GE Fanuc Automation

Programmable Control Products

PACSystems RX3i
System Manual

GFK-2314 *June 2004*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CIMSTAR	Modelmaster	PowerTRAC	VersaPoint
Field Control	Motion Mate	Series 90	VersaPro
GEnet	PACSystems	Series Five	VuMaster
	Proficy	Series One	Workmaster

Chapter 1 Introduction

This chapter is an overview of PACSystems™ RX3i products and features. The rest of the manual describes PACSystems RX3i products in detail, and explains installation procedures.

Chapter 2, Installation explains how to set up and install RX3i equipment.

Chapter 3, Backplanes describes RX3i Universal and Serial Expansion Backplanes.

Chapter 4, Power Supplies describes RX3i Power Supplies for use in Universal and Serial Expansion Backplanes.

Chapter 5, Serial Bus Transmitter Module and Expansion Cables describes the module and cables used to connect a Universal Backplane with Expansion or Remote Backplanes.

Chapters 6 to 12 provide detailed descriptions, specifications, and wiring diagrams for modules that can be used in RX3i systems:

Chapter 6, Discrete Input Modules
Chapter 7, Discrete Output Modules
Chapter 8, Discrete Mixed Modules
Chapter 9, Analog Input Modules
Chapter 10, Analog Output Modules
Chapter 11, Analog Mixed Modules
Chapter 12, Special-Purpose Modules

Additional information is provided in these appendixes:

Appendix A, Product Certifications and Installation Guidelines for Conformance
Appendix B, I/O Cables for 32-Point Modules
Appendix C, Calculating Heat Dissipation
Appendix D, Cable Shield Clamping Assembly

For more information about RX3i products, please refer to the manuals listed below.

GFK-2222B	PACSystems CPU Reference Manual
GFK-2224A	TCP/IP Ethernet Communications for PACSystems
GFK-2225A	PACSystems Station Manager User's Manual

PACSystems RX3i

The PACSystems™ RX3i controller is a member of the PACSystems family of programmable automation controllers (PACs). Like the rest of the PACSystems family, the RX3i features a single control engine and universal programming environment to provide application portability across multiple hardware platforms.

PACSystems RX3i Features

- High-speed processor and patented technology for faster throughput
- A Universal backplane that supports 2 different backplane busses per module slot:
    - High-speed, PCI-based for fast throughput of new advanced I/O
    - Serial backplane for RX3i serial modules and easy migration of Series 90-30 I/O
- Celeron (Pentium® III) 300 MHz CPU for advanced programming and performance with 10 Megabytes of memory
- Memory for ladder logic documentation and machine documentation in the controller to reduce downtime and improve troubleshooting.
- Open communications support
- Variety of discrete, analog, and special-purpose modules.
- Hot insertion in both the PCI Backplane and Serial Backplane for both new and migrated I/O modules
- Isolated 24 VDC terminal for I/O modules and a grounding bar that reduces user wiring

Programming and Configuration

PACSystems equipment is configured and programmed using Machine Edition software, Machine Edition features a common user interface across product families and drag-and-drop editing. Machine Edition also includes a built-in Web server for real-time data delivery during system operation. For more information about programming and configuration, see the *PACSystems CPU Reference Manual*, GFK-2222.

Migration from Series 90-30 to PACSystems RX3i

PACSystems RX3i is designed to facilitate migration of Series 90-30 PLC systems and equipment. System migration is discussed in detail in Appendix C of the *PACSystems CPU Reference Manual* GFK-2222, revision B or later.

Modules for RX3i Systems

The tables in this section list modules that can be included in an RX3i system:

- RX3i Modules (IC695)
- RX3i Modules (IC694)
- Series 90-30 Modules (IC693)

RX3i Modules (IC695)

These modules must be installed in a Universal (IC695) Backplane.

Description	***Catalog Number***
CPU, Ethernet, Expansion	
RX3i CPU, 300 MHz, 10 Megabytes of Memory	IC695CPU310
RX3i Serial Bus Transmitter Module	IC695LRE001
RX3i Ethernet Module	IC695ETM001
RX3i Power Supply, 120/240 VAC, 125VDC 40 Watts	IC695PSA040
RX3i Power Supply, 24 VDC, 40 Watts	IC695PSD040

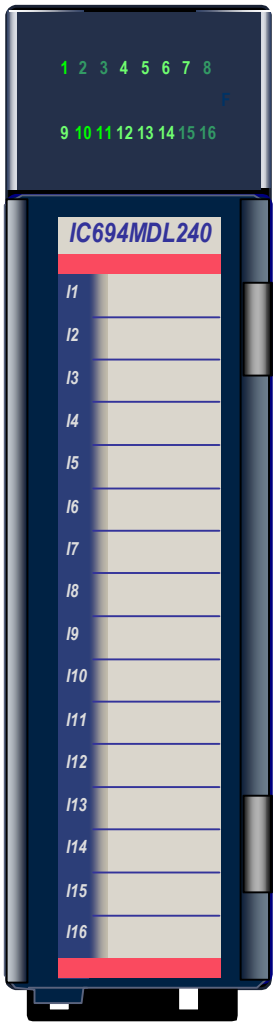
RX3i Modules (IC694)

IC694 modules are compatible with the RX3i serial bus in Universal Backplanes and RX3i Serial Expansion Backplanes. A wide range of discrete, analog, and special-purpose IC694 modules is available. A typical RX3i I/O module is shown at below.

Most I/O modules feature point LEDs, a removable terminal strip assembly, and a fully-hinged door with an insertable label. The module's wiring diagram is printed on the back of the label. Field wiring can be secured at the bottom of the module using tie-downs.

Some I/O modules have an additional fault LED. Some high-density modules have connectors on the front instead of removable terminals.

Descriptions and specifications for all RX3i modules are included in this manual.



Description	Catalog Number
Discrete Input Modules	
RX3i Input Simulator Module	IC694ACC300
RX3i Input 120 VAC 8 Point Isolated	IC694MDL230
RX3i Input 240 VAC 8 Point Isolated	IC694MDL231
RX3i Input 120 VAC16 Point	IC694MDL240
RX3i Input 24 VAC 16 Point	IC694MDL241
RX3i Input 125 VDC 8 Point Pos/Neg Logic	IC694MDL632
RX3i Input 24 VDC 8 Point Pos/Neg Logic	IC694MDL634
RX3i Input 24 VDC16 Point Pos/Neg Logic	IC694MDL645
RX3i Input 24 VDC16 Point Pos/Neg Fast	IC694MDL646
RX3i Input 5/12 VDC (TTL) 32 Point Pos/Neg	IC694MDL654
RX3i Input 24 VDC 32 Point Pos/Neg	IC694MDL655

continued

RX3i Modules (IC694)

continued

Description	*Catalog Number*
Discrete Output Modules	
RX3i Output 120 VAC 0.5 A 12 Point	IC694MDL310
RX3i Output 120/240 VAC 2 A 8 Point	IC694MDL330
RX3i Output 120 VAC 0.5 A 16 Point	IC694MDL340
RX3i Output 120/240 VAC 2 A 5 Point Isolated	IC694MDL390
RX3i Output 12/24 VDC 0.5 A 8 Point Positive Logic	IC694MDL732
RX3i Output 125 VDC 1 A 6 Point Isolated Pos/Neg	IC694MDL734
RX3i Output 12/24 VDC 0.5 A 16 Point Positive Logic	IC694MDL740
RX3i Output 12/24 VDC 0.5 A 16 Point Negative Logic	IC694MDL741
RX3i Output 12/24 VDC 1 A 16 Point Positive Logic ESCP	IC694MDL742
RX3i Output 5/24 VDC (TTL) 0.5 A 32 Point Negative Logic	IC694MDL752
RX3i Output 12/24 VDC 0.5 A 32 Point Positive Logic	IC694MDL753
RX3i Output Relay N.O. 4 A 8 Point Isolated	IC694MDL930
RX3i Output Relay N.C. and Form C 3 A 8 Point Isolated	IC694MDL931
RX3i Output Relay N.O. 2 A 16 Point	IC694MDL940
Discrete Mixed Modules	
RX3i High Speed Counter Module GFK-0293	IC694APU300
Analog Input Modules	
RX3i Input Analog 4pt Voltage	IC694ALG220
RX3i Input Analog 4pt Current	IC694ALG221
RX3i Input Analog 16sgl/8diff Voltage	IC694ALG222
RX3i Input Analog 16sgl Current	IC694ALG223
Analog Output Modules	
RX3i Output Analog 2pt Voltage	IC694ALG390
RX3i Output Analog 2pt Current	IC694ALG391
RX3i Output Analog Current/Voltage 8pt	IC694ALG392
Analog Mixed I/O Modules	
RX3i Analog Combination Current/Voltage 4in/2out	IC694ALG442
Special Purpose Modules	
RX3i DSM314 Motion Controller GFK-1742	IC694DSM314

Series 90-30 (IC693) Modules for RX3i Systems

The following 90-30 modules are compatible with the RX3i serial bus in Universal Backplanes and RX3i Serial Expansion Backplanes and 90-30 Expansion Backplanes.

Description	Catalog Number	Minimum Revision Supported	CE Mark Approved
Discrete Input Modules			
Series 90-30 Input Simulator Module	IC693ACC300	A	D
Series 90-30 Input 120 VAC 8 Point Isolated	IC693MDL230	A	C
Series 90-30 Input 240 VAC 8 Point Isolated	IC693MDL231	A	E
Series 90-30 Input 120 VAC 16 Point	IC693MDL240	A	E
Series 90-30 Input 24 VAC 16 Point	IC693MDL241	A	D
Series 90-30 Input 125 VDC 8 Point Pos/Neg Logic	IC693MDL632	A	D
Series 90-30 Input 24 VDC 8 Point Pos/Neg Logic	IC693MDL634	A	C
Series 90-30 Input 24 VDC 16 Point Pos/Neg Logic	IC693MDL645	A	D
Series 90-30 Input 24 VDC 16 Point Pos/Neg Fast	IC693MDL646	A	C
Series 90-30 Input 48 VDC 16 Point Pos/Neg Fast	IC693MDL648	A	B
Series 90-30 Input 5/12 VDC (TTL) 32 Point Pos/Neg	IC693MDL654	A	E
Series 90-30 Input 24 VDC 32 Point Pos/Neg	IC693MDL655	A	E
Discrete Output Modules			
Series 90-30 Output 120 VAC 0.5 A 12 Point	IC693MDL310	A	D
Series 90-30 Output 120/240 VAC 2 A 8 Point	IC693MDL330	A	F
Series 90-30 Output 120 VAC 0.5 A 16 Point	IC693MDL340	A	D
Series 90-30 Output 120/240 VAC 2 A 5 Point Isolated	IC693MDL390	A	E
Series 90-30 Output 12/24 VDC 2 A 8 Point Positive Logic	IC693MDL730	A	E
Series 90-30 Output 12/24 VDC 2 A 8 Point Negative Logic	IC693MDL731	A	E
Series 90-30 Output 12/24 VDC 0.5 A 8 Point Positive Logic	IC693MDL732	A	C
Series 90-30 Output 12/24 VDC 0.5 A 8 Point Negative Logic	IC693MDL733	A	C
Series 90-30 Output 125 VDC 1A 6 Point Isolated Pos/Neg	IC693MDL734	A	D
Series 90-30 Output 12/24 VDC 0.5 A 16 Point Positive Logic	IC693MDL740	A	E
Series 90-30 Output 12/24 VDC 0.5 A 16 Point Negative Logic	IC693MDL741	A	E
Series 90-30 Output 12/24 VDC 1 A 16 Point Positive Logic ESCP	IC693MDL742	A	D

continued

Series 90-30 (IC693) Modules for RX3i PACSystems

The following Series 90-30 modules are compatible with the RX3i serial bus in Universal Backplanes and RX3i Serial Expansion Backplanes and 90-30 Expansion Backplanes.

Description	Catalog Number	Minimum Revision Supported	CE Mark Approved
Discrete Output Modules, continued			
Series 90-30 Output 48 VDC 0.5 A 8 Point Positive Logic	IC693MDL748	A	B
Series 90-30 Output 5/24 VDC (TTL) 0.5 A 32 Point Negative Logic	IC693MDL752	A	D
Series 90-30 Output 12/24 VDC 0.5 A 32 Point Positive Logic	IC693MDL753	A	D
Series 90-30 Solenoid Out 11 Pt/24 VDC Out 5 Point Positive Logic	IC693MDL760	A	B
Series 90-30 Output Relay N.O. 4 A 8 Point Isolated	IC693MDL930	A	D
Series 90-30 Output Relay N.C. and Form C 3 A 8 Point Isolated	IC693MDL931	A	D
Series 90-30 Output Relay N.O. 2 A 16 Point	IC693MDL940	A	D
Discrete Mixed Modules			
Series 90-30 High Speed Counter Module GFK-0293	IC694APU300	D	H
Series 90-30 Mixed I/O 8 Point120 VAC In / 8 Point Relay Out	IC693MAR590	A	C
Series 90-30 Mixed I/O 8 Point24 VDC In / 8 Point Relay Out	IC693MDR390	A	C
Analog Input Modules			
Series 90-30 Input Analog 4 Point Voltage	IC693ALG220	A	G and H
Series 90-30 Input Analog 4 Point Current	IC693ALG221	A	G and H
Series 90-30 Input Analog 16 sgl/8 diff Voltage	IC693ALG222	A	C and D
Series 90-30 Input Analog 16 sgl/8 diff Current	IC693ALG223	A	C
Analog Output Modules			
Series 90-30 Output Analog 2 Point Voltage	IC693ALG390	A	F
Series 90-30 Output Analog 2 Point Current	IC693ALG391	A	E
Series 90-30 Output Analog Current/Voltage 8 Point	IC693ALG392	A	B
Analog Mixed I/O Modules			
Series 90-30 Analog Combination Current/Voltage 4 in/2 out	IC693ALG442	B	B
Communication Modules			
Series 90-30 Fanuc I/O Link Module (Slave)	IC693BEM320	B	E
Series 90-30 Fanuc I/O Link Module (Master)	IC693BEM321	C	F
Special Purpose Modules			
Series 90-30 DSM314 Motion Controller	IC693DSM314	AC	AA

Series 90-30 Modules that Cannot Be Used in an RX3i System

The Series 90-30 modules listed below cannot presently be included in a Universal Backplane or in any Expansion or Remote Backplane in an RX3i system.

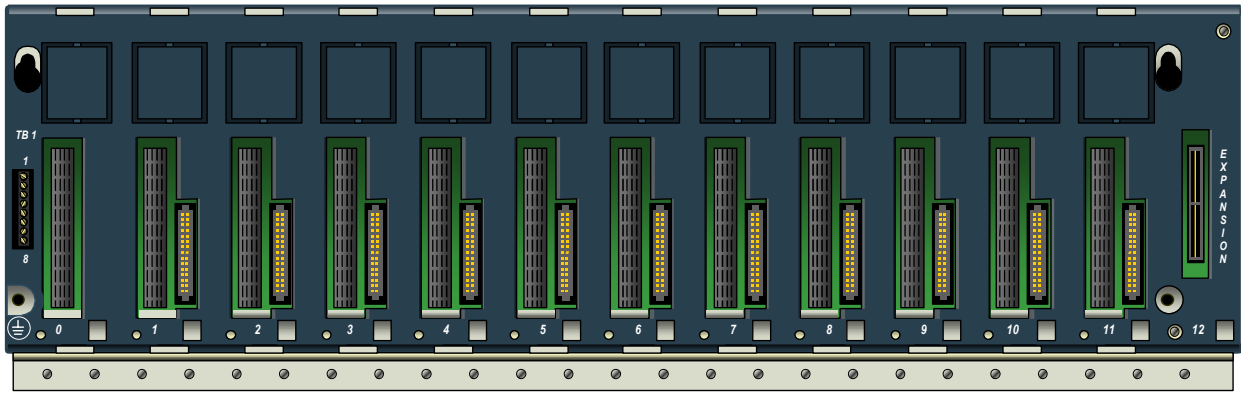
For information about whether another company's Series 90-30-compatible module may be suitable for PACSystems RX3i applications, please contact the manufacturer of the module. That includes Series 90-30 modules that have catalog numbers beginning with HE693.

Description	***Catalog Number***
CIMPLICITY 90-ADS 9030 Module	IC693ADC311
CIMPLICITY 90-ADS 9030 System	IC693ADS301
Axis Position Module (1-Axis)	IC693APU301
Axis Position Module (2-Axis)	IC693APU302
Series 90-30 Special I/O Processor	IC693APU305
Series 90-30 SDS Bus Interface	IC693BEM310
Remote FIP Interface Module	IC693BEM330
Series 90-30 Genius Bus Controller	IC693BEM331
FIP Remote I/O 2.5mhz	IC693BEM332
Remote FIP Interface	IC693BEM333
Genius Bus Controller	IC693BEM334
FIP Remote I/O 2.5mhz	IC693BEM335
Series 90-30 FIP Bus Controller 1M	IC693BEM340
Series 90-30 FIP Bus Controller 2.5M	IC693BEM341
Ethernet Network Interface Unit	IC693BEM350
Cscan Interface Module	IC693CDC200
Genius Communications Module	IC693CMM301
Enhanced Genius Communications Module	IC693CMM302
Alspa N80 Communication Module	IC693CMM304
Alspa Enhanced N80 Comm Module	IC693CMM305
Communication Control Module	IC693CMM311
Ethernet Interface Module 3.10	IC693CMM321
Series 90-30 DeviceNet Master	IC693DNM200
Digital Servo Module (2-Axis)	IC693DSM302
Digital Valve Driver Module	IC693DVM300
Power Mate "J "Interface Module	IC693MCM001
Power Mate "J" Interface 2 Axis	IC693MCM002
PM-J 1-Axis International Only	IC693MCS001
PM-J 2-Axis International Only	IC693MCS001

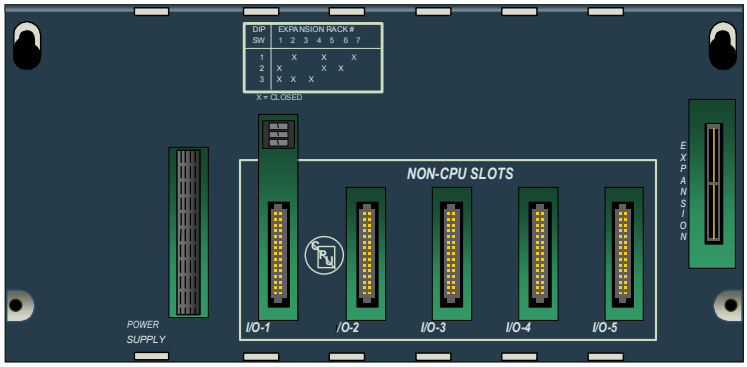
Description	*Catalog Number*
Input 120/240 VAC 8 Point Isolated	IC693MDL232
Input 24 VDC 8 Point Pos Logic	IC693MDL630
Input 24 VDC 8 Point Neg Logic	IC693MDL631
Input 24 VDC 8 Point Neg Logic	IC693MDL633
Input 24 VDC 16 Point Pos Logic	IC693MDL640
Input 24 VDC 16 Point Neg Logic	IC693MDL641
Input 24 VDC 16 Point Pos Logic Fast (1ms)	IC693MDL643
Input 24 VDC 16 Point Neg Logic Fast (1ms)	IC693MDL644
Fanuc Input 24 VDC 32 Point Pos/Neg	IC693MDL652
Fanuc Input 24 VDC 32 Point Pos/Neg Fast	IC693MDL653
Fanuc Output 12/24 VDC 0.3 A 32 Point Neg	IC693MDL750
Fanuc Output 12/24 VDC 0.3 A 32 Point Pos	IC693MDL751
Profibus-DP Master	IC693PBM200
Profibus-DP Slave	IC693PBS201
Programmable Coprocessor W/Epr	IC693PCM30
Programmable Coprocessor Module	IC693PCM300
Programmable Coprocessor Module (64k)	IC693PCM301
Programmable Coprocessor Module (640k)	IC693PCM311
Clamp Pos Module	IC693PMC801
Injection Pos Module	IC693PMI800
Series 90-30 Power Transducer Module	IC693PTM100
Series 90-30 Power Transducer Module	IC693PTM101
Series 90-30 Temperature Controller Module	IC693TCM302
Series 90-30 Temperature Controller, Ext Range	IC693TCM303

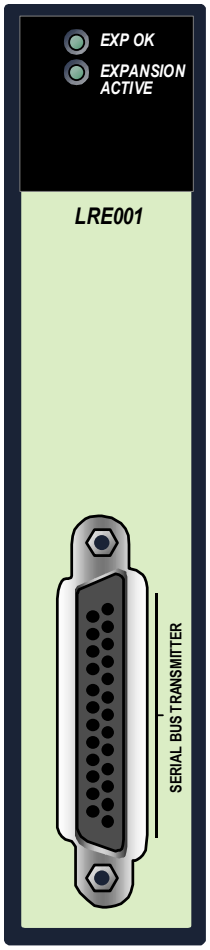
Backplanes and Power Supplies

The RX3i system must include either a 12-slot Universal Backplane IC695CHS012 (shown below) or 16-slot Universal Backplane (IC695CHS016).



If additional modules are required than the Universal Backplane can accommodate, or if some modules must be installed in another location, an RX3i Serial Bus Transmitter Module (IC695LRE001) must be installed in the last slot of the Universal Backplane. A cable from the Bus Transmitter module can link additional Serial Expansion (5-slot version IC694CHS398 is shown below) and Remote backplanes to the RX3i system.





Use of Expansion and Remote Backplanes is summarized on the following pages.

For more information about the Serial Bus Transmitter module and cables, refer to chapter 5.

Backplanes for the RX3i System

Universal and Expansion Backplanes that are compatible with RX3i systems are listed below. See chapter 3 of this manual for descriptions and specifications of the RX3i Backplanes. For information about Series 90-30 Expansion Backplanes, refer to the *Series 90-30 I/O Modules Specifications Manual*, GFK-0898.

Backplanes	
RX3i 16-Slot Universal Backplane	IC695CHS016
RX3i 12-Slot Universal Backplane	IC695CHS012
RX3i 10-Slot Serial Expansion Backplane	IC694CHS392
RX3i 5-Slot Serial Expansion Backplane	IC694CHS398
Series 90-30 10-Slot Expansion Backplane	IC693CHS392
Series 90-30 5-Slot Expansion Backplane	IC693CHS398
Series 90-30 10-Slot Remote Expansion Backplane	IC693CHS393
Series 90-30 5-Slot Remote Expansion Backplane	IC693CHS399

Power Supplies for RX3i Systems

Power Supplies for Universal and Serial Expansion Backplanes are listed below. See chapter 4 of this manual for descriptions and specifications of the RX3i Power Supplies. For information about Series 90-30 Power Supplies, refer to the *Series 90-30 I/O Modules Specifications Manual*, GFK-0898.

Description	***Catalog Number***	***Installed in Universal Backplane***	***Installed in Serial Expansion Backplane***
Power Supplies			
RX3i Power Supply, 120/240 VAC, 125VDC, 40 Watts	IC695PSA040	■	
RX3i Power Supply, 24 VDC, 40 Watts	IC695PSD040	■	
RX3i Serial Expansion Power Supply, 120/240 VAC, 125 VDC	IC694PWR321		■
RX3i Serial Expansion Power Supply, 120/240 VAC, 125 VDC, High Capacity	IC694PWR330		■
RX3i Serial Expansion Power Supply, 24 VDC, High Capacity	IC694PWR331		■
Series 90-30 Power Supply for Expansion Backplane, 120/240 VAC, 125 VDC	IC693PWR321		■
Series 90-30 Power Supply for Expansion Backplane, 120/240 VAC, 125 VDC, High Capacity	IC693PWR330		■
Series 90-30 Power Supply for Expansion Backplane, 24 VDC, High Capacity	IC693PWR331		■

Expansion Systems

The PACSystems R3i can include a combination of up to seven Serial Expansion and/or Remote Backplanes. The Expansion and Remote Backplanes can be any of the RX3i or Series 90-30 models listed earlier.

- If the system includes only Expansion Backplanes, the total distance from the CPU to the last backplane cannot be more than 15 meters (50 feet)
- If the system includes any Remote Backplanes, the total distance from the CPU to the last backplane cannot be more than 213 meters (700 feet).

Remote Backplanes provide the same functionality as Expansion Backplanes over a much greater distance. Remote Backplanes have extra isolation circuitry that lessens the effect of unbalanced ground conditions that can occur when backplanes are located long distances from each other and do not share the same ground system. Communications between the CPU and a Remote Backplane may take slightly longer than communications between the CPU and an Expansion Backplane. This delay is usually small compared to the total CPU scan time.

