 3	1 2 3	Routes LFP power directly to the base terminals.

NOTES:

1. This option can be selected to provide fused IFP or LFP power to the analog input channels; however, removing the I/O module from the base in a nonredundant application will result in a loss of power to all input current loops.
 2. Use this setting if current loop power must be maintained when the I/O module is removed from the base in nonredundant applications.
 3. Use this setting if analog inputs are RFP powered. Use this option if stations are connected.

Figure PR8-2 shows the field power connections made with jumpers J17 and J18.

- ☐
5. Set the input channel jumpers located on the AIN-220 base (Table PR8-3). Refer to Figure PR8-1 for jumper locations.

Table PR8-3. Input Channel Jumpers

Input	Field Power	n ¹ -J1	n ¹ -J2
4 to 20 mA	IFP/LFP	3 2 1	3 2 1
	RFP	3 2 1	3 2 1
Differential high level voltage	RFP	3 2 1	3 2 1

Table PR8-3. Input Channel Jumpers *(continued)*

Input	Field Power	n ¹ -J1	n ¹ -J2
Single-ended high level voltage	RFP	3 2 1	3 2 1
Thermocouple	RFP	3 2 1	3 2 1

NOTE:

1. n corresponds to the channel number from 1 to 16. For example, 1-J1 and 1-J2 configure channel one.

- ☐ 6. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.
- ☐ 7. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 8. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

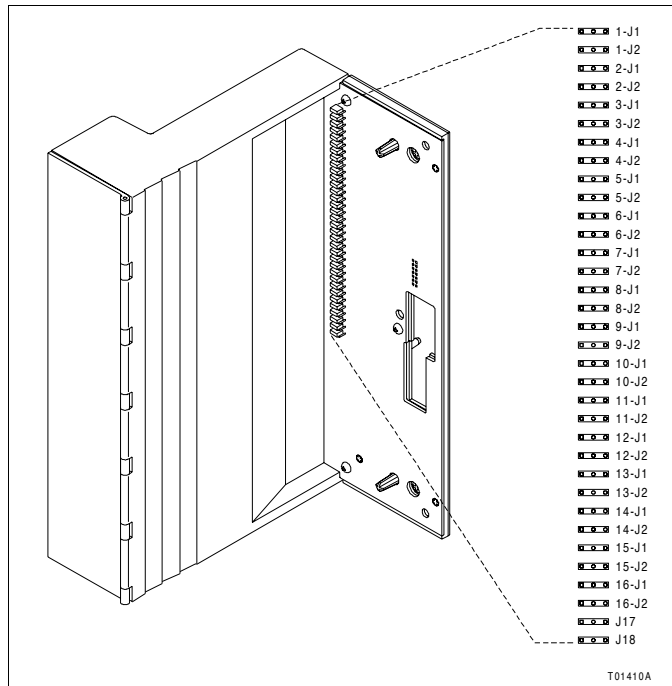


Figure PR8-1. User-Configurable Jumpers - Base

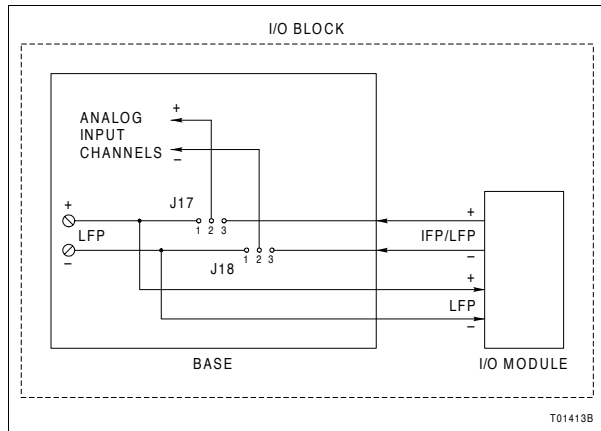


Figure PR8-2. Analog Input Field Power Selection (J17/J18)

Field Device Connection

Figure **PR8-3** shows the circuit connections made after attaching field wiring and setting jumpers.