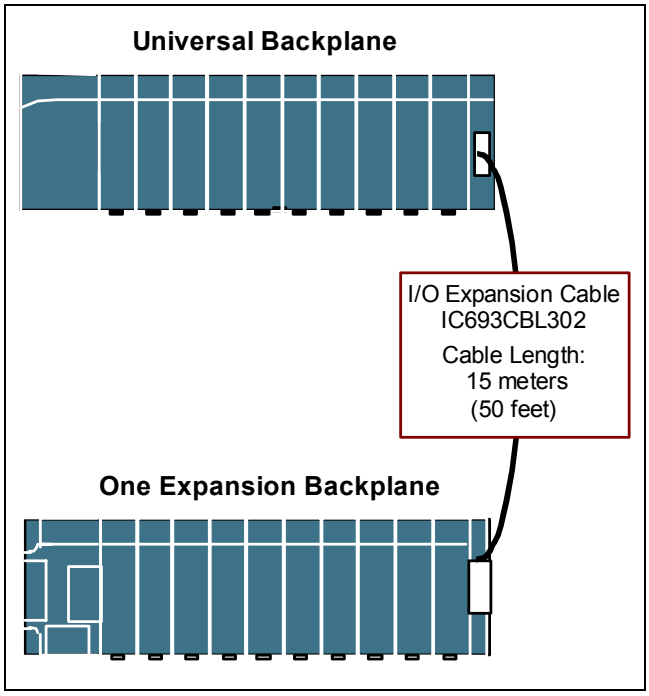
Expansion System with One Expansion or Remote Backplane

An Expansion system can consist of a Universal Backplane with just one Expansion or Remote Backplane

This example includes one Universal Backplane IC695CHS012 and one Expansion Backplane, IC694CHS392. Each Backplane in this example has a DC Power Supply. Together, they accommodate 19 discrete, analog, and special-function modules.

These backplanes are located 15 meters (50 feet) apart. They are connected by Expansion Cable IC693CBL302, which has a built-in terminating resistor.

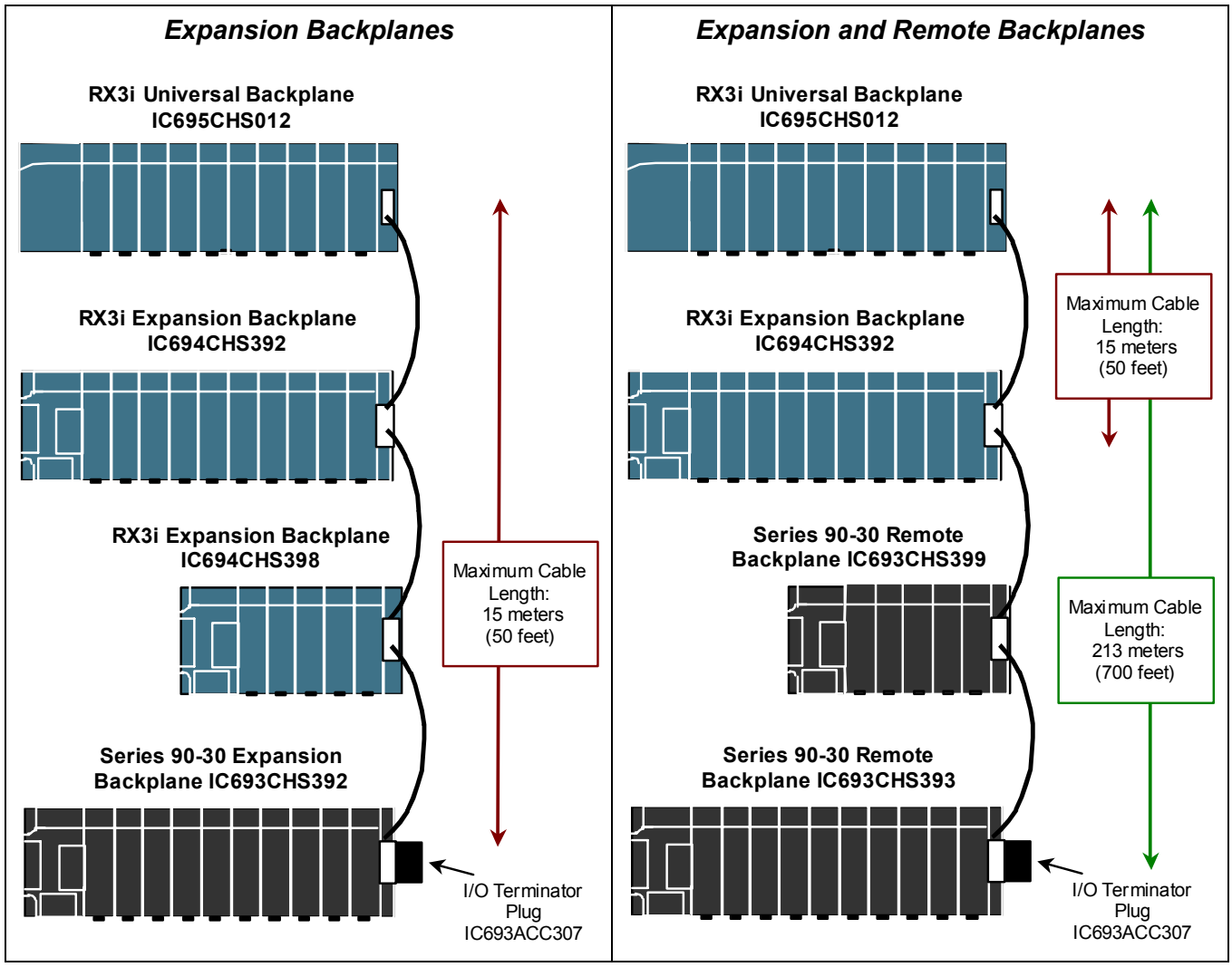
If it were necessary to locate the second backplane more than 15 meters (50 Feet) from the Universal Backplane, a Series 90-30 Remote Backplane could be used with a custom-length cable and external terminating resistor.



Using Multiple Expansion and Remote Backplanes

The next two example systems are similar to each other except for the distance between the backplanes. The example on the left includes two RX3i Expansion Backplanes and a Series 90-30 Expansion Backplane. The Expansion Backplanes can be any combination of RX3i (IC694) and Series 90-30 (IC693) Expansion Backplanes. I/O modules in the system can be any combination of RX3i and Series 90-30 modules.

In the example on the right, two of the backplanes must be installed beyond the 15-meter (50-foot) limit of an Expansion system. Two Series 90-30 Remote Backplanes are used in those locations. All other features of the two example systems are the same, including their I/O modules.



Chapter 2 Installation

This chapter provides general instructions for installing PACSystems RX3i equipment.

- Pre-Installation Check
- System Layout Guidelines
- Enclosures
  - Backplane Dimensions and Spacing
- System Wiring
  - General Wiring Information
  - Color-coding Wires
  - Wire Routing
  - Grouping Modules
- System Grounding
  - Ground Conductors
  - Backplane, Safety and EMC Reference Grounding
  - Programmer Grounding
  - Shield Grounding
- System Installation
  - Universal Backplanes
  - Expansion Backplanes
  - Modules
  - CPU
  - Power Supplies
  - Serial Bus Transmitter Modules

For additional information about system installation, also see:

- Chapter 3, Backplanes, for backplane dimension diagrams
- Chapter 4, Power Supplies, for power supply specifications and wiring diagrams
- Chapters 5 through 12 for module wiring diagrams and specifications
- Appendix A for general standards information
- Appendix B for information about cables and terminal strips for 32-point modules
- Appendix C for information about calculating heat dissipation
- Appendix D for information about the Cable Clamping Assembly

Pre-Installation Check

Upon receiving your RX3i equipment, carefully inspect all shipping containers for damage. If any part of the system is damaged, notify the carrier immediately. Save the damaged shipping container for inspection by the carrier.

As the consignee, it is your responsibility to register a claim with the carrier for damage incurred during shipment. However, GE Fanuc will fully cooperate with you, should such action be necessary.

After unpacking the RX3i equipment, **record all serial numbers**. Serial numbers are required if you should need to contact Customer Care during the warranty period. All shipping containers and all packing material should be saved should it be necessary to transport or ship any part of the system.

Verify that all components of the system have been received and that they agree with your order. If the system received does not agree with your order, contact customer service.

If you need technical help, technical support can be reached as listed below:

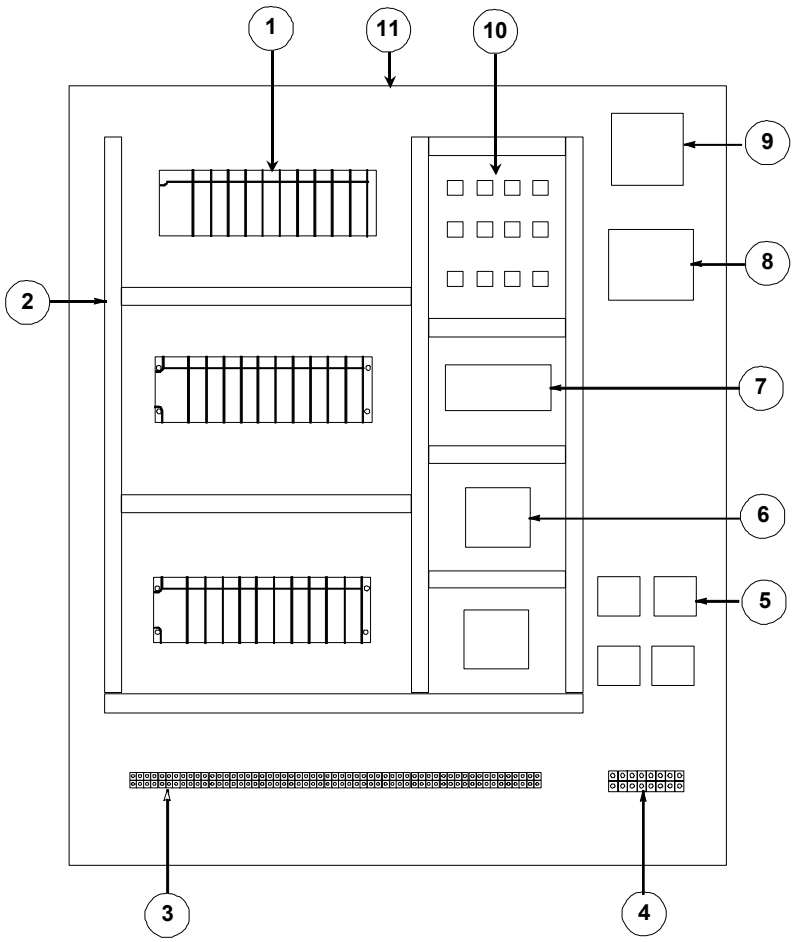
Technical support for control system components described in this manual:

Customer Care Hotline	Toll free: 800-GE FANUC (800-433-2682 International direct dial: 780-420-2197
Internet address	plchotline@cho.ge.com
Fax number	780-420-2197
Web Support	www.gefanuc.com

System Layout Guidelines

A good layout helps minimize the chance of electrical shock to personnel working on the system. It lets maintenance technicians easily access the unit to make measurements, load software, check indicator lights, remove and replace modules, etc. It also makes it easier to trace wiring and locate components while troubleshooting. In addition, proper system layout promotes good heat dissipation and helps eliminate electrical noise from the system. Excess heat and noise are two major causes of electronic component failure.

- Locate RX3i equipment away from other components that generate a lot of heat, such as transformers, power supplies, or power resistors.
- Locate RX3i equipment away from components that generate electrical noise such as relays and contacts.
- Locate RX3i equipment away from high-voltage components and wiring, such as circuit breakers and fusible disconnects, transformers, motor wiring, etc.
- Locate equipment at a convenient level that allows technicians reasonable access for maintaining the system.
- Route sensitive input wires away from electrically-noisy wires such as discrete output and AC wiring. This can be facilitated by grouping I/O modules to keep output modules separated from sensitive Input modules.



6. RX3i
7. Wireway (Wire Duct)
8. Field device connection terminal block
9. Motor connection terminal block
10. Motor starters
11. Circuit board

1. Power supply
2. Control transformer
3. Fusible disconnect or circuit breaker
4. Control relays
5. Protected enclosure

- Allow a 4" clearance space on all four sides of each RX3i backplane for ventilation/cooling.
- Use shielded cable connections with the shield grounded at one end (at source) for all analog modules, including RTD and Thermocouple modules.

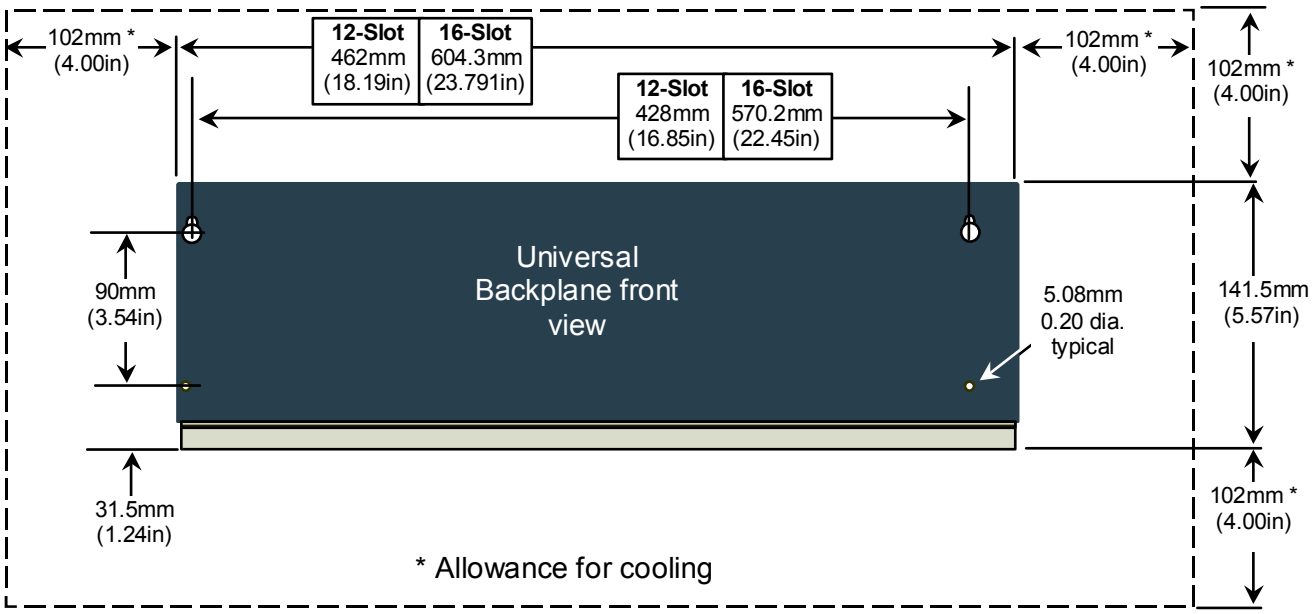
Enclosures

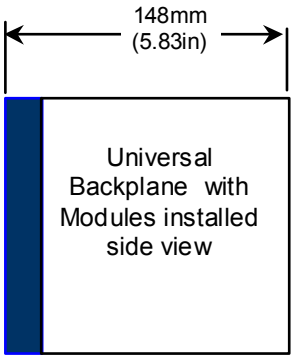
The RX3i system and its components are considered open equipment [having live electrical parts that may be accessible to users] and must be installed in a protective enclosure or incorporated into other assemblies manufactured to provide safety. As a minimum, the enclosure or assemblies shall provide a degree of protection against solid objects. This equates to a NEMA/UL Type 1 enclosure or an IP20 rating (IEC60529).

When a RX3i system is installed into an area designated as Class 1 Zone 2 in Europe, compliance with the ATEX Directive requires an enclosure with a higher degree of protection. Refer to “ATEX Class 1 Zone 2 Hazardous Location Requirements” located in Appendix A for specifications.

The enclosure must be able to adequately dissipate the heat generated by all of the components mounted inside so that no components overheat. Heat dissipation is also a factor in determining the need for enclosure cooling options such as fans and air conditioning. A minimum space of at least 102mm (4 inches) is required on all sides of the RX3i backplane for cooling. Additional space may be required, depending on the amount of heat generated by the equipment during operation. Appendix C explains how to calculate heat dissipation for RX3i modules and field devices in an enclosure.

RX3i Universal Backplane Dimensions and Spacing





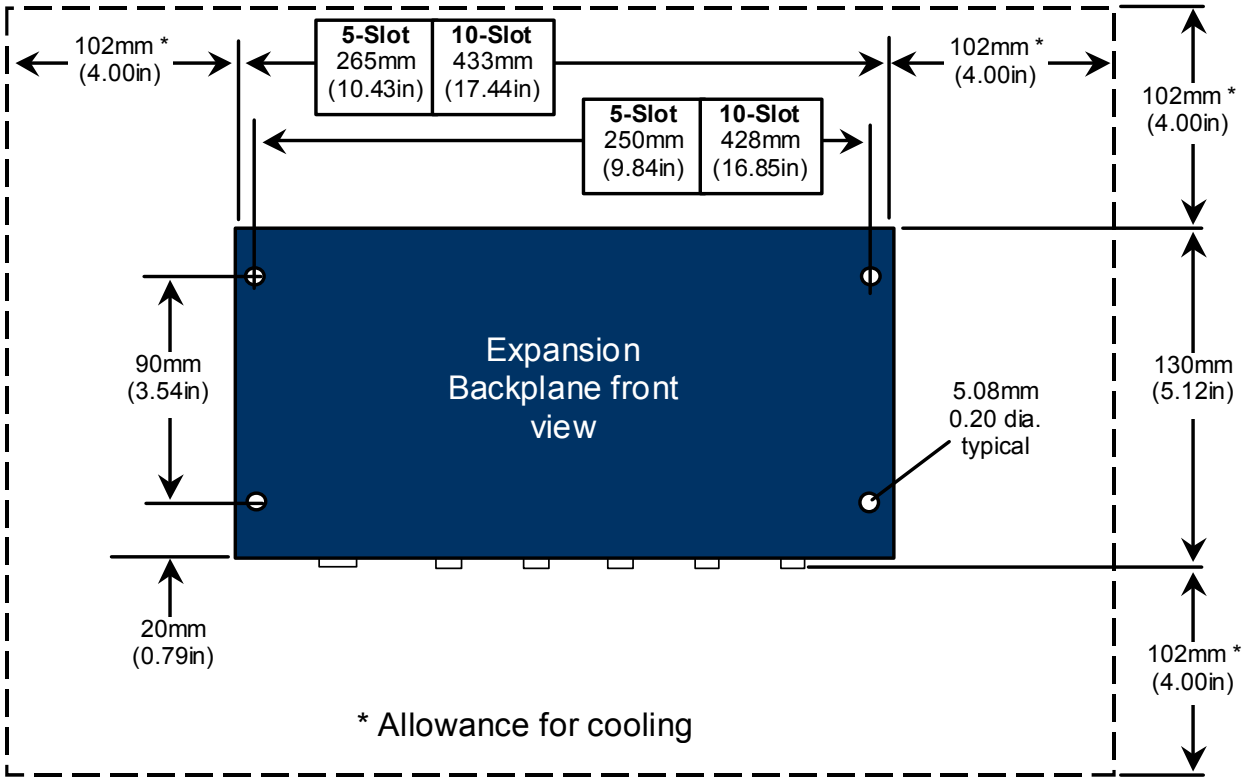
Side dimension is for modules with doors closed.

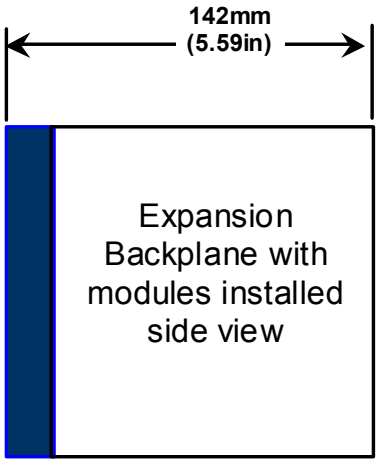
Side dimension does not include extra depth required for cables and connectors.

The mounting holes for the 12 slot RX3i Universal Backplane match the mounting holes of the 10 slot Series 90-30 Backplane exactly, for easy upgrades.

RX3i Serial Expansion Backplane Dimensions and Spacing

Each backplane has standard attachment flanges for mounting on an electrical panel.





Side dimension is for modules with doors closed.

Side dimension does not include extra depth required for cables and connectors.

System Wiring

General Wiring Information

To avoid possible misrouting of wiring to I/O modules, the following is recommended:

- Label all wires to and from I/O devices. Record circuit identification numbers or other pertinent data on the inserts that go in the module's faceplate door.
- Wires should be dressed so that each field I/O connector is fixed relative to its respective module.

Warning

In addition to information provided here, always follow all wiring and safety codes that apply to your area or your type of equipment. For example, in the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes will apply. For maximum safety to personnel and property you must follow these codes. Failure to do so can lead to personal injury or death, property damage or destruction, or both.

Color Coding Wires

These color codes are commonly used in industrial equipment manufactured in the United States. Where they differ from codes that apply to your area or your type of equipment, follow your applicable codes instead. Besides satisfying code requirements, wire color coding makes testing and troubleshooting safer, faster, and easier.

- Green or green with stripe- Ground
- Black - Primary AC
- Red - Secondary AC
- Blue - DC
- White - Common or neutral
- Yellow - Secondary power source not controlled by the main disconnect. Alerts maintenance personnel that there may be power present (from an external source) even if the equipment is disconnected from its main power source.

Wire Routing

To reduce noise-coupling among PLC wires, electrically-noisy wiring such as AC power wiring and discrete output module wiring should be separated from low-level signal wiring such as DC and analog input module wiring or communications cables. Where practical, group separately the following types of wiring:

- **AC power wiring.** This includes the AC input to the PLC power supply, as well as other AC devices in the control cabinet.
- **Analog Input or Output Module wiring**. This should be shielded to further reduce noise coupling.
- **Discrete Output Module wiring.** These often switch inductive loads that produce noise spikes when switched off.
- **DC Input Module wiring.** Although suppressed internally, these low-level inputs should be further protected against noise coupling by observing these wiring practices.
- **Communications Cables.** Wiring such as Genius bus or serial cables should be kept away from noise-producing wiring.

Where AC or Output wiring bundles must pass near noise-sensitive signal wiring bundles, avoid running them beside each other. If they have to cross, route them a right angle to minimize coupling between them.

Grouping Modules to Keep Wires Segregated

If practical, grouping similar modules together on the backplanes can help keep wiring segregated. For example, one backplane could contain only AC modules, and another only DC modules, with further grouping by input and output types.

System Grounding

All components of a control system and the devices it is controlling must be properly grounded. This is particularly important for the reasons listed below.

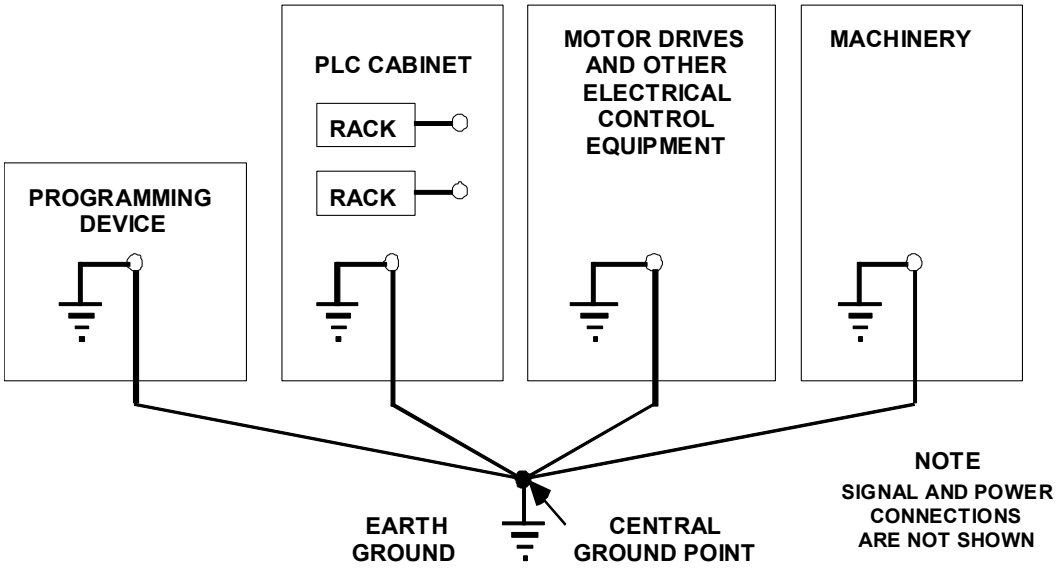
- A low resistance path from all parts of a system to earth minimizes exposure to shock in the event of short circuits or equipment malfunction.
- The RX3i system requires proper grounding for correct operation.
- All backplanes grouped together in the PLC system must have a common ground connection. This is especially important for backplanes that are not mounted in the same control cabinet.

Warning

In addition to observing the grounding procedures described here, it is important to follow local grounding codes. In the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes apply. For maximum safety to personnel and property, follow these codes. Failure to do so can mean injury or death to personnel, damage to property, or both.

In addition to observing the system grounding procedures, periodic inspections of the ground connections should be performed to ensure that the system remains properly grounded.

The PLC equipment, other control equipment, and the machine should be interconnected to maintain a common earth ground reference, also called the machine chassis ground.



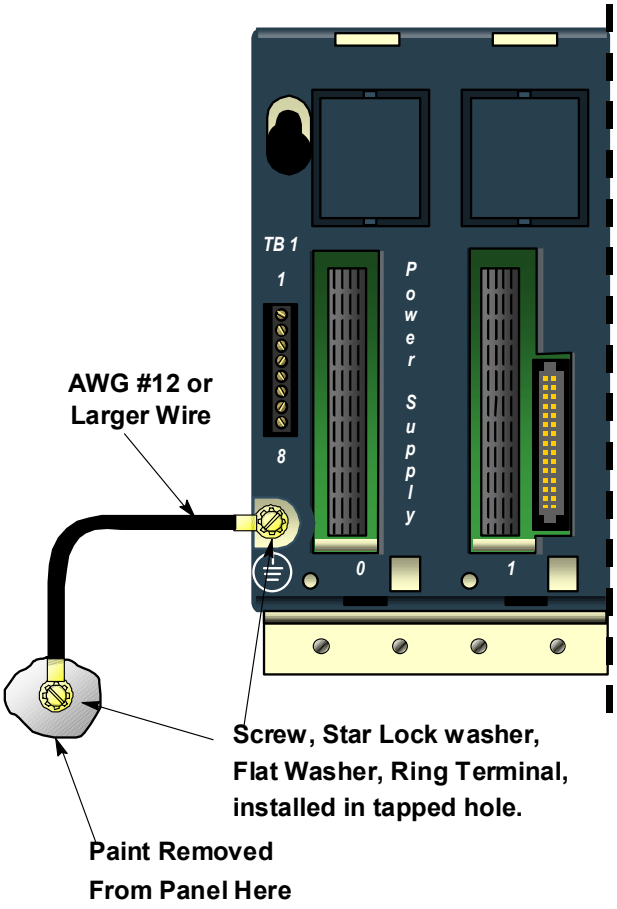
Ground Conductors

Ground conductors should be connected in a tree fashion with branches routed to a central earth ground point, as shown on the previous page. This ensures that no ground conductor carries current from any other branch.

A low inductance path from all parts of a system to earth minimizes emissions and increases immunity to electrical interferences. Ground conductors should be as short and as large in size as possible. Braided straps (maximum 10:1 length to width ratio recommended) or ground cables (typically green insulation with a yellow tracer - AWG #12 (3.3 mm^2) or larger) can be used to minimize resistance. Conductors must always be large enough to carry the maximum short circuit current of the path being considered.

Backplane Safety and EMC Reference Grounding

The backplane's metal back must be grounded using a separate conductor; the backplane mounting screws alone do not provide an adequate ground connection. Use a minimum AWG #12 (3.3 mm^2) wire with a ring terminal and star lock washer. Connect the other end of this ground wire to a tapped hole in the mounting panel using a machine screw, star lock washer, and flat washer. Alternately, if the panel has a ground stud, use a nut and star lock washer for each wire on the ground stud to ensure adequate grounding. Where connections are made to a painted panel, the paint should be removed so that clean, bare metal is exposed at the connection point. Terminals and hardware used should be rated to work with the aluminum backplane material.



Warning

All backplanes must be grounded to minimize electrical shock hazard. Failure to do so can result in severe personal injury.

All backplanes grouped together in the PLC system must have a common ground connection. This is especially important for backplanes that are not mounted in the same control cabinet.

Power Supply Grounding See the information on Power Supply Field Wiring later in this chapter.

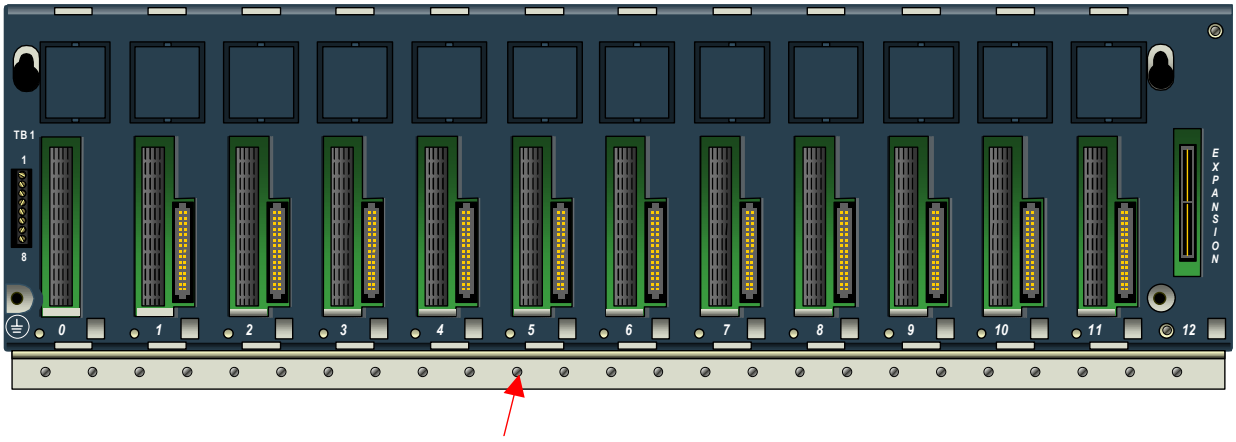
Programmer Grounding

For proper operation, the computer (programmer) running the PLC software must have a ground connection in common with the CPU. Normally, this common ground connection is provided by connecting the programmer's power cord to the same power source (with the same ground reference point) as the backplane. If the programmer ground is at a different potential than the PLC ground, a shock hazard could exist. Also, damage to the ports could occur when the programmer serial cable is connected between the two.

Shield Grounding

In general, the aluminum PLC backplane is used for module shield grounding. On some modules, shield connections to the user terminal connector on the module are routed to the backplane through the module's backplane connector. Other modules, such as the DSM314 require a separate shield ground, as shown in the module description in this manual.

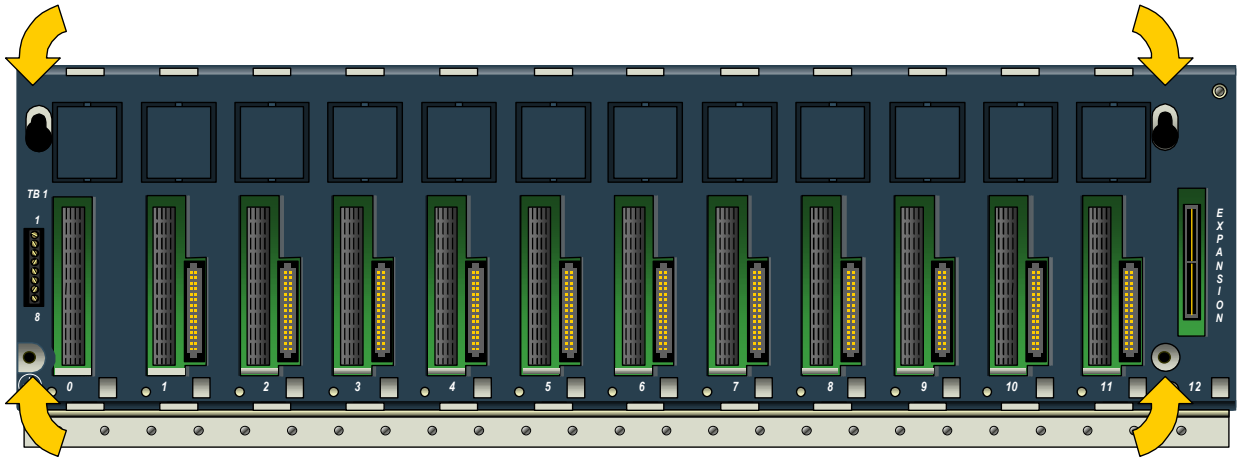
For modules installed in a Universal Backplane, shield grounds can be connected to the Grounding Bar at the bottom of the Backplane using size M3 screws. The recommended torque is 4 in/lb maximum.



System Installation

Universal Backplanes

Mount a Universal Backplane using four good-quality 8-32 x 1/2 (4 x 12mm) machine screws, lock washers and flat washers. Install the screws in the four tapped holes.



The dimensions and mounting clearances for each type of backplane were shown in the previous pages. Vertical mounting is preferred for maximum heat dissipation.

- IC695 Power Supply modules may be installed in any slot. DC Power Supply IC695PSD040 occupies 1 slot. AC Power Supply IC695PSA040 occupies 2 slots. RX3i (IC694) and Series 90-30 (IC693) Power Supplies cannot be installed in Universal Backplanes.
- An RX3i CPU module can be installed anywhere in the backplane except the Expansion slot. CPU modules occupy 2 slots.
- I/O and option modules can be installed in any available slot except slot 0, which can only accept IC695 Power Supplies, and the Expansion slot. Each I/O slot has two connectors, so either an RX3i PCI-based module or a serial module can be installed in any I/O slot.
- The rightmost slot is the expansion slot. It can only be used for optional Serial Bus Transmitter module IC695LRE001.

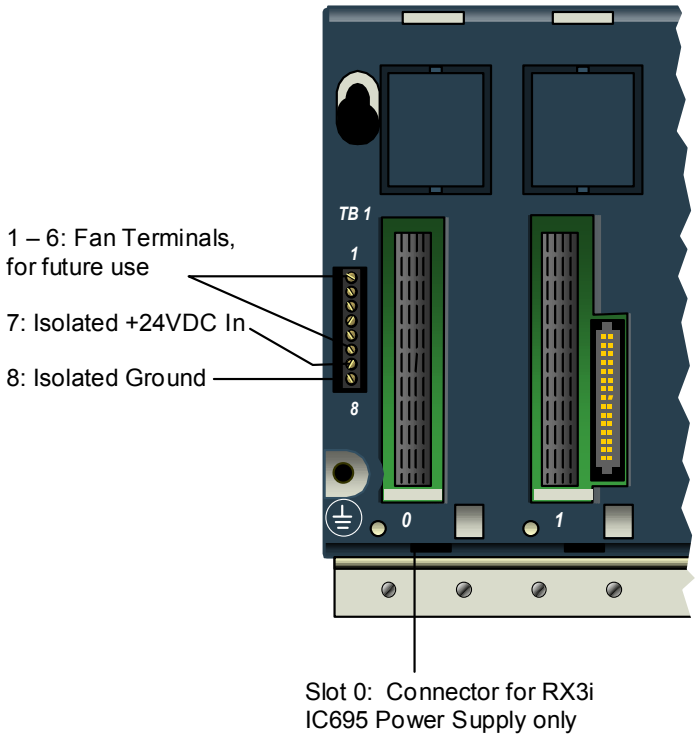
Universal Backplane Terminals (TB1)

Terminals 1 through 6 on the left end of the Universal Backplane are reserved for external fan control (available in future systems).

The RX3i PCI Power Supplies do not provide Isolated +24V output power over the backplane. Terminals 7 and 8 can be used to connect an optional external source of Isolated +24VDC, which is required for some IC693 and IC694 modules as listed in the table of Module Load Requirements in chapter 4.

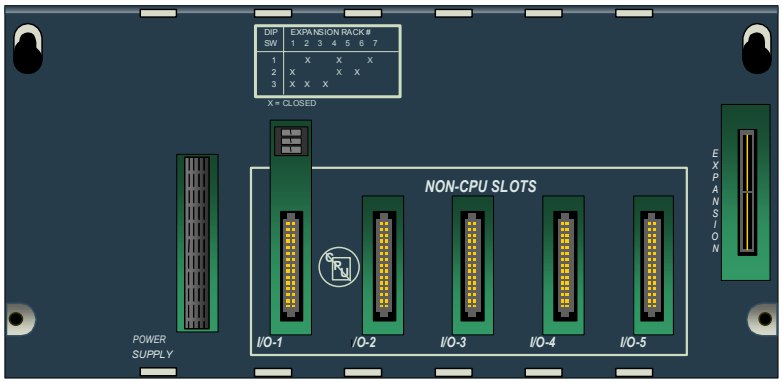
These terminals accept individual wires from 14 to 22 AWG.

If modules that require Isolated +24VDC are installed in an Expansion Backplane instead, an external Isolated +24V power supply is not required.



Expansion Backplanes

To mount an Expansion Backplane on a panel, use four good-quality 8-32 x 1/2 (4 x 12mm) machine screws, lock washers and flat washers. Install the screws in the four tapped holes.



An Expansion Backplane can also be mounted in a 19-inch rack using a mounting bracket as described in this section.

Setting the Rack Number DIP Switch

Each backplane is identified with a unique number called a "Rack Number." Rack number 0 is always automatically assigned to the backplane with the CPU. Rack numbers must not be duplicated in a system. Backplanes do not need to be sequentially numbered, although for consistency, rack numbers should not be skipped.

Rack Numbers for Expansion and Remote backplanes are set using a DIP switch on the backplane. The following table shows the switch positions for rack number selection.

	Rack Number						
DIP Switch	***1***	***2***	***3***	***4***	***5***	***6***	***7***
1	open	closed	open	closed	open	closed	open
2	closed	open	open	closed	closed	open	open
3	closed	closed	closed	open	open	open	open

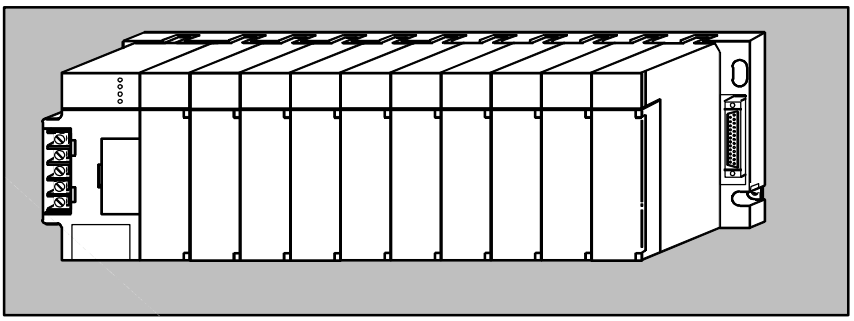
For example, these switch settings select rack number 2:

Do not use a pencil to set the DIP switches. Graphite from the pencil can damage the switch.

Recommended Mounting Orientation for Expansion Backplanes

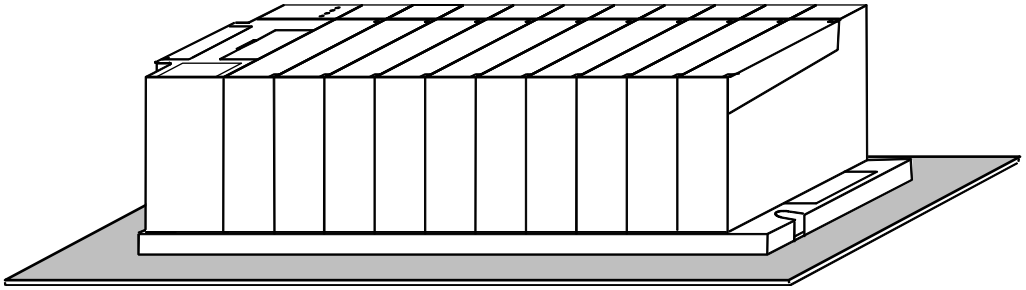
For Expansion and Remote Backplanes, power supply load rating depends on the mounting position of the backplane and the ambient temperature.

The load rating with the Expansion Backplane mounted upright on a panel is100% at 60°C (140°F)



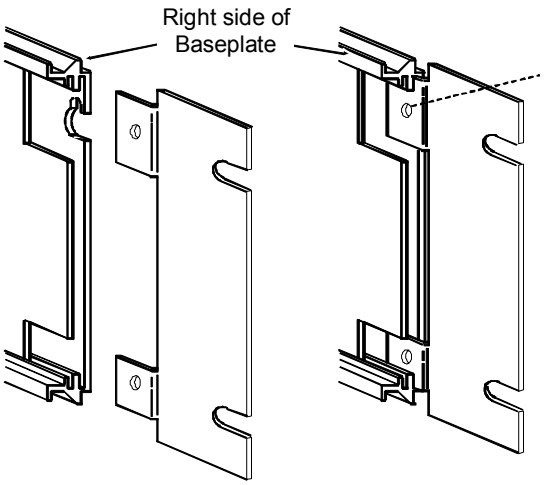
Power supply load ratings with the backplane mounted horizontally are:

- Temperature at 25°C (77°F) – full load
- Temperature at 60°C (140°F) – 50% of full load



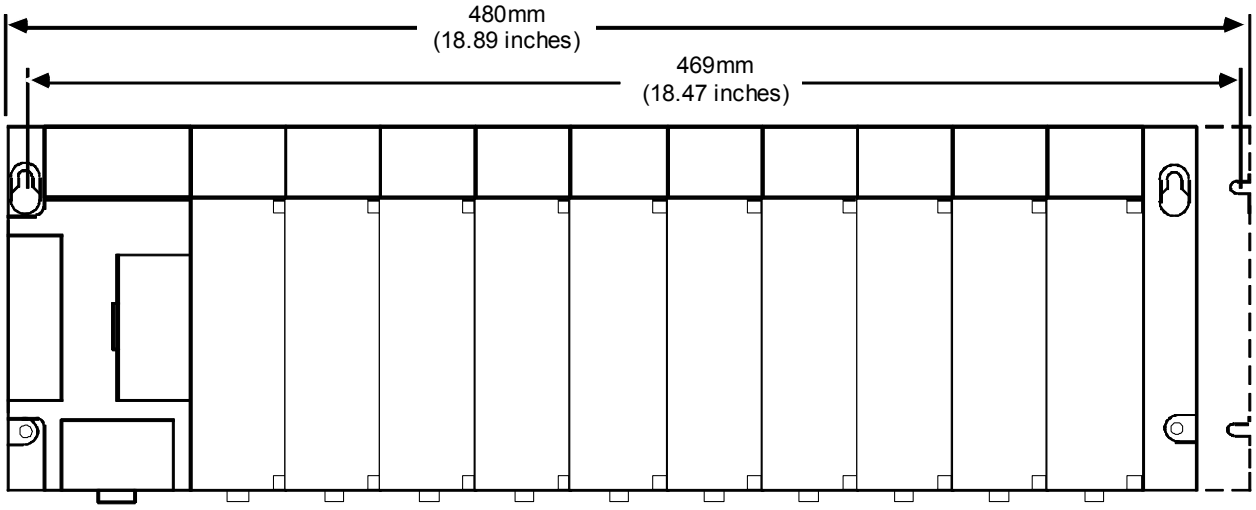
Mounting a Backplane in a 19-Inch Rack

The **IC693ACC308 Front Mount Adapter Bracket** can be used to mount a 12-Slot Universal Backplane (IC695CHS012) or a 10-Slot Expansion Backplane (IC694CHS392) to the front face of a 19" rack. Install the adapter bracket by inserting the tabs at the top and bottom of the adapter bracket into the corresponding slots at the top and bottom of the plastic backplane cover. It is not necessary to remove the cover to install the bracket. With the bracket in place, insert and tighten the two screws (included with the bracket) through the back of the backplane holes into the threaded holes in the bracket.



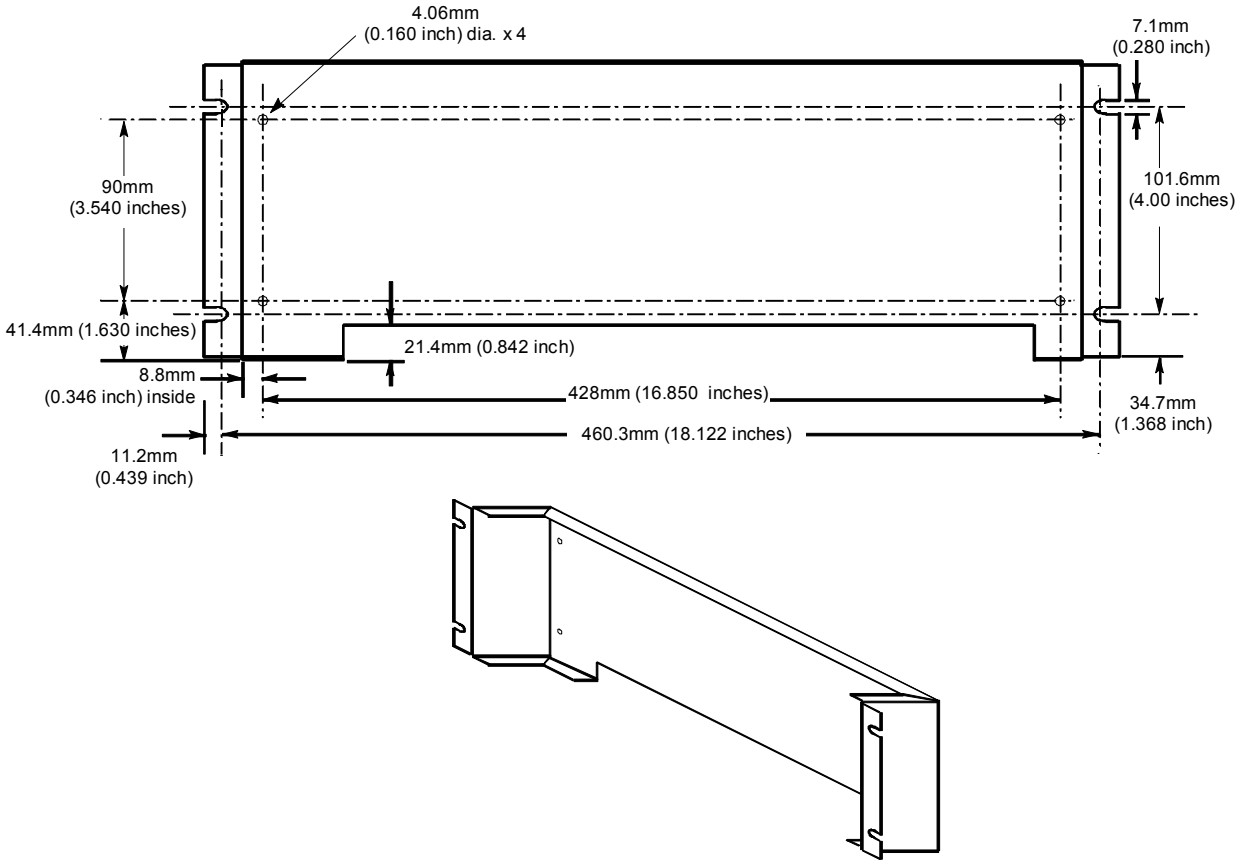
Insert two screws (one at top; one at bottom) from the back of the baseplate through the baseplate mounting holes into tapped holes in the bracket. Tighten both screws to secure the bracket to the baseplate.

Dimensions for rack mounting a backplane with the IC693ACC308 Front Mount Adapter Bracket are shown below.



The **IC693ACC313 Recessed Mount Adapter Bracket** can be used to recess-mount a 10-Slot Expansion Backplane (IC694CHS392) inside a 19” rack. This bracket cannot be used with a Universal Backplane.

An Expansion Backplane mounts on the rear panel of this adapter bracket using four 8-32 (4mm) screws, nuts, lock washers, and flat washers. The Adapter Bracket bolts through its four slotted holes to the face of the 19” rack using applicable hardware (lock washers recommended).



Grounding Rack-Mounted Expansion Backplanes

If an Expansion Backplane is mounted in a 19-inch rack using an Adapter bracket, the rack must be properly grounded as described in “System Grounding Procedures”. In addition, the backplane should be grounded according to the guidelines in the “Backplane Safety Grounding” section, using a separate ground wire from the PLC backplane.

- For a Recessed Mount Adapter Bracket (IC693ACC313), the ground wire can be installed with the ground attached to the Recessed Mount Adapter Bracket. An additional ground wire should be installed that connects the Adapter Bracket to a solid chassis ground.
- For a Surface Mount Adapter Bracket (IC693ACC308), the ground wire should be run from the backplane to a solid chassis ground on the rack.

Modules

Hot Insertion and Removal

Modules in a Universal Backplane (IC695CHS012 or CHS016) can be installed or removed while power is applied to the system. This includes backplane power and field power supplied to the module.