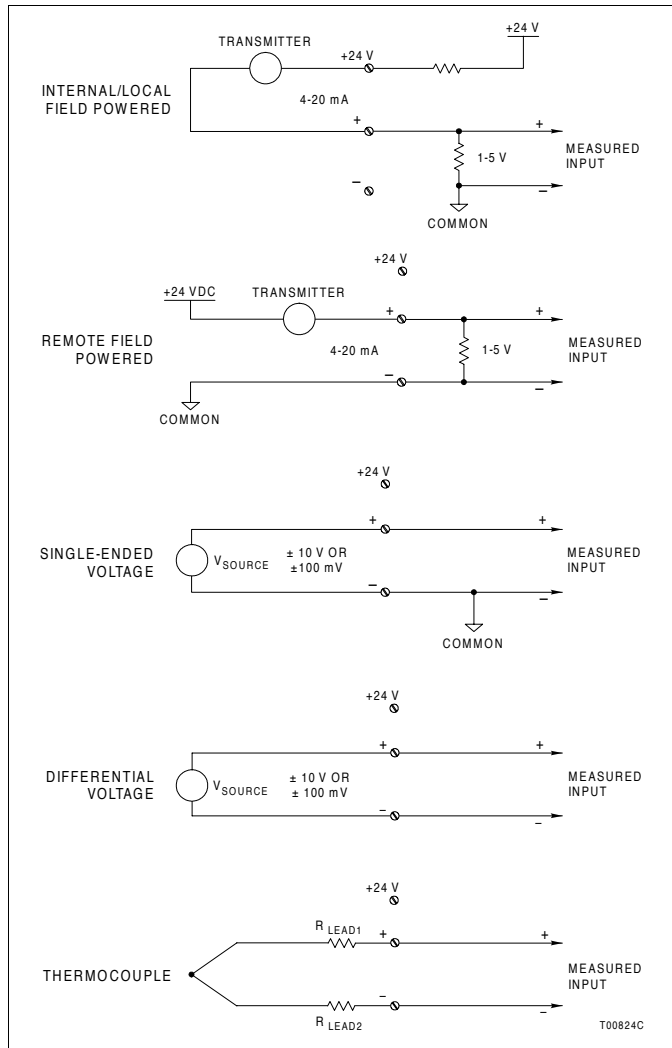


Figure PR8-3. Analog Input (Simplified)



Purpose/Scope

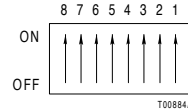
5 min.

This procedure gives the steps required to set up the AIN-300 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

- Prerequisites**
- Completed worksheet **WS4**.
- Parts** None.
- Tools**
- Small-tipped, flat-blade screwdriver.
 - Needlenose pliers (optional).

Procedure

- Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- Verify the field power select jumpers J1 and J2 located on the back of the I/O module are set as shown in Table **PR9-1**.

Table PR9-1. Field Power Select Jumpers

Field Power	J1	J2	Description
IFP	1 2 3	1 2 3	Field power from mounting column bus

- Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.
- Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.



- 6. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

Field Device Connection

Figure PR9-1 shows the circuit connections made after attaching field wiring.

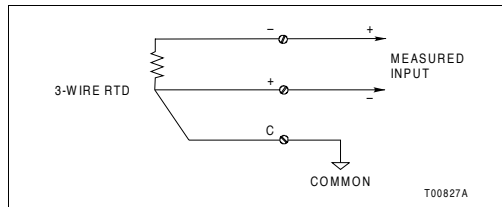


Figure PR9-1. Analog Input (Simplified)



Purpose/Scope

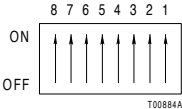
5 min.

This procedure gives the steps required to set up the AOT-150 block for proper operation. This includes setting jumpers and switches, and checking for fuses.

- Prerequisites
- Completed worksheet **WS5**.
- Parts
- None.
- Tools
- Small-tipped, flat-blade screwdriver.
 - Needlenose pliers (optional).

Procedure

- 1. Set the special operations switch SW2 located on the back of the I/O module to normal operation.



- 2. Determine the block field power and I/O channel requirements. Refer to the appropriate worksheet or any other system documentation available.
- 3. Set the field power select jumpers J1 and J2 located on the back of the I/O module as appropriate (Table **PR10-1**).

Table PR10-1. Field Power Select Jumpers

Field Power	J1	J2	Description
IFP	1 2 3	1 2 3	Field power from mounting column bus
LFP	1 2 3	1 2 3	Field power from LFP terminals on base

- 4. Verify 1.6 A, 250 V fuses are present in both the A and B channel block power fuse holders on the I/O module.



- ☐ 5. Verify a 3.15 A, 250 V fuse is present in the field power fuse holder.
- ☐ 6. If installing redundant I/O modules, insure the settings for both I/O modules are the same.

Field Device Connection

Figure PR10-1 shows the circuit connections made after attaching field wiring.

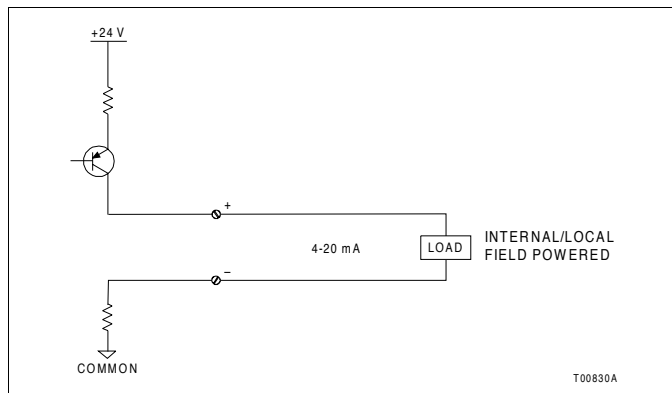


Figure PR10-1. Analog Output (Simplified)



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