NOTE: For products that support hot insertion, the module must be properly seated on the carrier with the latch engaged and all pins connected within 2 seconds. For removal, the module must be completely disengaged from the carrier within 2 seconds. It is important that the module not remain partially inserted during the insertion or removal process. There must be at a minimum of two seconds between the removal and insertion of modules.

NOTE: The CPU, IC695CPU310, cannot be installed or removed from a Universal Backplane while power is applied to system. System power must be removed before installing or removing the CPU.

The following warnings must be observed.

Warning

Inserting or removing a module with power applied to the system may cause an electrical arc. This can result in unexpected and potentially dangerous action by field devices. Arcing is an explosion risk in hazardous locations. Be sure that the area is non hazardous or remove system power before removing or inserting a module.

Warning

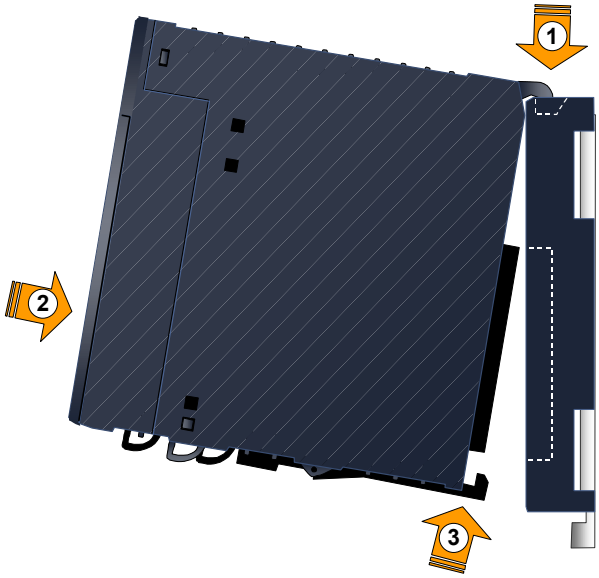
Do not insert or remove modules in RX3i Serial Expansion Backplanes or Series 90-30 Expansion Backplanes with power applied to the backplane. This could cause the PLC to stop or malfunction. Injury to personnel and damage to the module or backplane may result. If the PLC is in RUN mode, I/O data to/from this backplane will not be updated while power is removed.

Installing Modules

WARNING

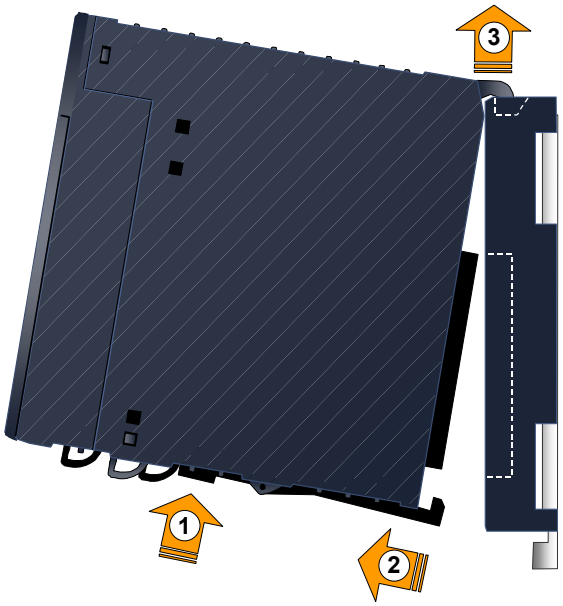
Potentially dangerous voltages may be present on a module's screw terminals even when power to the backplane is turned off. Always be very careful handling the module's removable terminal board and any wires connected to it.

- Be sure the module catalog number matches the intended slot configuration.
- Holding the module firmly, align the module with the correct slot and connector.
- Engage the module's rear pivot hook(s) in the notch(es) on the top of the backplane (1).
- Swing the module down (2) until the module's connector engages the backplane's backplane connector, and the release lever(s) on the bottom of the module snaps into place in the bottom module retainer (3).
- Visually inspect the module to be sure it is properly seated.



Removing Modules

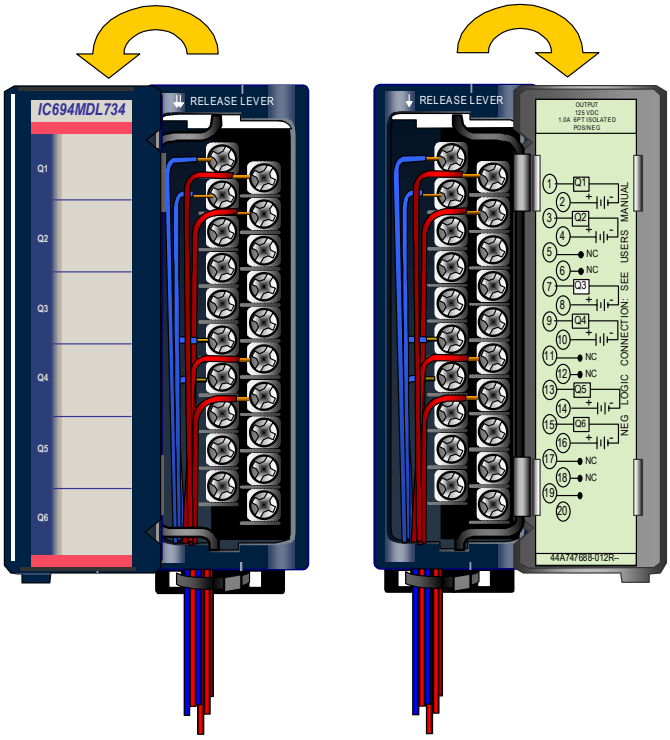
- If the module has a removable terminal board, remove it as described later in this section.
- Locate the release lever(s) at the bottom of the module and firmly press upward (1), toward the module. Wider modules have two release levers that must both be pressed up at the same time.
- While holding the module firmly and fully depressing the release lever(s), pivot the module upward until its connector is out of the backplate (2).
- Lift the module up and away from the backplane to disengage the pivot hook.

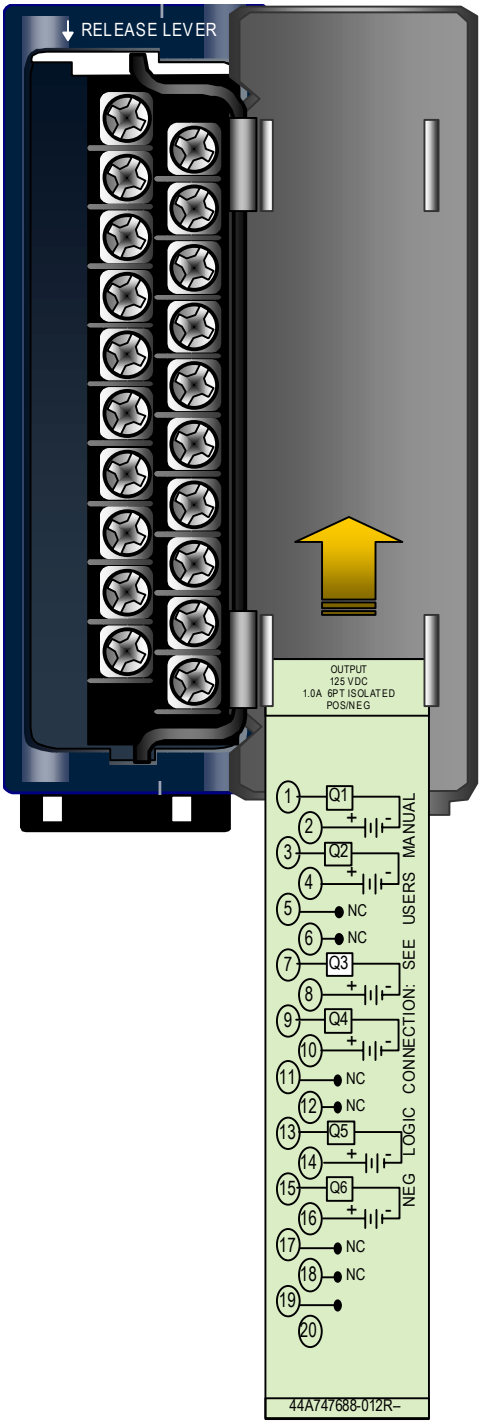


I/O Module Terminal Block Assemblies

Most PACSystems RX3i I/O modules have removable front terminal block assemblies. Each module of this type has an insertable door label with a wiring diagram printed on the back. The front of the label has color bands that indicate the module type, and space to record identifying information about the module's inputs or outputs.

The terminal blocks have fully-hinged doors that can be opened to either the left or right to access wiring.





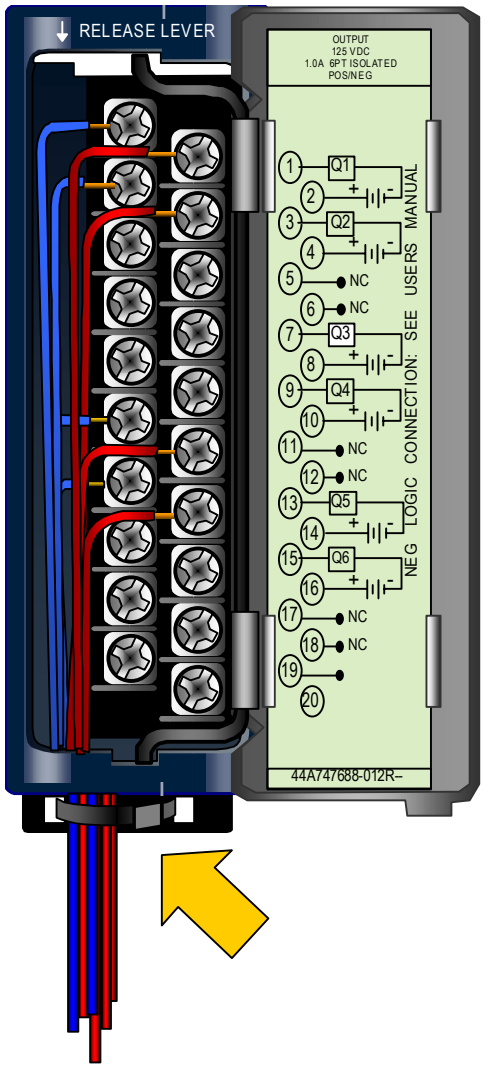
I/O Module Connections

Modules with 32 input or output points have two 20-pin connectors on the front of the module. Appendix B describes cable connections for 32-point modules.

For most RX3i I/O modules, connections are made to the module's removable terminal board. Specific wiring information for each module is printed on the door insert and also shown in the module description in this manual.

Screw terminals accept from two AWG #22 (0.36 mm^2) to two AWG #16 (1.3 mm^2), or one AWG #14 (2.1 mm^2) copper 90°C (194°F) wire(s). Each terminal can accept solid or stranded wires, but the wires into any given terminal should be the same type (both solid or both stranded) to ensure a good connection. Wires are routed to and from the terminals out of the bottom of the terminal board cavity. The suggested torque for the I/O terminal board connection screws is from 9.6 in-lbs to 11.5 in-lbs (1.1 to1.3 Newton-meters).

After the wiring is completed, wires should be bundled and fastened at the bottom of the module as shown at right.



Installing or Removing a Module's Terminal Block Assembly

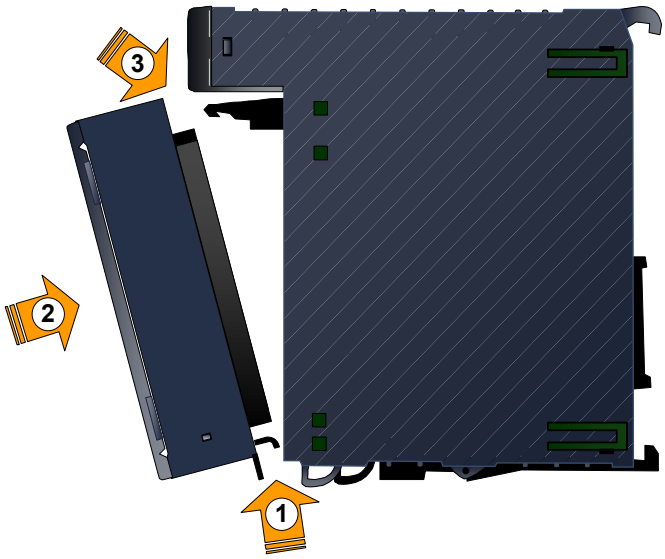
Compare the module catalog number on the label on the terminal assembly door and the label on the side of the to be sure they match. If a wired terminal block is installed on the wrong module type, the module may be damaged when the system is powered up.

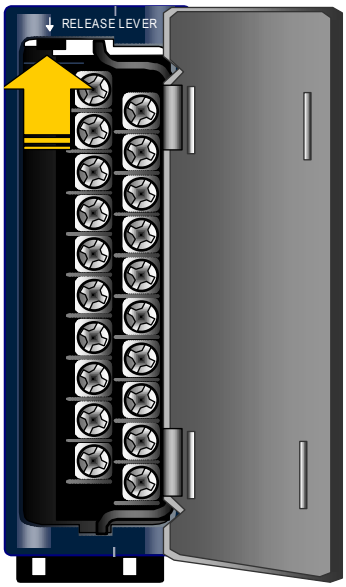
Warning

Potentially dangerous voltages from user devices may be present on a module's screw terminals even though power to the backplane is turned off. Always be very careful handling the module's removable terminal board and any wires connected to it.

Installing a Terminal Block

1. Insert the pivot hook on the bottom of the terminal block assembly into the slot on the bottom of the module.
2. Pivot the terminal block assembly upward to engage the connector.
3. Press the terminal block assembly toward the module until the release lever latch snaps into place. Check to be sure the terminal block is firmly seated.





Removing a Terminal Block

1. Open the terminal block door.
2. Push up the release lever to unlock the terminal block.
3. Pull the terminal block away from the module until the contacts have separated and the bottom pivot hook has disengaged.

Installing or Removing a Terminal Block Cover

The terminal block assembly cover can be removed for easier access to the terminals.

Warning

Potentially dangerous voltages from user devices may be present on a module's screw terminals even though power to the backplane is turned off. Always be very careful handling the module's removable terminal block assembly and any wires connected to it.

Removing a Terminal Block from its Cover

To remove a Terminal Block from its cover:

1. Grasp the sides of the Terminal Block cover.
2. Pull down on the bottom of the Terminal Block as shown at left.

Inserting a Terminal Block in its Cover

To re-insert a Terminal Block in its cover:

1. Align the top of the Terminal Block with the bottom of the cover, making sure that the notches in the Terminal Block match up with the grooves in the cover.
2. Slide the Terminal Block upward until it clicks into place.

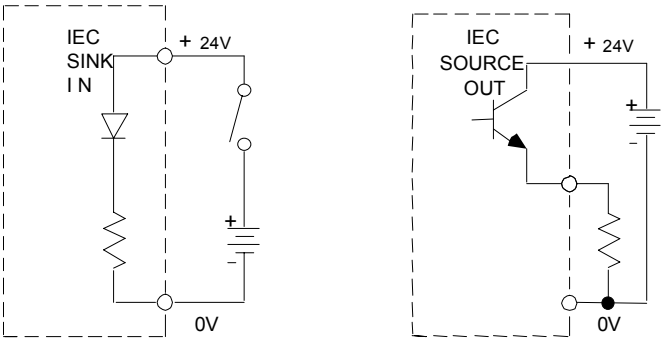
Positive and Negative Logic Connections to Discrete Modules

The IEC definitions for positive logic and negative logic for PACSystems RX3i modules are described below.

Positive Logic

Positive logic input modules sink current from the input device to the user common or negative power bus (left). The input device is connected between the positive power bus and the input terminal.

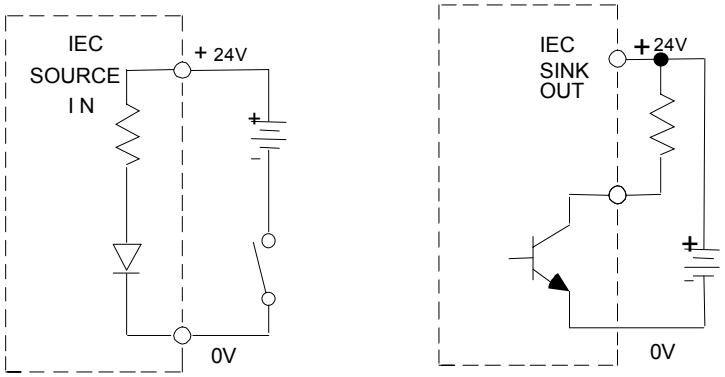
Positive logic output modules (right) source current to the loads from the user common or positive power bus. The load is connected between the negative power bus and the module output.



Negative Logic

Negative logic input modules (left) source current through the input device to the user common or positive power bus. The input device is connected between the negative power bus and the input terminal.

Negative logic output modules (right) sink current from the loads to the user common or negative power bus. The load is connected between the positive power bus and the output terminal.



Wiring for Analog Modules

Twisted, shielded instrumentation cable is strongly recommended for analog module input or output signal connections. Proper grounding of the shield is also important. For maximum electrical noise suppression, the cable shield should only be grounded at one end of the cable.

It is generally best to ground the cable shield as close to the source of the noise as possible. For Analog Input modules, ground the end that is in the noisiest environment (usually the field device end). Cut the shield off at the module end of cable and insulate with shrink tubing. For Analog Output modules, ground at the module end. Cut the shield off at device end of cable and insulate with shrink tubing.

It is best to keep the length of stripped cable leads as short as possible to minimize the length of unshielded conductors exposed to the noisy environment.

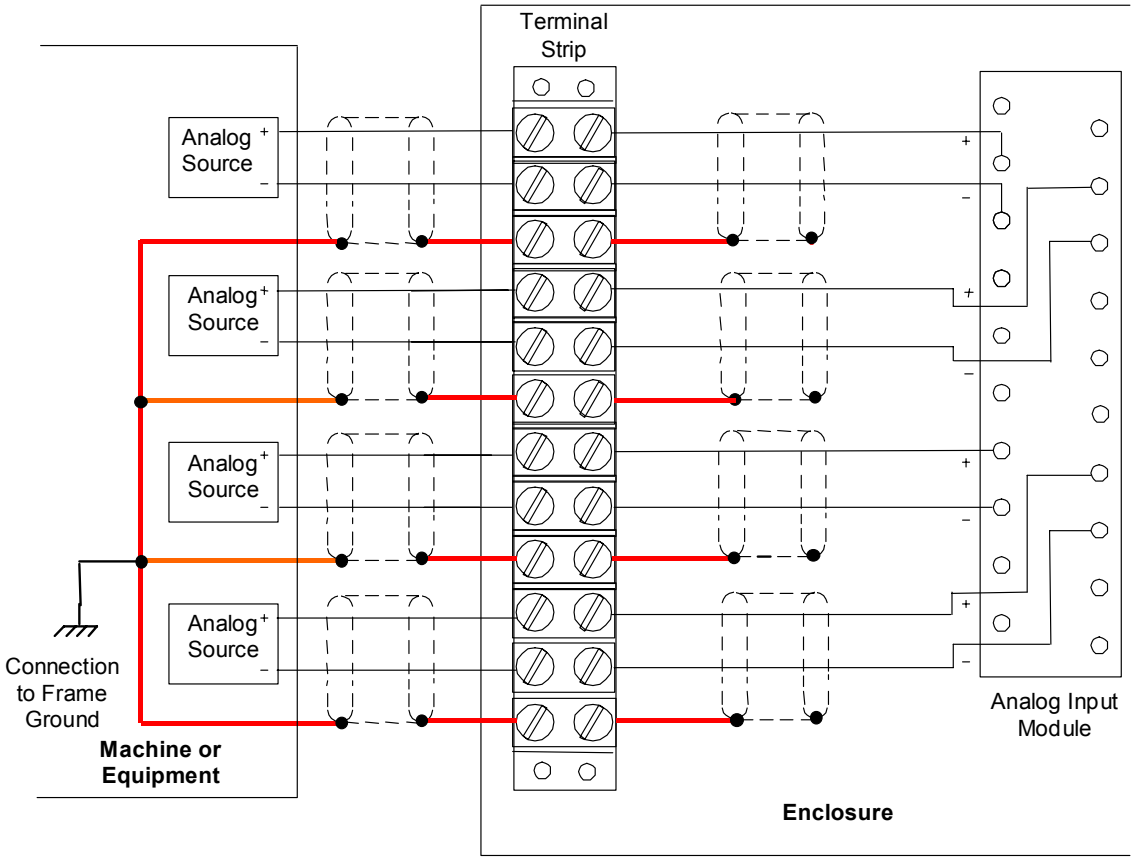
Connections can be made directly to the module terminals, or via an intermediate terminal block. The diagrams in this section show wiring for various types of analog input and analog output installations.

Shielding for Analog Input Modules

Generally, the shield for analog input cables should be grounded at the analog source. However, ground connections for each channel, labeled COM and GND, can be used to connect shields at the analog input module if appropriate. An analog input module's COM terminals connect to the analog circuit common in the module. The GND terminals connect to the backplane (frame ground). Shields may be connected to either COM or GND. This section shows four shield grounding examples for analog input modules.

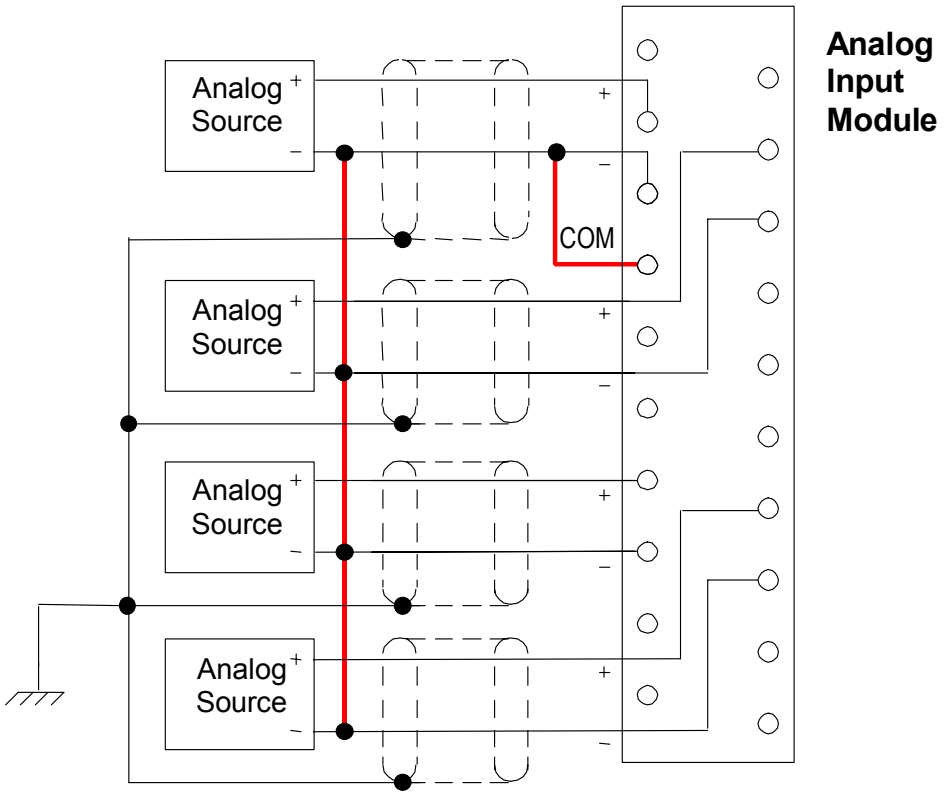
Analog Input Shield Grounding with a Terminal Strip

For an unbalanced source, the ground shield should be connected to the source common or ground at the source end. If all source inputs to the module come from the same location and are referenced to the same common, all shield grounds should be connected to the same ground point. If there is an additional terminal strip between the analog input module and the field devices (analog sources), use the method shown below to continue each cable shield using a terminal on the terminal strip. Each cable is only grounded at one end - the end closer to the field devices (analog sources). Shield connections are shown in red (bold).



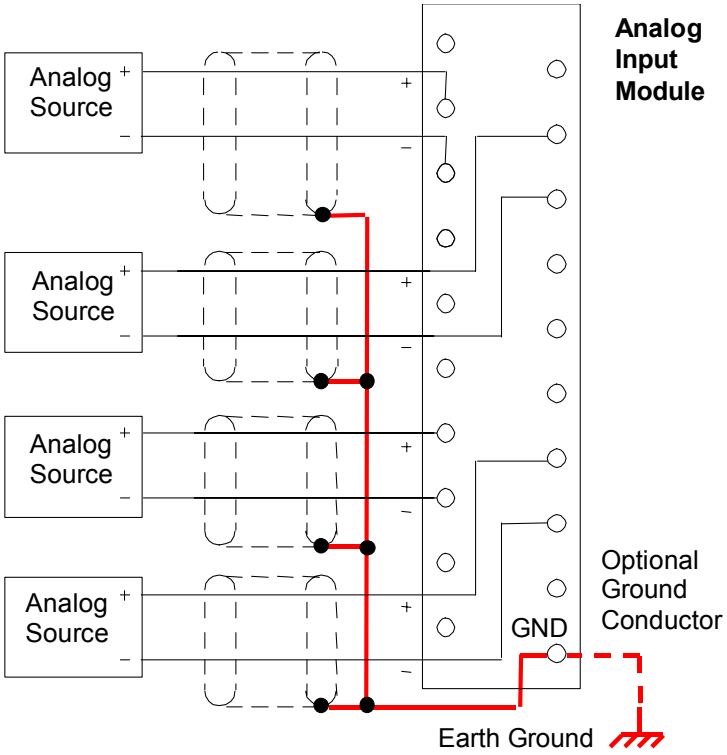
Analog Input Shield Grounding to Common Connections

In some applications, noise rejection can be improved by connecting the source common points together at the source end, then connecting a common line to the module at only one module COM terminal. That will eliminate multiple grounding or ground loops that could cause false input data. The common connections here are shown in red (bold).



Analog Input Shields Connected to Module Terminal Board

It is usually preferable to ground cable shields at the source end. If that is difficult, or if electrical noise is not a concern, it may be acceptable to ground cable shields at the analog input module end. They can be connected to one of the module's GND terminals (which is connected to frame ground through an internal path) as shown left below. If necessary to improve noise immunity, a conductor can be used to connect a ground terminal on the module to earth ground as shown below. This will bypass noise around the module.

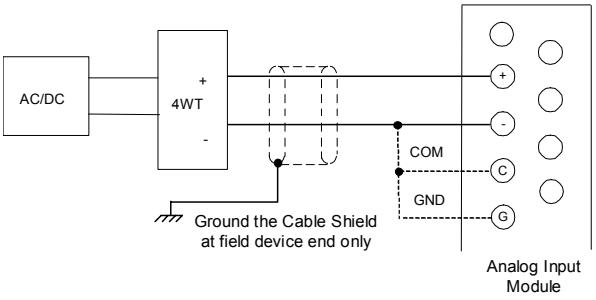


Wiring for Current Transducers

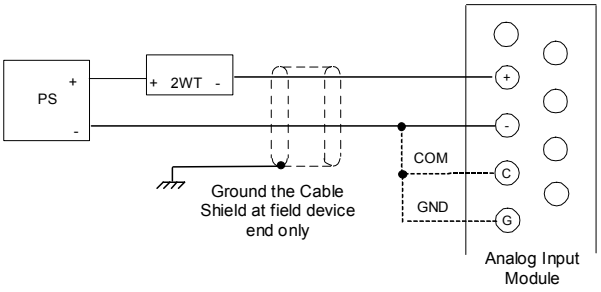
For all of the examples shown below, connect the (-) conductor to the Analog Input module COM terminal, if the source is floating, to limit common-mode voltages. Common mode voltage is limited to 11 volts.

If noise causes inaccurate readings, the (-) conductor can also be connected to the Analog Input module GND terminal.

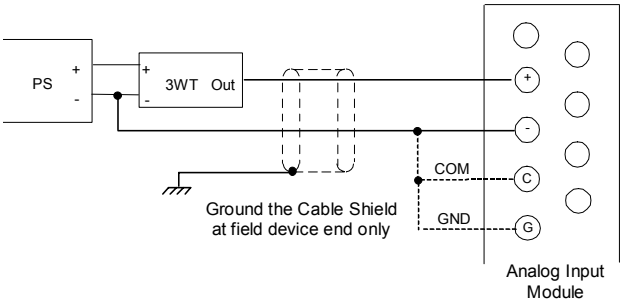
4-Wire Transducer, Externally Powered via AC or DC Supply



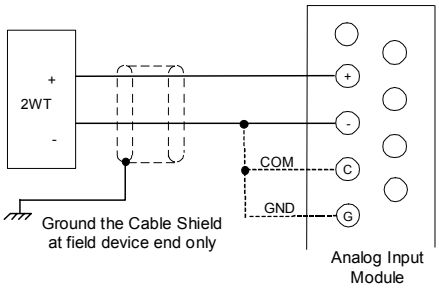
2-Wire Transdducer, Externally Powered via DC Supply



3-Wire Transducer, Externally Powered via DC Supply



2-Wire Transducer, Self Powered

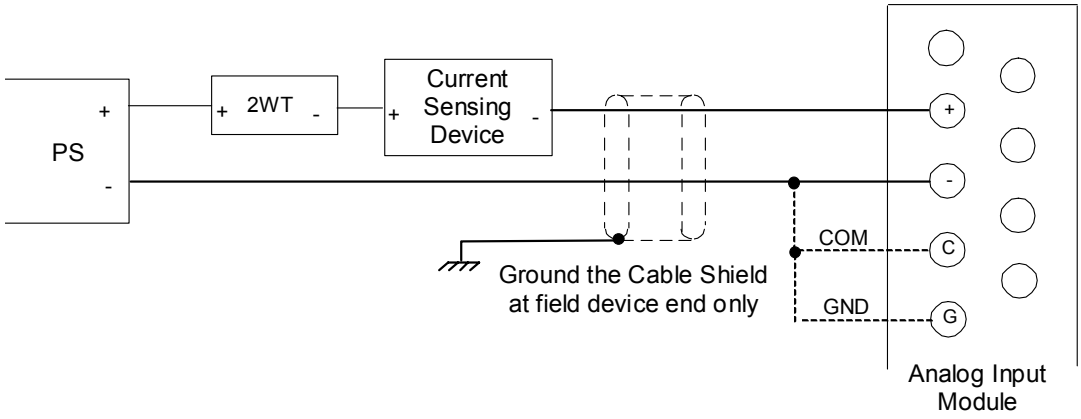


2-Wire Transducer Connected to Two Measuring Devices

Connect the (-) conductor to the Analog Input module COM terminal, if the source is floating, to limit common-mode voltages. Common mode voltage is limited to 11 volts.

If noise causes inaccurate readings, the (-) conductor can also be connected to the Analog Input module GND terminal.

The analog module must be the last device on the circuit. When grounding the (-) return side of the Analog Input Module, the other current-sensing device must be floating and able to withstand a common mode voltage of at least 20 volts, including the noise level.



Verifying Analog Input Current

RX3i Analog Current Input Modules have an internal 250 ohm resistor across the input terminals. You can measure the voltage across the input terminals using a volt meter, then use Ohm's Law to determine the input current:

Input Current (in Amps) = Volts / 250

For example, if you measured 3 volts across the input terminals:

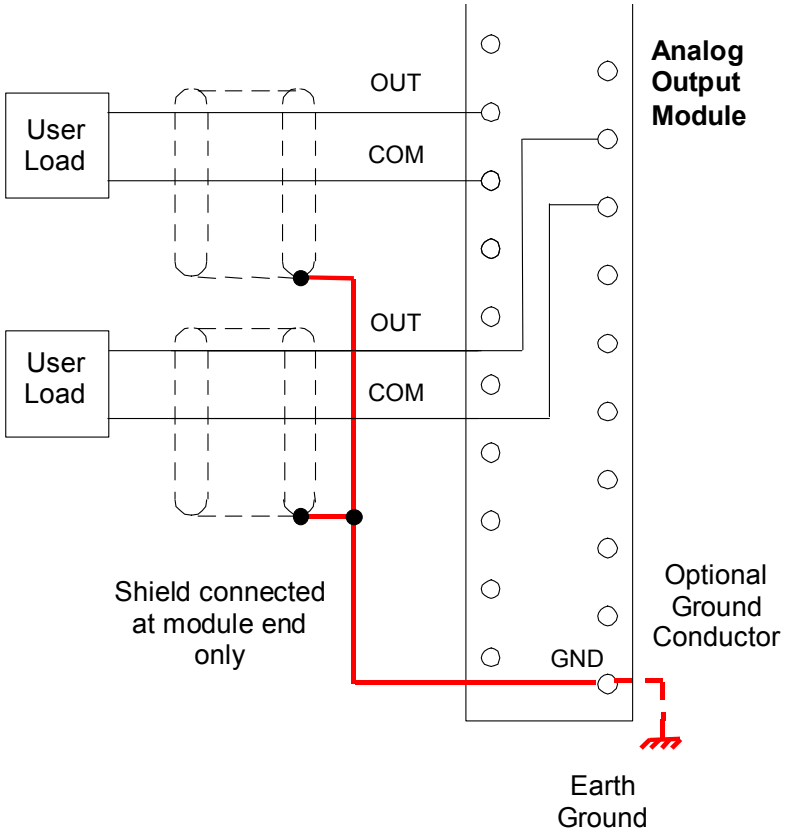
Input Current (in Amps) = Volts / 250

Input Current (in Amps) = 3/250

Input Current (in Amps) = .012 (which equals 12 mA)

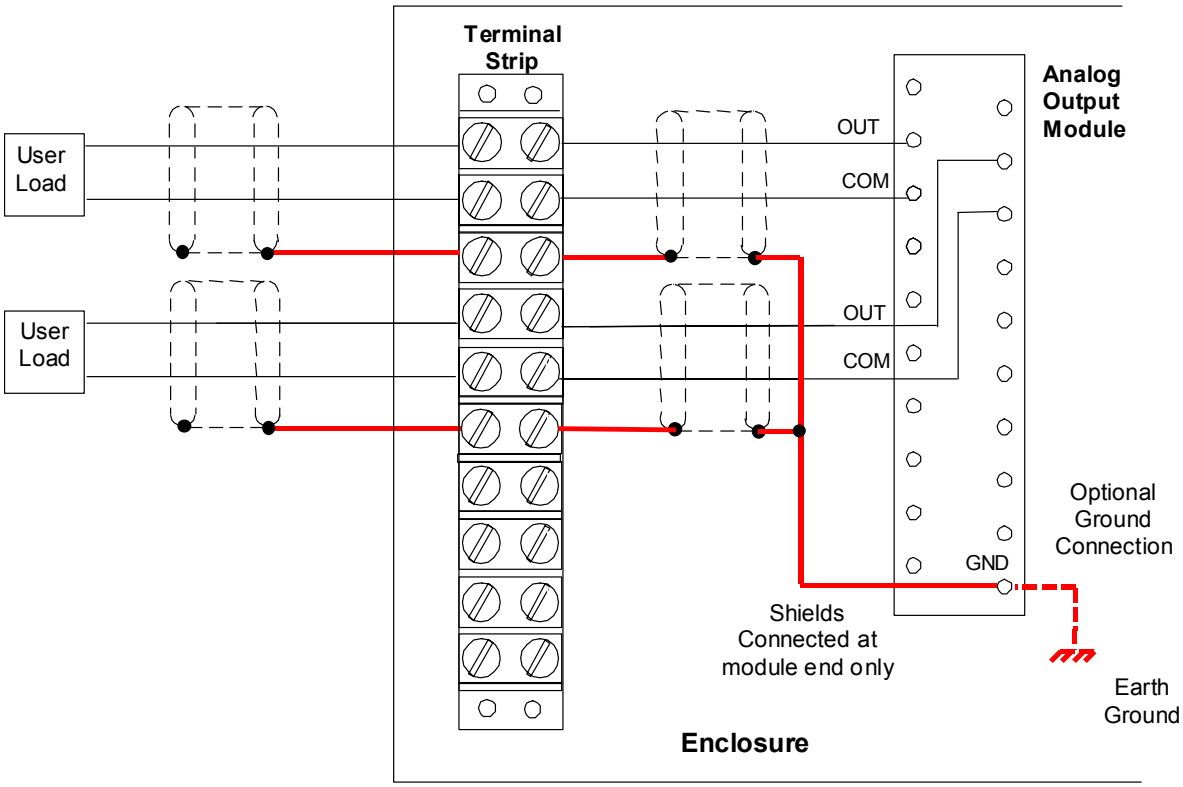
Shield Connections for Analog Output Modules

For analog output modules, the shield is normally grounded at only the source end (the module). The GND connection provides access to the backplane (frame ground) resulting in superior rejection of noise caused by any shield drain currents. In extreme-noise environments, you can connect an optional ground braid from the GND terminal to an external earth ground to bypass noise around the module.



Analog Output Shield Grounding with a Terminal Strip

If there is a terminal strip between the analog output module and the field devices (user loads), use the method in the following figure for grounding the cable shields. Each cable is only grounded at one end - the end closer to the Analog Output Module. An optional external ground connection to the output module's GND terminal is shown for installations that require extra noise suppression.



Module Fuse List

Warning

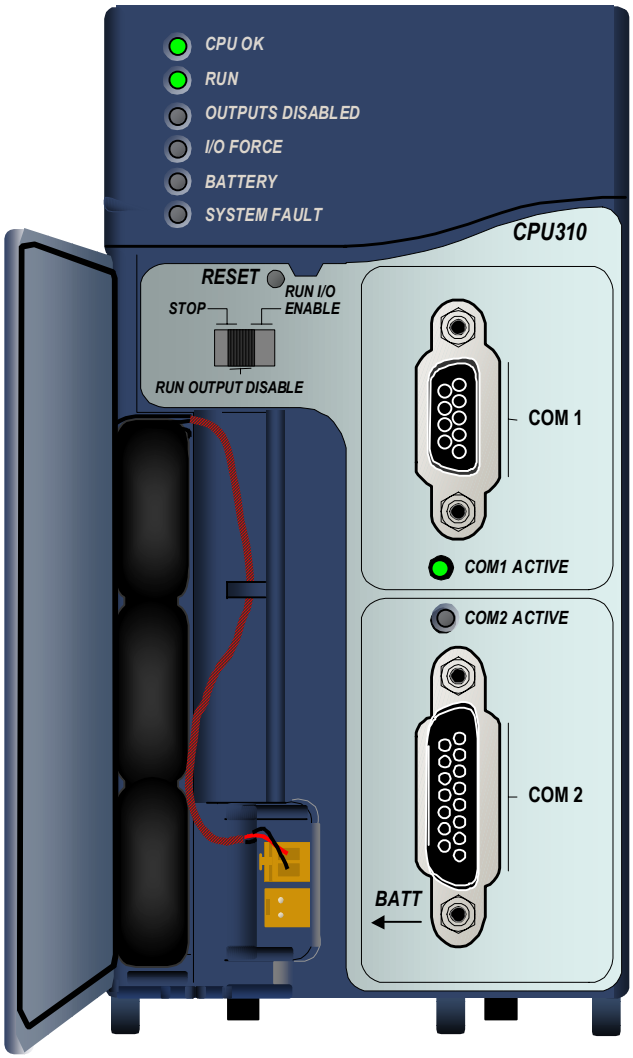
Replace fuse only with the correct size and type. Using an incorrect fuse can result in harm to personnel, damage to equipment, or both.

Module Catalog Number	*Module Type*	*Current Rating*	*Quantity on Module*	*GE Fanuc Fuse Part Number*	*Other Sources and Part Numbers*
IC694MDL310	120 VAC, 0.5A	3A	2	44A724627-111 (1)	Bussman – GMC-3 Littlefuse – 239003
IC694MDL330	120/240 VAC, 1A	5A	2	44A724627-114 (1)	Bussman – GDC-5 Bussman S506-5
IC694MDL340	120 VAC, 0.5A	3A	2	44A724627-111 (1)	Bussman – GMC-3 Littlefuse – 239003
IC694MDL390	120/240 VAC, 2A	3A	5	44A724627-111 (1)	Bussman – GMC-3 Littlefuse – 239003
IC694PWR321 and IC694PWR330	120/240 VAC or 125 VDC Input, 30 Watt Power Supply	2A	1	44A724627-109 (2)	Bussman – 215-002 (GDC-2 or GMC-2) Littlefuse – 239-002
IC694PWR331	24 VDC Input, 30 Watt Power Supply	5A	1	44A724627-114 (2)	Bussman – MDL-5 Littlefuse – 313005

(1) Mounted in clip. Accessible by removing circuit board from module housing.
(2) Line fuse. Mounted in clip – accessible by removing module front.

CPU

1. Make sure that rack power is off.
2. Install the CPU module in the appropriate slot. The CPU requires two slots and can use any slots except the highest numbered (rightmost) slot.
3. Turn on power. The module should power up. When the CPU has successfully completed initialization, the OK LED stays on and the RUN and EN LEDs are off. The CPU is now ready to be programmed.
4. Connect the battery to either of the battery connectors on the module. (You can connect the battery at any step in the installation process but it will begin to drain immediately unless power is applied. To maximize battery life, install it after power has been turned on).
5. If appropriate, communications cables can be secured to the tie-downs on the bottom of the module.



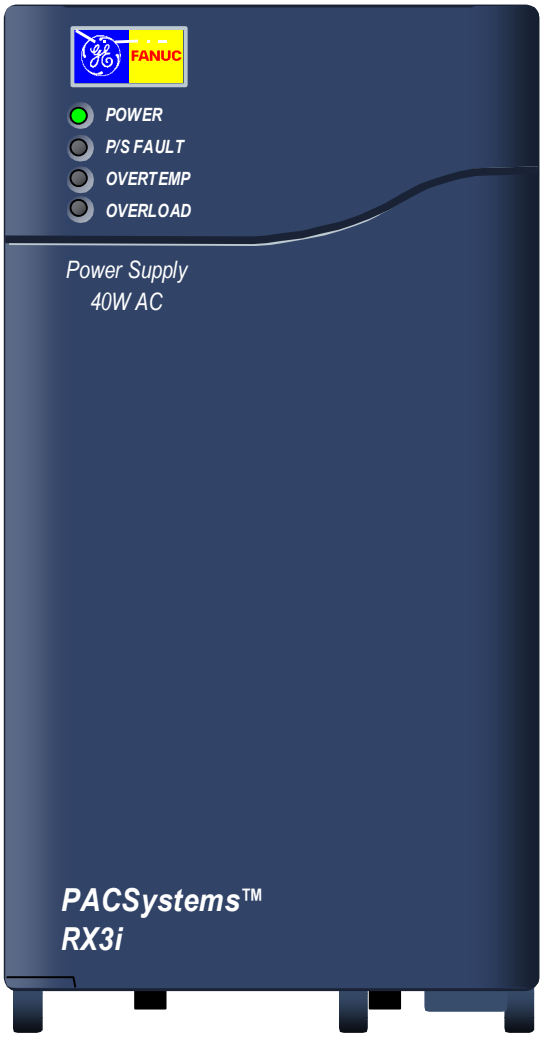
After the program has been verified, the mode switch can be moved to the appropriate operation mode position: RUN I/O ENABLED, RUN OUTPUT DISABLE, or STOP. The LEDs indicate the position of the mode switch and status of serial port activity.

Caution

This module may NOT be hot-inserted in the backplane; power must be removed before installing or removing the CPU.

Power Supplies

1. Install the Power Supply module in the appropriate slot. All RX3i Power Supplies except the DC Power Supply IC695PSD040 require two slots.
2. Universal Power Supplies (IC695) can be installed in any slots except the highest numbered (rightmost) slot in a Universal Backplane. Expansion Power Supplies (IC694) must be installed in the Power Supply (leftmost) slot in an Expansion Backplane, See chapter 3, Backplanes, for more information about module locations.
3. Connect wiring to the Power Supply as described below.
4. Use the three wiring tie-downs on the bottom of the module to secure the power and ground wires after installation.



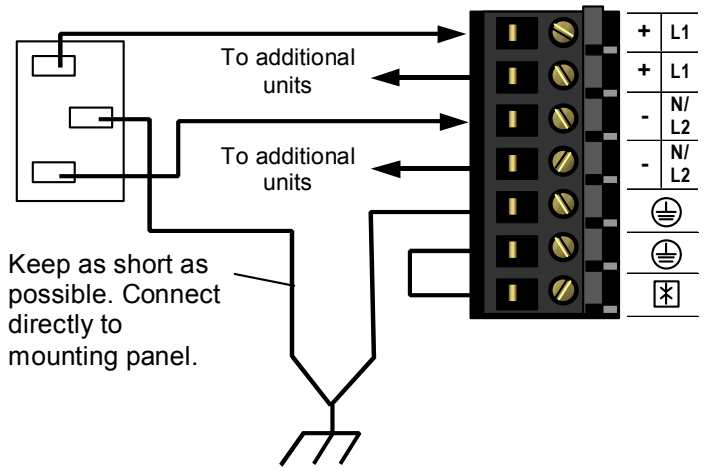
Warning

For all Power Supplies, if the same input power source is used to provide power to two or more power supplies in the system, connection polarity must be identical at each power supply. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each backplane must be connected to a common system ground.

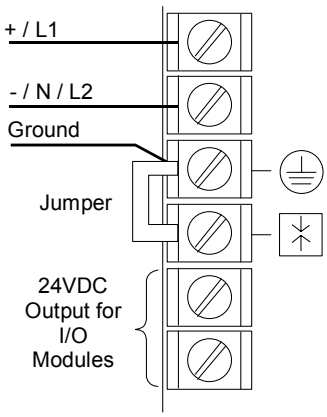
Power Supply Field Wiring

- For IC695 Power Supplies, each terminal accepts one AWG #14 to AWG #22 wire.
- For IC694 Power Supplies, each terminal accepts one AWG #14 (2.1mm^2) or two AWG #16 (1.3mm^2) copper 75°C (167°F) wires. The suggested torque for the Power Supply terminals is 12 in-lbs (1.36 Newton-meters). Each terminal can accept solid or stranded wires. Both the wires in any terminal should be the same type.

IC695 Power Supply Terminals



IC694 Power Supply Terminals



For Expansion (IC694) Power Supplies only, the bottom terminals provide access to the Expansion Backplane's Isolated +24V DC output, which can be used to power input circuits for certain IC694 modules. See the table of module load requirements in chapter 4 for information.

Caution

If the Isolated 24 VDC supply is overloaded or shorted, the PLC will stop operation.

AC Power Source Connections

Connect the hot and neutral wires or lines L1 and L2 to the appropriate Power Supply terminals.

DC Power Source Connections

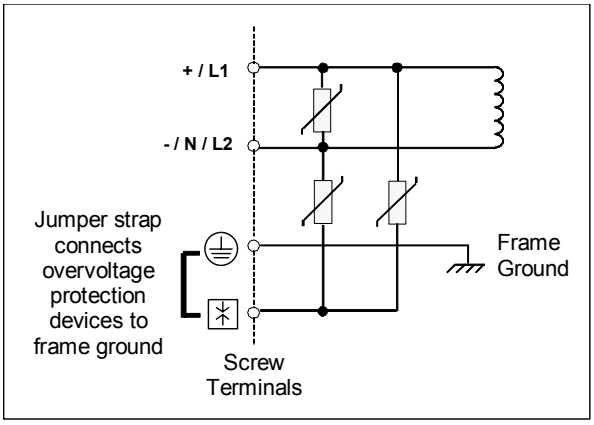
All RX3i Power Supplies have DC input capabilities. Connect the + and - wires from the DC source to the appropriate terminals. These connections are polarity-sensitive DC-only supplies.

Ground Connection

Connect the safety ground wire to the terminal marked with a ground symbol.

External Overvoltage Protection

The Ground and MOV terminals on a Power Supply module are normally connected to frame ground with a user-installed jumper as shown at right. If overvoltage protection is not required or is supplied upstream, no jumper is needed.

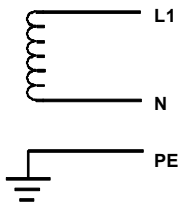


In systems with a floating neutral input (the neutral line is not referenced to Protective Earth Ground), this jumper must NOT be installed. In addition, in a floating neutral system, voltage surge protection devices such as MOVs **must** be installed from L1 to earth ground, and from L2 (Neutral) to earth ground.

AC Power Supply Connections for Floating Neutral (IT) Systems

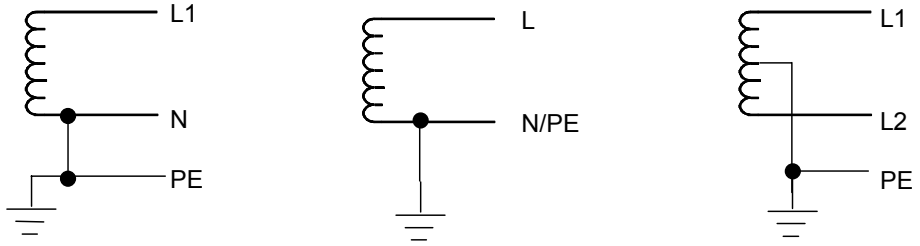
If an AC input power supply is installed in a system where the Neutral line is not referenced to Protective Earth Ground, special installation instructions must be followed to prevent damage to the power supply.

A *Floating Neutral System* is a system of power distribution wiring where Neutral and Protective Earth Ground are not tied together by a negligible impedance. In Europe this is referred to as an IT system (see IEC950). In a *Floating Neutral System*, voltages measured from input terminals to protective earth ground may exceed the 264 Volts AC maximum input voltage power supply specification.



***Non*-Floating Neutral System**

Systems where one leg of the power distribution wiring is tied to Protective Earth or a tap between two legs of the power distribution wiring is tied to Protective Earth are not *Floating Neutral Systems*. Non-floating neutral systems **do not** require special installation procedures.



Instructions for Floating Neutral Systems

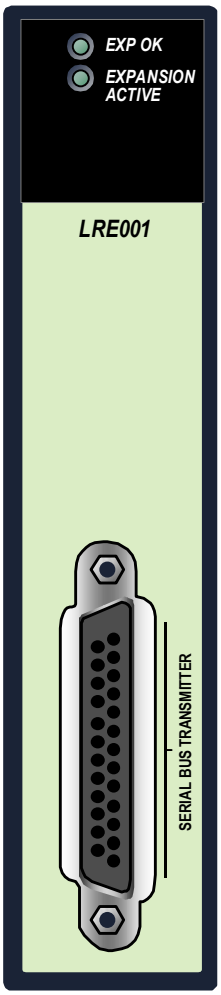
1. The input power terminals should be wired as shown previously.
2. No jumper may be installed jumper between terminals 3 and 4 of the Power Supply module.
3. Voltage surge protection devices such as MOVs must be installed:
   - From L1 to earth ground
   - From L2 (Neutral) to earth ground

The voltage surge devices must be rated such that the system is protected from power line transients that exceed *Line voltage + 100V +(N-PE)$_{MAX.}$* The expression *N-PE* refers to the voltage potential between neutral and Protective Earth (PE) ground.

For example, in a 240 Volt AC system with neutral floating 50V above earth ground, the transient protection should be rated at: 240V + 100V + 50V= 390V

Serial Bus Transmitter Module

The RX3i Serial Bus Transmitter Module, IC695LRE001, provides communications between a PACSystems RX3i Universal Backplane (IC695-model number), and serial expansion and remote backplanes (IC694- or IC693-model numbers). It must reside in the expansion connector on the right end of a Universal Backplane.

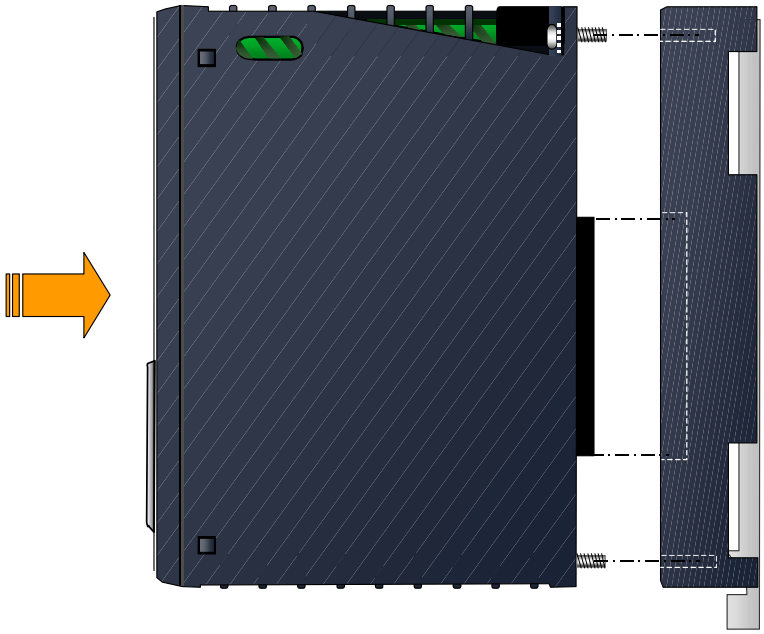


Module Installation

This module may NOT be hot-inserted in the backplane; power must be removed before installing or removing the Bus Transmitter Module.

Insert the Serial Bus Transmitter Module straight into its slot as shown below. This module does not have the same pivoting and latching mechanisms as other RX3i modules.

Tighten the two captive screws in the corners of the module. Recommended torque is 4.4 in/lb maximum.*



Expansion Cable Installation

Subsequent backplanes in the system are linked by expansion cables as described in chapter 5. The expansion cable may not be attached or removed if the expansion rack has power applied.

Chapter 3 Backplanes

This section describes the following RX3i backplanes for PACSystems:

- 16 Slot RX3i Universal Backplane, IC695CHS016
- 12 Slot RX3i Universal Backplane, IC695CHS012
- 5 Slot RX3i Serial Expansion Backplane, IC694CHS398
- 10 Slot RX3i Serial Expansion Backplane, IC694CHS392

Backplane Types

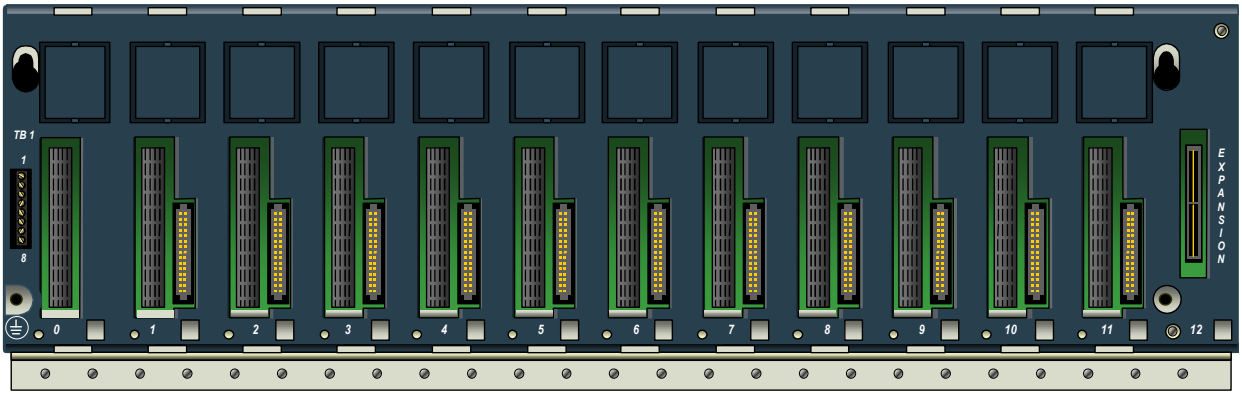
The following types of backplanes can be included in an RX3i system:

Backplane Type	***Catalog Number***
16 Slot RX3i Universal Backplane	IC695CHS016
12 Slot RX3i Universal Backplane	IC695CHS012
5 Slot RX3i Serial Expansion Backplane	IC694CHS398
10 Slot RX3i Serial Expansion Backplane	IC694CHS392
5 Slot Series 90-30 Expansion Backplane	IC693CHS398
10 Slot Series 90-30 Expansion Backplane	IC693CHS392
5 Slot Series 90-30 Remote Backplane	IC693CHS399
10 Slots Series 90-30 Remote Backplane	IC693CHS393

For information about Series 90-30 Expansion and Remote Backplanes, see GFK-0898, the *Series 90-30 PLC Installation Manual*.

RX3i Universal Backplanes: IC695CHS012, IC695CHS016

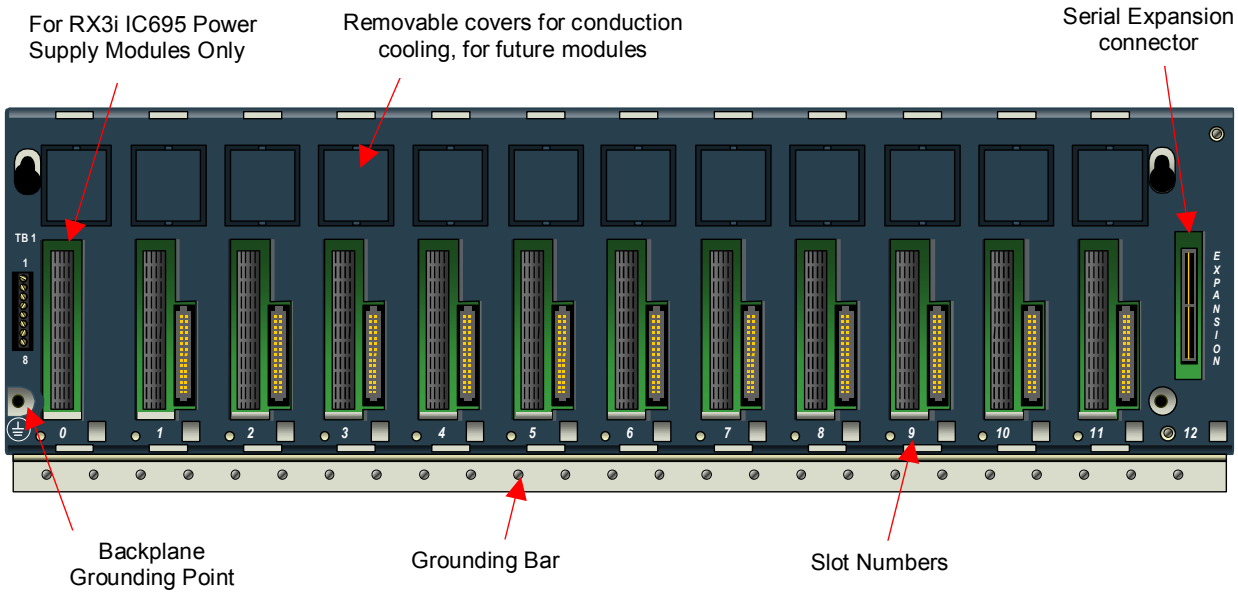
Two Universal Backplanes are available for RX3i PACSystems: the 16-slot Universal Backplane (IC695CHS016), and the 12-slot Universal Backplane (IC695CHS012), shown below.



The RX3i Universal Backplane supports both PCI (IC695) and serial (IC694) I/O and option modules with its dual-bus backplane. The RX3i Universal Backplane also supports 90-30 IO and option modules. See Chapter 1 for lists of supported modules.

RX3i modules (IC695 catalog numbers) communicate over the backplane's PCI bus. RX3i modules (IC694 catalog numbers) and Series 90-30 modules (IC693) communicate over the backplane's serial bus.

Universal Backplane Features



Features of the Universal Backplane include:

- Terminal Strip on the left end for future fan connection and Isolated +24V input
- Backplane grounding point as described in chapter 2
- An integral grounding bar for connecting module/shield grounds as described in chapter 2
- Removable covers that provide access for module conduction cooling (for future use).
- Serial Expansion connector for connection to Serial Expansion and Remote Backplanes
- Slot numbers are printed on the backplane and are used for reference for configuration in Machine Edition. Slots and connectors are described on the following pages. Most modules occupy one slot. Some, such as CPU modules and AC Power Supplies, are twice as wide, and occupy two slots.

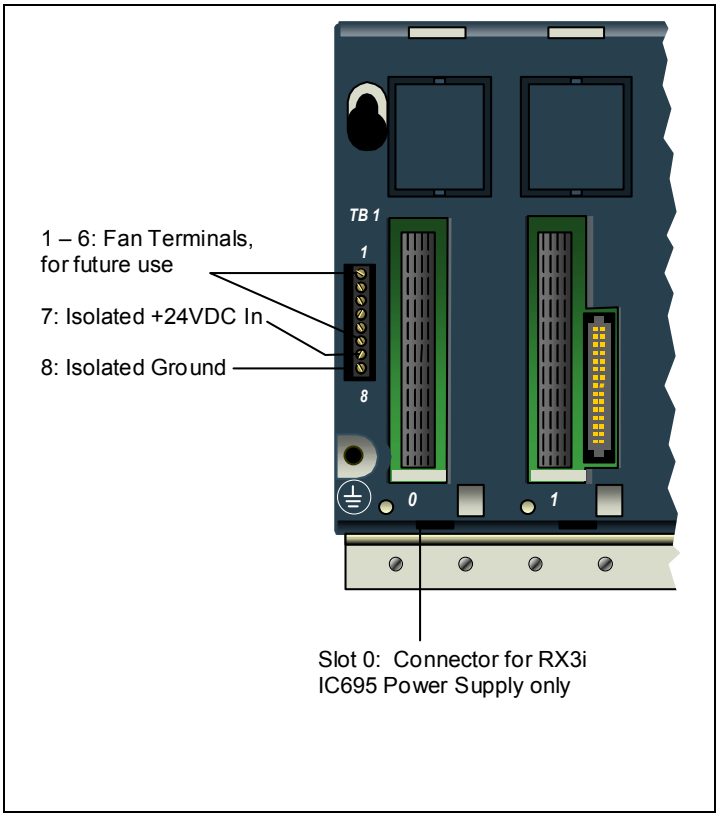
Universal Backplane TB1 Input Terminals

Terminals 1 through 6 on the left end of the Universal Backplane are reserved for external fan control (available in future systems).

The RX3i IC695 Power Supplies do not provide Isolated +24V output power over the backplane. Terminals 7 and 8 can be used to connect an optional external source of Isolated +24VDC, which is required for some IC693 and IC694 modules as listed in the table of Module Load Requirements in chapter 4.

These terminals accept individual wires from 14 to 22 AWG.

If modules that require Isolated +24VDC are installed in an Expansion Backplane instead, an external Isolated +24V power supply is not required.



Slot 0

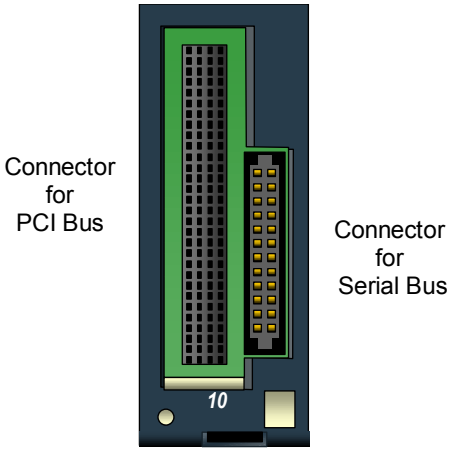
The leftmost slot in a Universal Backplane is slot 0. Only the backplane connector of IC695 Power Supplies can be installed in slot 0 (note: IC695 Power Supplies can be installed any slot). However two-slot wide modules that have right-justified connectors, like the CPU310 for example, can be plugged into slot 1and also cover slot 0.

The CPU is referenced for configuration and by user logic applications by the leftmost slot that it occupies. For example, if a CPU module is installed in slot 1, slot 0 is also occupied by the module and the CPU is considered by the configuration and logic to be in slot 0.

Slot 1 to Slot 11 or 15

Slots 1 through 11 or 15 have two connectors as shown at right, a connector for the RX3i PCI bus and connector for the RX3i serial bus. Each of these slots can accept any type of compatible module: IC695 Power Supply, IC695 CPU, or IC695, IC694 and IC693 I/O or option modules.

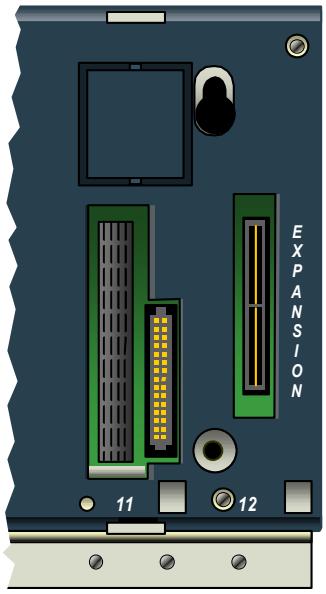
Provided the Hot Installation procedure described in chapter 2 is carefully followed, I/O and option modules in a Universal Backplane may be removed and replaced without powering-down.



Expansion Slot (Slot 12 or 16)

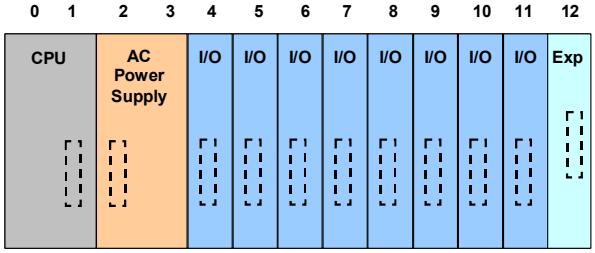
The rightmost slot in a Universal Backplane has a different connector than the other slots. It can only be used for an RX3i Serial Expansion Module (IC695LRE001).

An RX3i two-slot module cannot occupy this expansion slot.

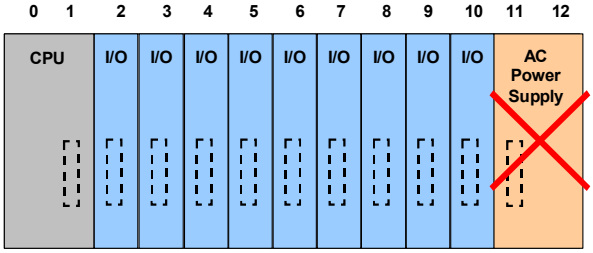


Module Locations in a Universal Backplane

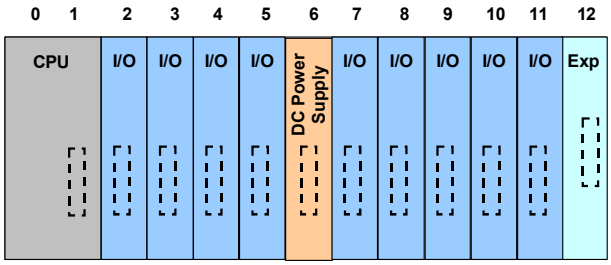
- IC695 Power Supply modules may be installed in any slot. DC Power Supply IC695PSD040 occupies 1 slot. AC Power Supply IC695PSA040 occupies 2 slots. RX3i (IC694) and Series 90-30 (IC693) Power Supplies cannot be installed in Universal Backplanes.
- An RX3i CPU module can be installed anywhere in the backplane except the Expansion slot. CPU modules occupy 2 slots.
- I/O and option modules can be installed in any available slot except slot 0, which can only accept IC695 Power Supplies, and the Expansion slot. Each I/O slot has two connectors, so either an RX3i PCI-based module or a serial module can be installed in any I/O slot.
- The rightmost slot is the expansion slot. It can only be used for optional serial expansion module IC695LRE001. See chapter 5 for information about the LRE001 Serial Expansion Module and expansion cables.



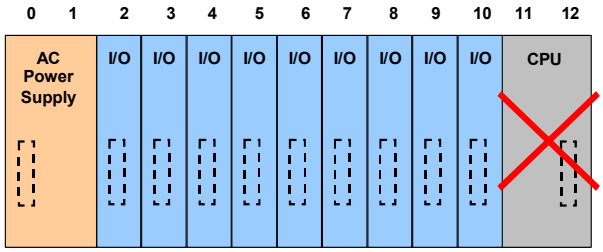
Configured as CPU in slot 0, Power Supply in slot 2



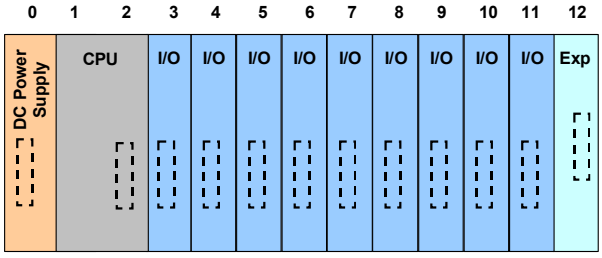
Invalid: AC Power Supply cannot be in Slot 11.



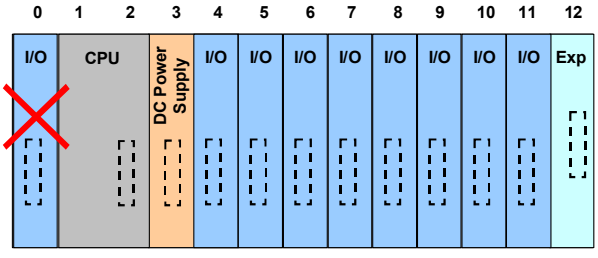
Configured as CPU in slot 0, Power Supply in slot 6



Invalid: CPU cannot be configured in slot 11



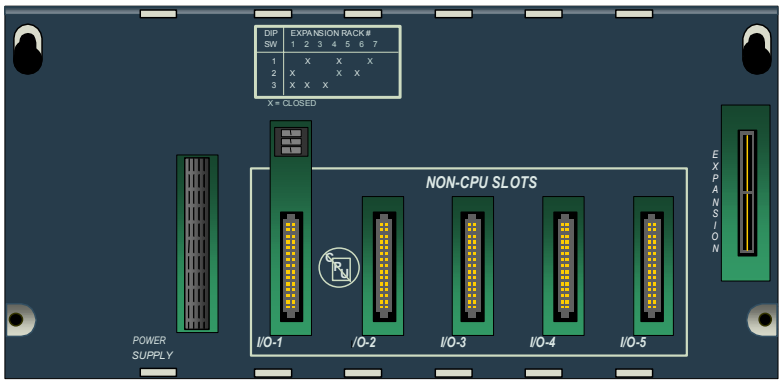
Configured as Power Supply in slot 0, CPU in slot 1



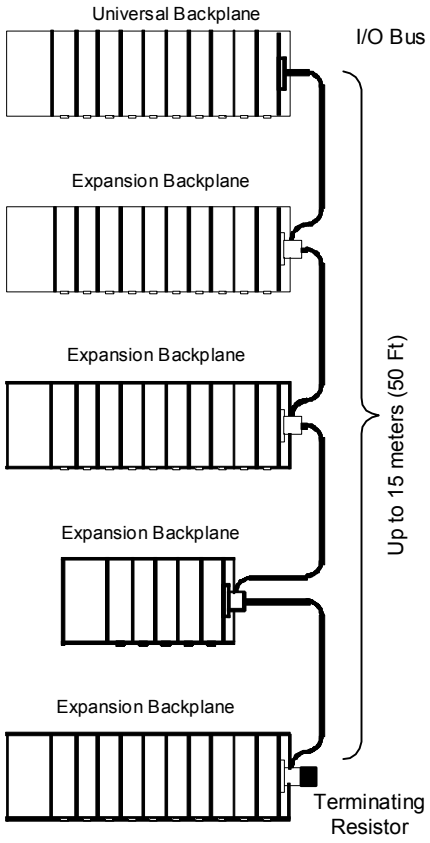
Invalid: Only a Power Supply can be installed in slot 0.

Serial Expansion Backplanes: IC694CHS392, IC694CHS398

The system can include any combination of up to seven RX3i Serial Expansion backplane and/or Series 90-30 Expansion/Remote Backplanes. RX3i Serial Expansion Backplanes are available with either 5 I/O slots (IC694CHS398, shown below) or 10 I/O slots (IC694CHS392).



- The leftmost module in an RX3i Serial Expansion Backplane must be a Serial Expansion Power Supply:
  - *IC694PWR321: Serial Expansion Power Supply, 120/240VAC, 125VDC*
  - *IC694PWR330: Serial Expansion Power Supply, 120/240VAC, 125VDC, High Capacity*
  - *IC694PWR331: Serial Expansion Power Supply, 24VDC, High Capacity*
- Module Hot Installation and Removal are NOT permitted on Expansion Backplanes.
- Each Expansion Backplane has a Rack Number Selection DIP switch that must be set before module installation. See chapter 2 for details.
- Each Expansion Backplane has a Bus Expansion connector at its right end for attaching an optional expansion cable. There can be no more than 50 feet (15 meters) of cable interconnecting Expansion backplanes with the Universal Backplane. If the system includes Series 90-30 Remote Backplanes, the additional requirements summarized in chapter 1 must also be observed.



Chapter 4 Power Supplies

This chapter describes Power Supplies for RX3i PACSystems:

Power Supply Type	***Catalog Number***
120/240 VAC, 125 VDC, 40 Watt Power Supply	IC695PSA040
24 VDC, 40 Watt Power Supply	IC695PSD040
120/240 VAC, 125 VDC, Serial Expansion Power Supply	IC694PWR321
120/240 VAC, 125 VDC, High Capacity Serial Expansion Power Supply	IC694PWR330
24 VDC, High Capacity Serial Expansion Power Supply	IC694PWR331

Power Supply Overview

This section provides a general description of the IC695 Power Supplies, which must be used in RX3i (IC695) Universal Backplanes, and IC694 Power Supplies, which must be used in RX3i Serial Expansion (IC694) Backplanes. Individual Power Supply specifications are listed in the sections that follow.

The IC695 Power Supplies provide up to 40 Watts each. The IC694 (Expansion) Power Supplies provide up to 30 Watts each. However, IC694PWR321 is limited to 15 Watts on the +5 VDC output.

The total of all outputs combined cannot exceed the stated load capacity in Watts. Machine Edition will automatically calculate the power consumption of modules as they are added to the system configuration. Power requirements of system modules are shown in this section, for reference when planning the system.

The maximum load for each type of Power Supply is shown below.

Catalog Number	***Can be Located In***	***Load Capacity****	***Nominal Input***	***Maximum +3.3 VDC***	***Maximum +5 VDC***	***Maximum +24 VDC Isolated***	***Maximum +24 VDC Relay***
IC695PSA040	Universal Backplane	40 Watts	120/240 VAC or 125 VDC	30 Watts	30 Watts	--	40 Watts
IC695PSD040	Universal Backplane	40 Watts	24 VDC	30 Watts	30 Watts	--	40 Watts
IC694PWR321	Serial Expansion Backplane	30 Watts	100/240 VAC or 125 VDC	--	15 Watts	20 Watts	15 Watts
IC694PRW330	Serial Expansion Backplane	30 Watts	100/240 VAC or 125 VDC	--	30 Watts	20 Watts	15 Watts
IC694PRW331	Serial Expansion Backplane	30 Watts	24 VDC	--	30 Watts	20 Watts	15 Watts

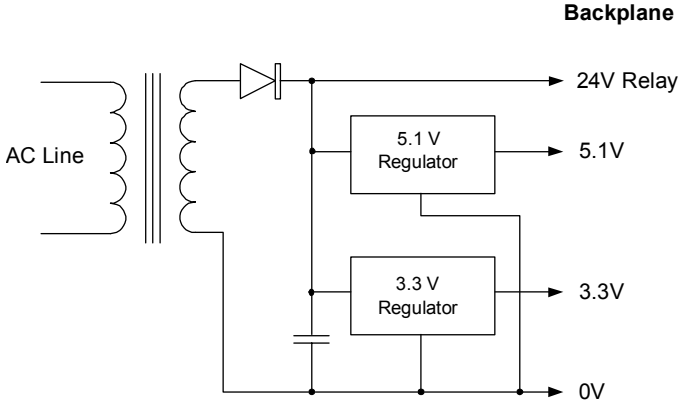
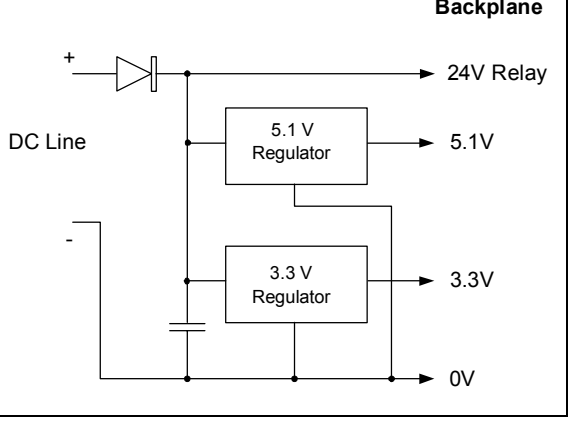
A power supply must be able to provide the total of the internal and external loads that may be placed upon it by all the hardware components in the backplane as well as the loads that may be connected to the Isolated +24 VDC supply on an expansion backplane.

24 VDC Isolated Power

The IC695 Power Supplies do not have Isolated +24 VDC output terminals. The RX3i Universal Backplane provides external input terminals (TB1) for connecting an optional Isolated +24 VDC external supply. Modules that draw +24 VDC from the backplane are listed in the table of Module Load Requirements that follows. (See Chapter 3 for more details on how to wire to TB1).

RX3i IC695 Power Supply Outputs

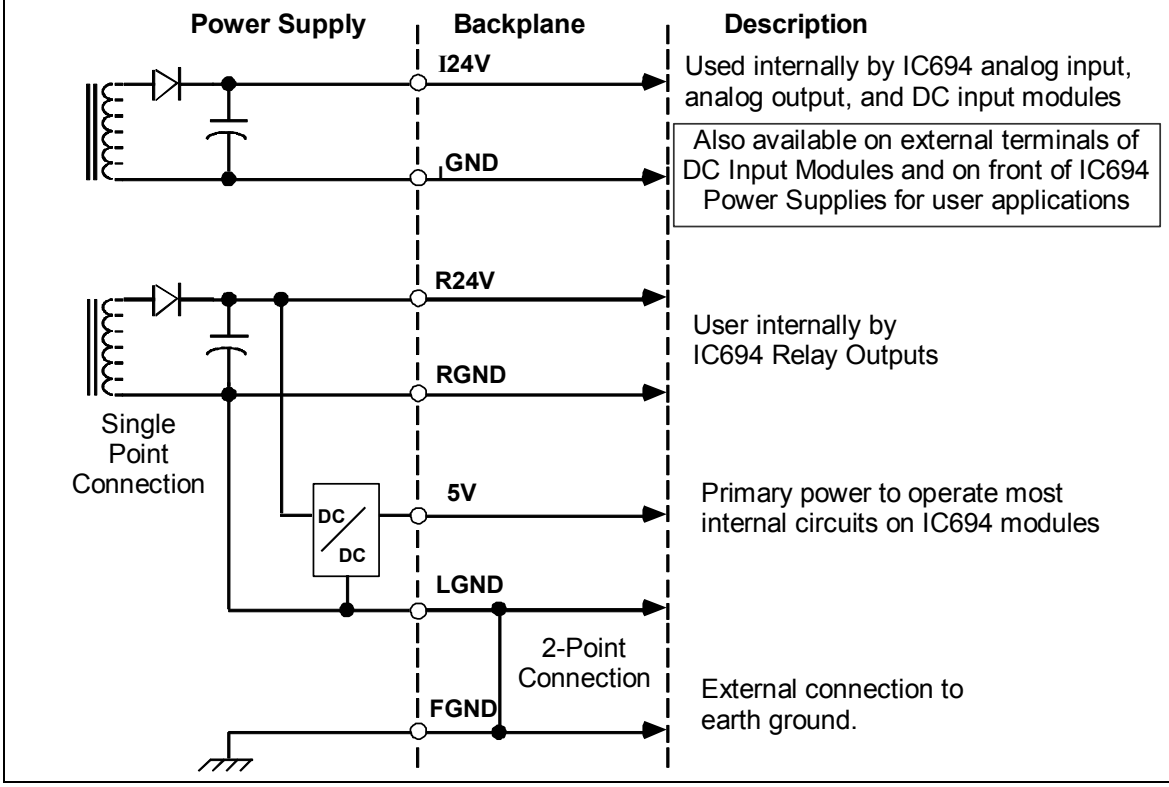
The IC695 power supplies have +5.1 VDC, +24 VDC Relay, and 3.3 VDC outputs that are connected internally on the backplane. The voltage and power required by modules installed on the backplane is supplied through the backplane connectors.

Outputs of Power Supply IC695PSA040	*Outputs of Power Supply IC695PSD040*
	

Expansion Power Supply Outputs

The IC694 power supplies have +5 VDC, Relay +24 VDC and Isolated +24 VDC outputs that are connected internally on the backplane. The voltage and power required by modules installed on the backplane is supplied through the backplane connectors.

Outputs of Power Supplies IC694PWR321, IC694PWR330, and IC694PWR331



Module Load Requirements

The table below summarizes the maximum load requirements in milliamps and Watts for RX3i modules. For I/O modules, the actual load may depend on the number of points on at the same time.

Catalog Number	***Module***	***+3.3 VDC***		***+5 VDC***		***+24 VDC Relay***		***+24 VDC Isolated***	
		mA	***Watts***	***mA***	***Watts***	***mA***	***Watts***	***mA***	***Watts***
IC695CHS012	Universal Backplane, 12-Slot	600	1.98	240	1.20	--	--	--	--
IC695CHS016	Universal Backplane, 16-Slot	600	1.98	240	1.20	--	--	--	--
IC695CPU310	300MHz CPU 10 Meg memory	1250	4.125	1000	5.00	--	--	--	--
IC695ETM001	Ethernet Module	840	2.772	614	3.07	--	--	--	--
IC695LRE001	Expansion Module	--	--	132	1.60	--	--	--	--
IC694ACC300	Input Simulator	--	--	120	0.60	-	-	--	--
IC694ACC307	Expansion Bus Termination Plug	--	--	72	0.36	-	-	-	-
IC694ALG220	Analog Input, Voltage, 4 Ch.	--	--	27	0.135	-	-	98	2.352
IC694ALG221	Analog Input, Current, 4 Ch	--	--	25	0.125	-	-	100	2.4
IC694ALG222	Analog Input, 8/16 Ch Voltage	--	--	112	0.56	-	-	41	0.984
IC694ALG223	Analog Input, 8/16 Ch, Current	--	--	120	0.60	-	-	-	-
IC694ALG390	Analog Output 2 Ch Voltage	--	--	32	0.16	-	-	120	2.88
IC694ALG391	Analog Output 2 Ch Current	--	--	30	0.15	-	-	215	5.16
IC694ALG392	Analog Output 8 CH Current/Voltage	--	--	110	0.55	-	-		
IC694ALG442	Analog Current/Voltage 4 Ch In / 2 Ch Out	--	--	95	0.475	-	-	129	3.096
IC694APU300	High-Speed Counter	--	--	250	0.125	-	-	-	-
IC694CHS392	Expansion/Remote Backplane, 10 Slot	--	--	150	0.75	-	-	-	-
IC694CHS398	Expansion/Remote Backplane, 5 Slot	--	--	170	0.85	-	-	-	-
IC694DSM314	Motion Controller	--	--	1300	6.50	-	-	-	-
IC694MDL230	120VAC Isolated, 8 Pt Input	--	--	60	0.30	-	-	-	-
IC694MDL231	240VAC Isolated 8 Pt Input	--	--	60	0.30	-	-	-	-
IC694MDL240	120VAC 16 Pt Input	--	--	90	0.45	-	-	-	-
IC694MDL241	24VAC/DC Pos/Neg Logic 16 Pts	--	--	80	0.40	-	-	125	3.00
IC694MDL310	120VAC 0.5A 12 Pt Output (all outputs on)	--	--	210	1.05	-	-	-	-
IC694MDL330	120/240VAC 0.5A 16 Pt Output (all outputs on)	--	--	160	0.80	-	-	-	-
IC694MDL340	120VAC 0.5A 16 Pt Output (all outputs on)	--	--	315	1.575	-	-	-	-
IC694MDL390	124/240VAC Isolated 2A 5Pt Out. (all outputs on)	--	--	110	0.55	-	-	-	-
IC694MDL632	125VDC Pos/Neg Logic 8 Pt Input	--	--	40	0.20	-	-	-	-
IC694MDL634	24VDC Pos/Neg Logic 8 Pt Input	--	--	45	0.225	-	-	62	1.488

Catalog Number	Module	+3.3 VDC		+5 VDC		+24 VDC Relay		+24 VDC Isolated	
		mA	Watts	mA	Watts	mA	Watts	mA	Watts
IC694MDL645	24VDC Pos/Neg Logic 16 Pt Input	--	--	80	0.40	-	-	125	3.00
IC694MDL646	24VDC Pos/Neg Logic FAST 16 Pt	--	--	80	0.40	-	-	125	3.00
IC694MDL654	5/12VDC (TTL) Pos/Neg 32 Pts 195 = (29mA + 0.5mA/point ON + 4.7mA/LED ON) 440mA (maximum) from +5V bus on backplane (if module isolated +5V supply used to power inputs and all 32 inputs ON)	--	--	195/440	0.975 / 2.20				
IC694MDL655	24VDC Pos/Neg 32 Pt Input (29mA +0.5mA/point ON +4.7mA/LED ON)	--	--	195	0.975	-	-	224 (typ)	5.376
IC694MDL732	12/24VDC Pos Logic 0.5A 8 Pt Out	--	--	50	0.25	-	-	-	-
IC694MDL734	125VDC Pos/Neg Logic 6 Pt Out. (all outputs on)	--	--	90	0.45	-	-	-	-
IC694MDL740	12/24 VDC Pos Logic 0.5A 16 Pt Out (all outputs on)	--	--	110	0.55	-	-	-	-
IC694MDL741	12/24VDC Neg Logic 0.5A 16 Pt Out.(all outputs on)	--	--	110	0.55	-	-	-	-
IC694MDL742	12/24VDC Pos Logic ESCP 1A 16 Pt Out.(all outputs on)	--	--	130	0.65	-	-	-	-
IC694MDL752	5/24VDC (TTL) Neg Logic 0.5A 32 Pt Output (13mA + 3 mA/point ON + 4.7 mA/LED)	--	--	260	1.30	-	-	-	-
IC694MDL753	12/24VDC Pos Logic 0.5A 32 Pt Output (13mA + 3mA/point ON + 4.7mA/LED)	--	--	260	1.3	-	-	-	-
IC694MDL930	Relay NO 4A Isolated 8 Pt Output (all outputs on)	--	--	6	0.03	70	1.68	-	-
IC694MDL931	Relay NC and Form C 8 A Isolated 8 Pt Output (all outputs on)	--	--	6	0.03	110	2.64	-	-
IC694MDL940	Relay NO 2A 16 Pt Output (all outputs on)	--	--	7	0.035	135	3.24	-	-

Power Supply Loading Example

To determine the total load placed on a Power Supply, add the current requirements of each module and the backplane.

For example:

Catalog Number	*Module*	*+3.3 VDC*	*+5.1 VDC*	*+24 VDC Relay*	*+24 VDC Isolated**
IC695CPU310	300MHz CPU 10 Meg memory	1250	1000	--	--
IC695CHS012	Universal Backplane, 12-Slot	600	240	-	-
IC695ETM001	Ethernet Module	840	614	--	--
IC695LRE001	Expansion Module	--	132	-	-
IC694ALG220	Analog Input, Voltage, 4 Ch.		27	-	98*
IC694ALG390	Analog Output 2 Ch Voltage		32	-	120*
IC694ALG442	Analog Current/Voltage 4 Ch In / 2 Ch Out	--	95		
IC694APU300	High-Speed Counter	-	250	-	-
IC694MDL340	120VAC 0.5A 16 Pt Output	-	315	-	-
IC694MDL230	120VAC Isolated, 8 Pt Input	--	60		
IC694MDL240	120VAC 16 Pt Input	--	90		
IC694MDL930	Relay NO 4A Isolated 8 Pt Output (all outputs on)	--	6	70	
IC694MDL931	Relay NC and Form C 8 A Isolated 8 Pt Output (all outputs on)	--	6	110	
	Total Amps	2.690	2.867	0.180	
	Converted to Watts	(x3.3V)	(x5.1V)	(x24V)	
	Power Consumption from Power Supply	=8.877W	=14.622W	=4.32W	
Total Power Consumption from Power Supply		8.877 + 14.622 + 4.32 = 27.817			

At ambient temperatures up to 32°C, Power Supply IC695PSA040 provides the following power outputs:

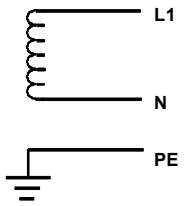
- 40 Watts maximum total
- 5.1VCD = 30 Watts maximum
- 3.3VDC = 30 Watts maximum

In this example, all of the module power requirements are met by Power Supply PSA040. Because the Universal Backplane and IC695 power supply do not provide +24 VDC Isolated power, an external +24 VDC supply will be required for analog modules ALG220, ALG221 and ALG222.

AC Power Supply Connections for Floating Neutral (IT) Systems

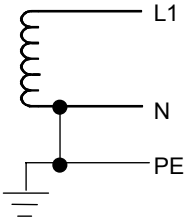
If an AC input power supply is installed in a system where the Neutral line is not referenced to Protective Earth Ground, special installation instructions must be followed to prevent damage to the power supply.

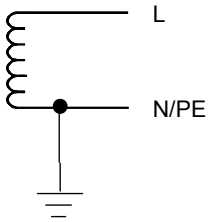
A *Floating Neutral System* is a system of power distribution wiring where Neutral and Protective Earth Ground are not tied together by negligible impedance. In Europe this is referred to as an IT system (see IEC950). In a *Floating Neutral System*, voltages measured from input terminals to protective earth ground may exceed the 264 Volts AC maximum input voltage power supply specification.

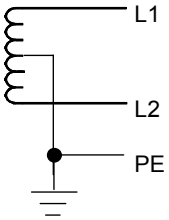


***Non*-Floating Neutral System**

Systems where one leg of the power distribution wiring is tied to Protective Earth or a tap between two legs of the power distribution wiring is tied to Protective Earth are not *Floating Neutral Systems*. Non-floating neutral systems **do not** require special installation procedures.







Instructions for Floating Neutral Systems

1. The input power terminals should be wired according to the instructions in this chapter.
2. For IC695 Power Supplies, no jumper may be installed between terminal 5 or 6 and terminal 7. For IC694 or IC693 Power Supplies. no jumper may be installed jumper between terminals 3 and 4 of the Power Supply module.
3. Voltage surge protection devices such as MOVs must be installed:
   - From L1 to earth ground
   - From L2 (Neutral) to earth ground

The voltage surge devices must be rated such that the system is protected from power line transients that exceed *Line voltage + 100V +(N-PE)$_{MAX.}$* The expression *N-PE* refers to the voltage potential between neutral and Protective Earth (PE) ground.

For example, in a 240 Volt AC system with neutral floating 50V above earth ground, the transient protection should be rated at: 240V + 100V + 50V = 390V

Power Supply, 120/240 VAC or 125 VDC, 40 Watt: IC695PSA040

Power Supply IC695PSA040 is a 40-Watt supply that operates from an input voltage source in the range of 85 to 264 VAC or 100 VDC to 300 VDC.

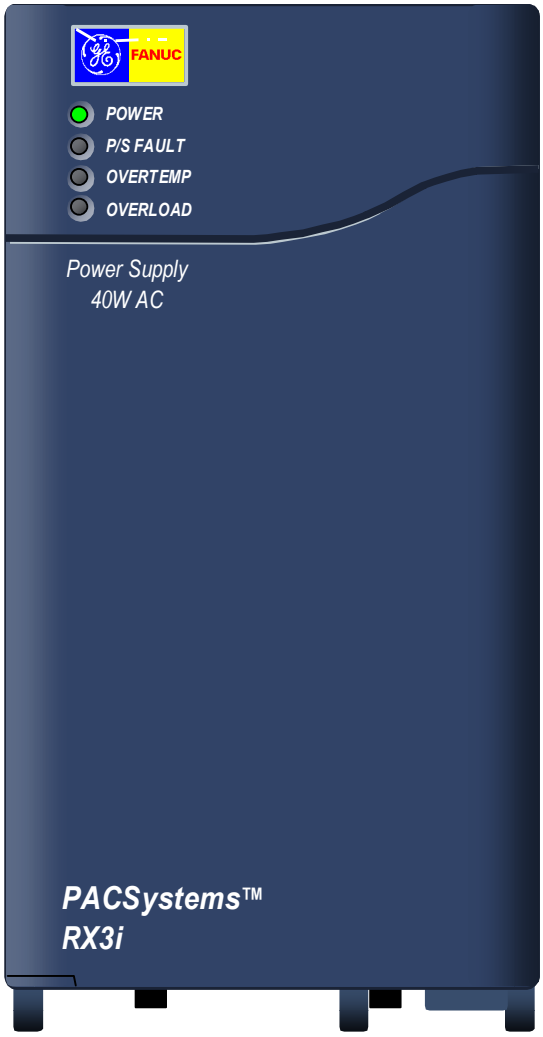
This power supply provides three outputs:

- +5.1 VDC output.
- +24 VDC relay output that can be used to power circuits on Output Relay modules.
- +3.3 VDC. This output is used internally by RX3i modules with IC695 catalog numbers.

Only one IC695PSA040 can be used in a PACSystems RX3i (IC695 catalog number) Universal Backplane. It occupies two slots. This Power Supply cannot be used with other RX3i power supplies in redundant or increased capacity modes.

If the number of modules required exceeds the capacity of the Power Supply, the additional modules must be installed in Expansion or Remote backplanes.

The Power Supply indicates when an internal fault occurs so the CPU can detect loss of power or log the appropriate fault code.

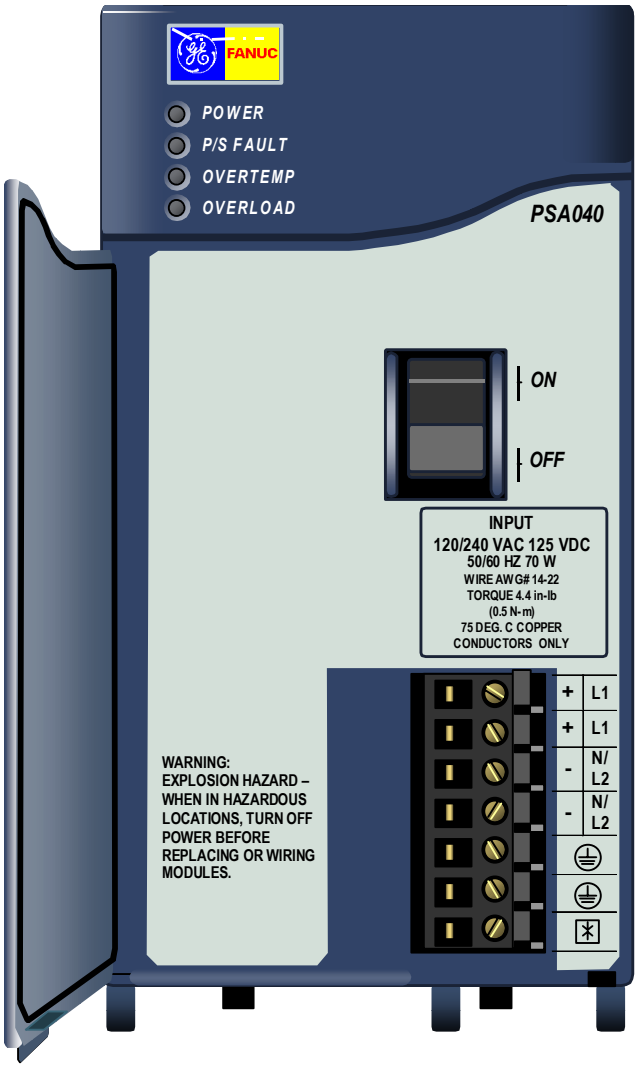


LEDs

Four LEDs on the Power Supply indicate:

- Power (Green/Amber). When this LED is green, it indicates power is being supplied to the backplane. When this LED is amber, power is applied to the Power Supply but the Power Supply switch is off.
- P/S Fault (Red). When this LED is lit, it indicates the Power Supply has failed and is no longer supplying sufficient voltage to the backplane.
- Over Temperature (Amber). When this LED is lit, it indicates the Power Supply is near or exceeding its maximum operating temperature.
- Overload (Amber). When this LED is lit, it indicates the Power Supply is near or exceeding its maximum output capability on at least one of its outputs.

The CPU Fault Table shows a fault if any Overtemperature, Overload, or P/S Fault occurs.



On/Off Switch

The ON/OFF switch is located behind the door on the front of the module. The switch controls the operation of the outputs of the supply. It does NOT interrupt line power. Projecting tabs next to the switch help prevent accidentally turning it on or off.

Wiring Terminals

Terminals for power, ground, and MOV disconnect accept individual 14 to 22 AWG wires.

Specifications: IC695PSA040

Nominal Rated Voltage **Input Voltage Range** **AC** **DC**	120/240 VAC or 125 VDC 85 to 264 VAC 100 to 300 VDC
Input Power (Maximum with Full Load) **Inrush Current**	70 Watts maximum 4 Amps, 250 milliseconds maximum *
Output Power	40 Watts maximum total 5.1 VDC = 30 Watts maximum 3.3 VDC = 30 Watts maximum The maximum total output power available depends on the ambient temperature, as shown.
Output Voltage	24 VDC: 19.2 VDC to 28.8 VDC 5.1 VDC: 5.0 VDC to 5.2 VDC (5.1 VDC nominal) 3.3 VDC: 3.1 VDC to 3.5 VDC (3.3 VDC nominal)
Output Current	24 VDC: 0 to 1.6 Amps 5.1 VDC: 0 to 6 Amps 3.3 VDC: 0 to 9 Amps
Isolation (input to backplane):	250 VAC continuous; 1500 VAC for 1 minute
Ripple (all outputs)	150 mV
Noise (all outputs)	150 mV
Ride-through time	20 ms. This is the length of time the Power Supply maintains valid outputs if the power source is interrupted
Wiring Terminals	Each terminal accepts one 14 AWG to 22 AWG wire.
Current per Terminal	6 Amps
Number of Daisy-Chained PSA040 Supplies	Up to 4

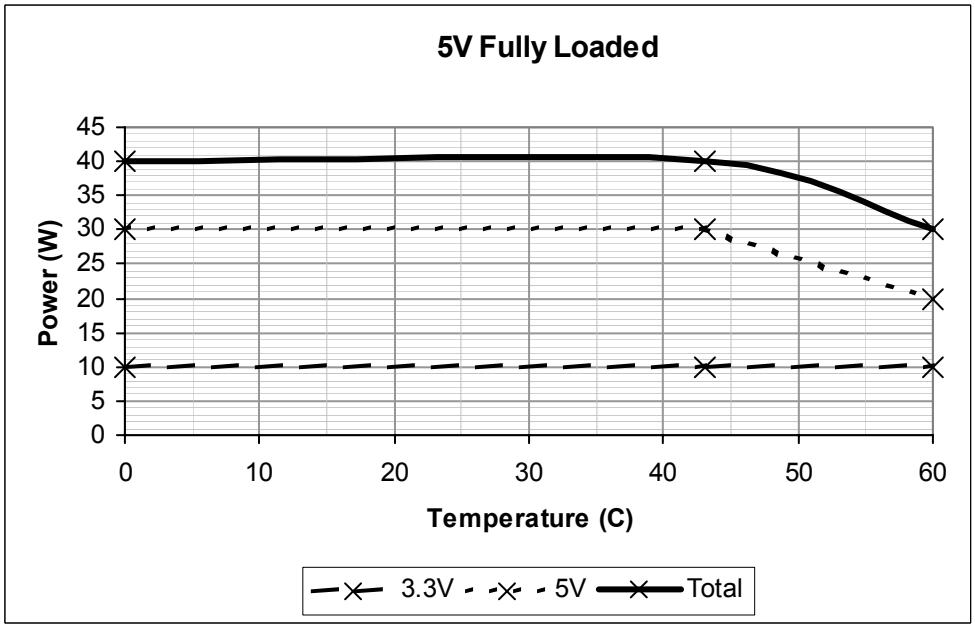
* The Inrush Current specification is given as a guide for sizing the external power source for the IC695PSA040. Peak inrush current may be higher for shorter durations.

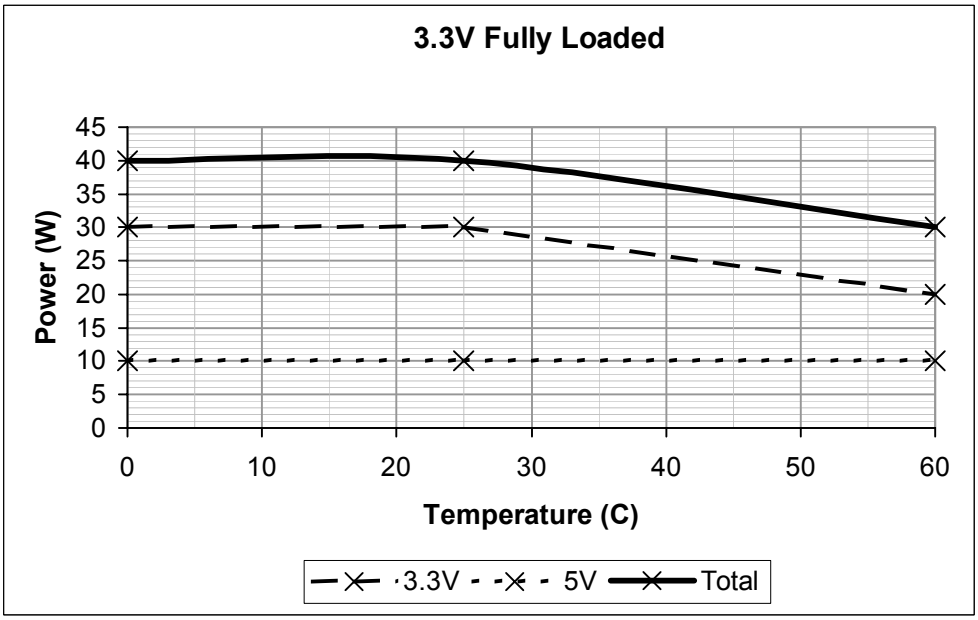
Warning

The power supply's door must be closed. During normal operation with an AC power source either 120 VAC or 240 VAC is present on the AC Power Supply. The door protects against accidental shock hazard that could cause severe or fatal injury to personnel.

Thermal Deratings

The maximum output power for Power Supply PSA040 depends on the ambient temperature, as shown below. Full output power is available up to at least 32°C (89.6°F).





Overcurrent Protection

The 5.1 VDC output is electronically limited to 7 Amps. The 3.3 VDC output is limited to10 Amps. If an overload (including short circuits) occurs, it is sensed internally and the Power Supply shuts down. The Power Supply continually tries to restart until the overload condition is removed. An internal, non-repariable, fuse in the input line is provided as a backup. The Power Supply usually shuts down before the fuse blows. The fuse also protects against internal supply faults The CPU Fault Table shows a fault if any Overtemperature, Overload, or P/S Fault occurs. There is no additional indication if the Power Supply fuse blows

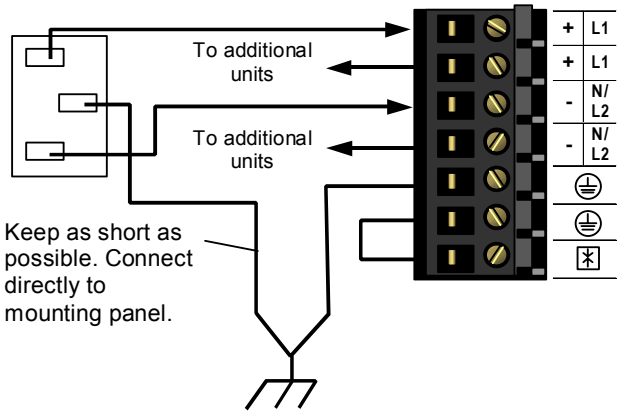
Field Wiring: IC695PSA040

Power Source and Ground Connections

The wires from the power source and ground connect to the terminals on the Power Supply as shown at right. Each terminal accepts one AWG 14 to AWG 22 wire.

Warning

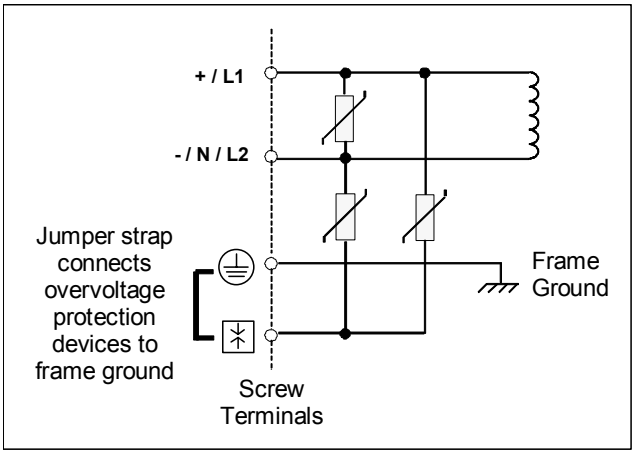
If the same external AC power source is used to provide power to two or more RX3i power supplies in the system, connection polarity must be identical at each power supply. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each backplane must be connected to a common system ground.



Input Overvoltage Protection

The bottom terminal is normally connected to frame ground with a user-installed jumper as shown lower right. If overvoltage protection is not required or is supplied upstream, no jumper is needed.

To Hi-pot test this supply, overvoltage protection must be disabled during the test by removing the jumper. Re-enable overvoltage protection after testing by reinstalling the jumper.



In systems with a floating neutral input (the neutral line is not referenced to Protective Earth Ground), this jumper must NOT be installed. In addition, in a floating neutral system, voltage surge protection devices such as MOVs **must** be installed from L1 to earth ground, and from L2 (Neutral) to earth ground.

Power Supply, 24 VDC, 40 Watt: IC695PSD040

Power Supply IC695PSD040 is a 40-Watt supply that operates from an input voltage source in the range of 18 VDC to 39 VDC.

- +5.1 VDC output.
- +24 VDC relay output that can be used to power circuits on Output Relay modules.
- +3.3 VDC. This output is used internally by RX3i modules with IC695 catalog numbers.

Only one IC695PSD040 can be installed in a PACsystems RX3i (IC695 catalog number) Universal Backplane. This Power supply cannot be used with other RX3i power supplies in redundant or increased capacity modes.

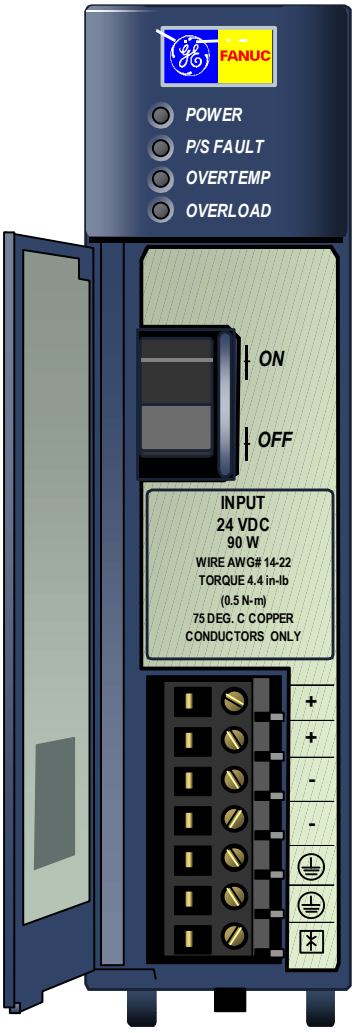
It occupies one slot. If the number of modules required exceeds the capacity of the Power Supply, the additional modules must be installed in Expansion or Remote backplanes.

The Power Supply indicates when an internal fault occurs so the CPU can detect loss of power or log the appropriate fault code.

LEDs

Four LEDs on the Power Supply indicate:

- Power (Green/Amber). When this LED is green, it indicates power is being supplied to the backplane. When this LED is amber, power is applied to the Power Supply but the Power Supply switch is off.
- P/S Fault (Red). When this LED is lit, it indicates the Power Supply has failed and is no longer supplying sufficient voltage to the backplane.
- Over Temperature (Amber). When this LED is lit, it indicates the Power Supply is near or exceeding its maximum operating temperature.
- Overload (Amber). When this LED is lit, it indicates the Power Supply is near or exceeding its maximum output capability on at least one of its outputs.



If the red P/S FAULT LED is lit, the Power Supply has failed and is no longer supplying sufficient voltage to the backplane .

The amber OVERTEMP and OVERLOAD LEDs light to warn of high temperature or high load conditions.

The CPU Fault Table shows a fault if any Overtemperature, Overload, or P/S Fault occurs.

On/Off Switch

The ON/OFF switch is located behind the door on the front of the module. The switch controls the operation of the outputs of the supply. It does NOT interrupt line power. A projecting tab next to the switch helps prevent accidentally turning it on of off.

Wiring Terminals

Terminals for +24V and –24V power, ground, and MOV disconnect accept individual 14 to 22AWG wires.

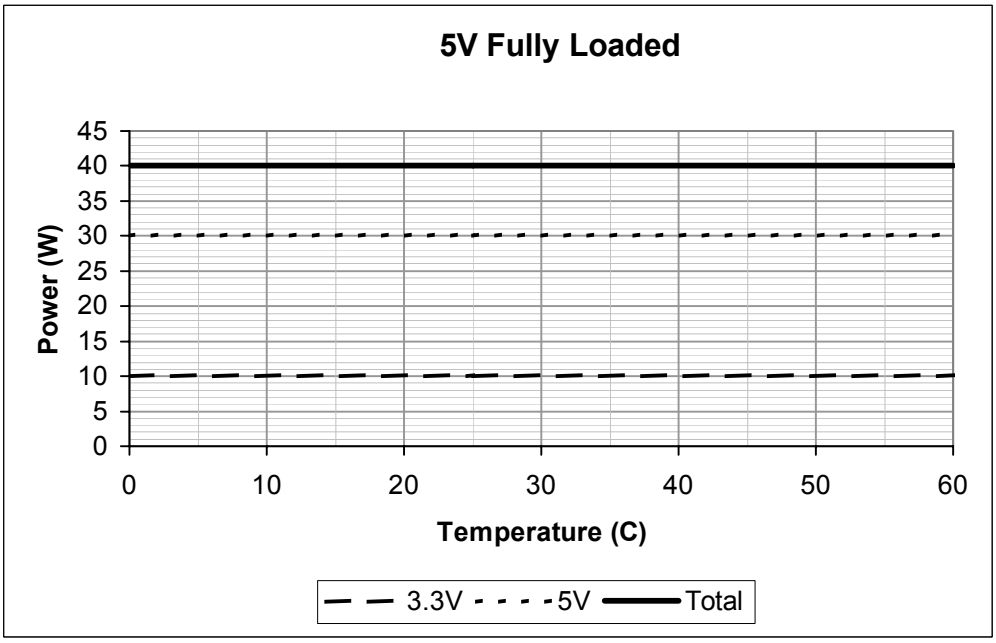
Specifications: IC695PSD040

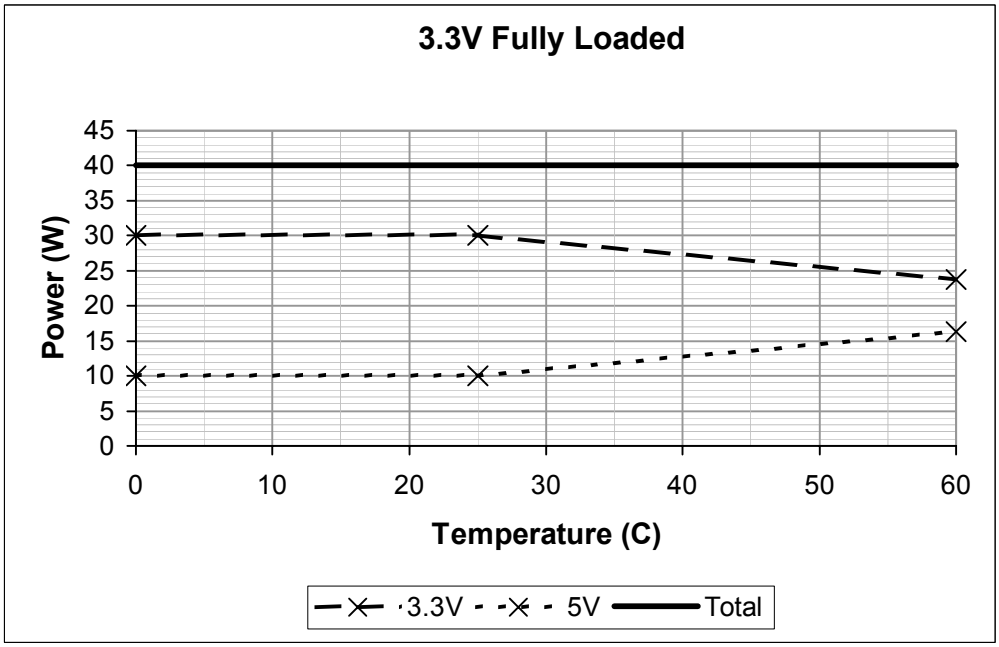
Nominal Rated Voltage **Input Voltage Range** **Start** **Run**	24 VDC 18 to 30 VDC 12 to 30 VDC
Input Power **Inrush Current**	60 Watts maximum at full load 4 Amps, 100 milliseconds maximum *
Output Power	40 Watts maximum total of both outputs. 5.1 VCD = 30 Watts maximum 3.3 VDC = 30 Watts maximum Maximum output power depends on ambient temperature, as shown.
Output Voltage	5.1 VDC: 5.0 VDC to 5.2 VDC (5.1 VDC nominal) 3.3 VDC: 3.1 VDC to 3.5 VDC (3.3 VDC nominal)
Output Current	5.1 VDC: 0 to 6 Amps 3.3 VDC: 0 to 9 Amps
Isolation	NONE
Ripple (all outputs)	50 mV
Noise (all outputs)	50 mV
Ride-through time	10 ms This is the length of time the Power Supply maintains valid outputs if the power source is interrupted
Wiring Terminals	Each terminal accepts one 14 AWG to 18 AWG wire.
Terminal Current	6 Amps
Number of Daisy-Chained PSD040 Supplies	Up to 2

* The Inrush Current specification is given as a guide for sizing the external power source for the IC695PSD040. Peak inrush current may be higher for shorter durations.

Thermal Deratings

The maximum output power for Power Supply PSD040 depends on the ambient temperature, as shown below. Full output power is available up to at least 40°C (89.6°F).





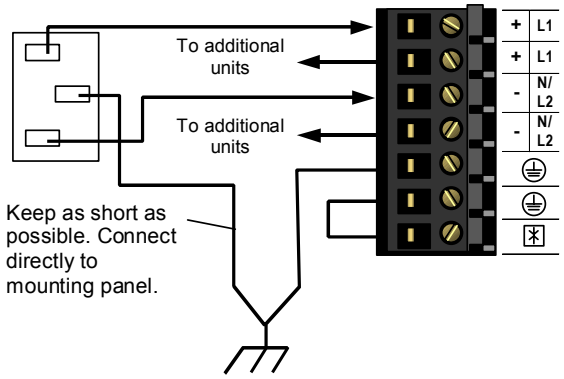
Overcurrent Protection

The 5.1 VDC output is electronically limited to 7 Amps. The 3.3 VDC output is limited to 10 Amps. If an overload (including short circuits) occurs, it is sensed internally and the Power Supply shuts down. The Power Supply continually tries to restart until the overload condition is removed. An internal fuse in the input line is provided as a backup. The Power Supply usually shuts down before the fuse blows. The fuse also protects against internal supply faults. The CPU Fault Table shows a fault if any Overtemperature, Overload, or P/S Fault occurs. There is no additional indication if the Power Supply fuse blows

Field Wiring: IC695PSD040

Power Source and Ground Connections

The wires from the power source and ground connect to the terminals on the Power Supply as shown at right. Each terminal accepts one AWG 14 to AWG 22 wire.



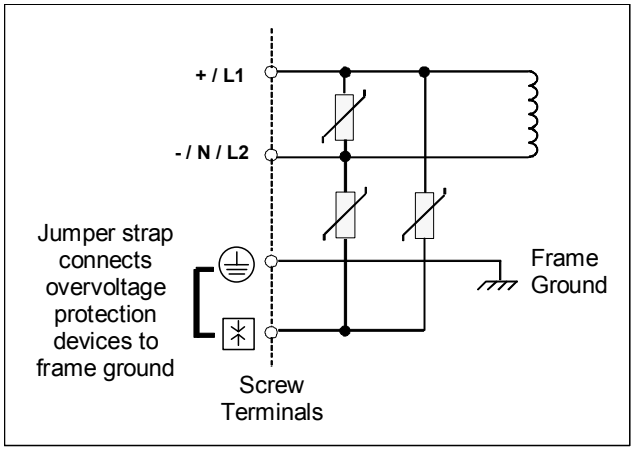
Warning

If the same external DC power source is used to provide power to two or more power supplies in the system, connection polarity must be identical at each RX3i power supply. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each backplane must be connected to a common system ground.

Input Overvoltage Protection

The bottom terminal is normally connected to frame ground with a user-installed jumper as shown at lower right. If overvoltage protection is not required or is supplied upstream, no jumper is required.

To Hi-pot test this supply, overvoltage protection must be disabled during the test by removing the jumper. Re-enable overvoltage protection after testing by reinstalling the jumper.



Warning

This power supply is not isolated and is therefore not compatible with floating or positive grounded systems.

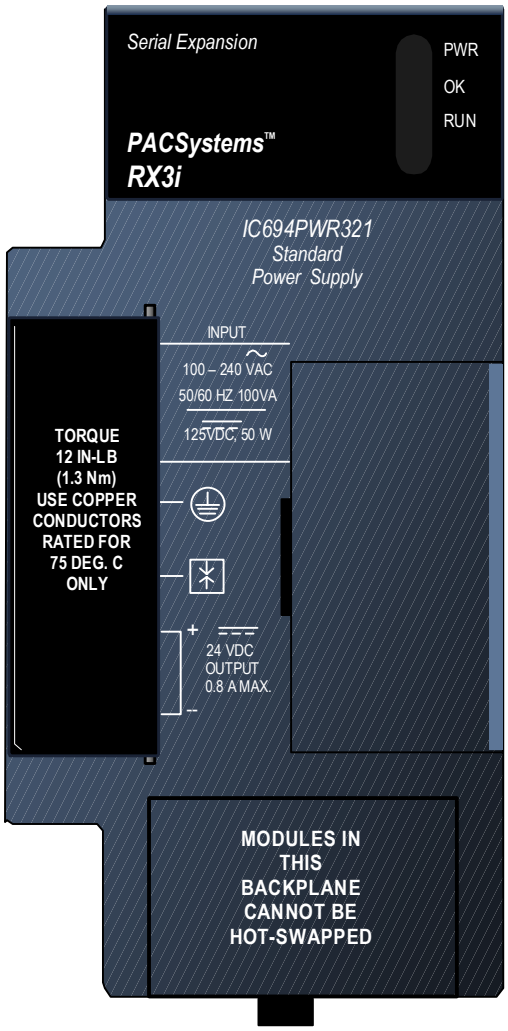
Power Supply, 120/240 VAC or 125 VDC: IC694PWR321

Power Supply IC694PWR321 is a 30-Watt supply that operates from an input voltage source in the range of 85 VAC to 264 VAC or 100 VDC to 300 VDC.

This power supply provides three outputs:

- +5 VDC output.
- Relay +24 VDC output that can be used to power circuits on Output Relay modules.
- Isolated +24 VDC. This power is used internally by some modules. It can also be used to power field devices connected to 24 VDC Input modules.

Power Supply IC694PWR321 can be used in an Expansion backplane in an RX3i system. The battery backup and serial port functions are not available in Expansion Backplanes.



LEDs

The green PWR LED shows the operating state of the Power Supply. PWR is ON when the Power Supply has a correct source of power and is operating properly. It is OFF when a Power Supply fault occurs or power is not applied.

The green OK LED is steady ON if the PLC is operating properly. It is OFF if a problem is detected by the PLC.

The green RUN LED is ON when the PLC is in Run mode.

Specifications: IC694PWR321

Nominal Rated Voltage **Input Voltage Range** **AC** **DC**	120/240 VAC or 125 VDC 85 VDC to 264 VAC 100 VDC to 300 VDC
Input Power (Maximum with Full Load) **Inrush Current**	90 VA with VAC Input 50 W with VDC Input 4 Amperes peak, 250 milliseconds maximum
Output Power	5 VDC and 24 VDC Relay: 15 Watts maximum 24 VDC Relay: 15 Watts maximum 24 VDC Isolated: 20 Watts maximum *NOTE: 30 Watts maximum total (all three outputs)*
Output Voltage	5 VDC: 5.0 VDC to 5.2 VDC (5.1 VDC nominal) Relay 24 VDC: 24 VDC to 28 VDC Isolated 24 VDC: 21.5 VDC to 28 VDC
Isolation (input to backplane):	1500 VAC (for 1 minute)
Protective Limits **Overvoltage:** **Overcurrent:**	 5 VDC output: 6.4 VDC to 7 VDC 5 VDC output: 4 Amperes maximum
Ride-through Time:	20 milliseconds minimum This is the length of time the Power Supply maintains valid outputs if the power source is interrupted.
Fuse	2 Amps, GE Fanuc part number 44A724627-109 (2). See chapter 2 for more information.

Overcurrent Protection

The 5 VDC output is electronically limited to 3.5 Amps. If an overload (including short circuits) occurs, it is sensed internally and the Power Supply shuts down. The Power Supply continually tries to restart until the overload condition is removed. An internal fuse in the input line is provided as a backup. The Power Supply usually shuts down before the fuse blows. The fuse also protects against internal supply faults.

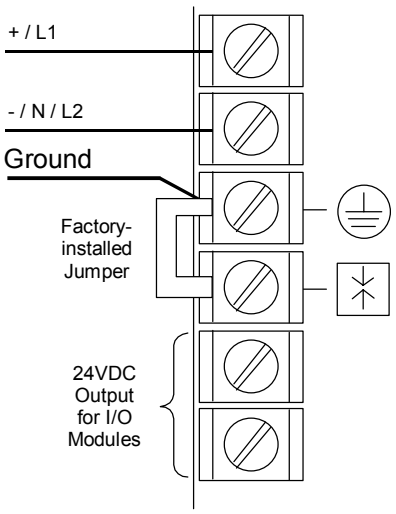
Warning

The power supply's door must be closed. During normal operation with an AC power source either 120 VAC or 240 VAC is present on the AC Power Supply. The door protects against accidental shock hazard that could cause severe or fatal injury to personnel.

Field Wiring: IC694PWR321

AC Power Source Connections

The Hot, Neutral, and Ground wires from the 120 VAC power source or L1, L2, and Ground wires from the 240 VAC power source connect to the top three terminals on the Power Supply.



DC Power Source Connections

Connect the + and - wires from the 125 VDC power source to the top two terminals. These connections are not polarity-sensitive on Power Supply PWR321.

Warning

If the same external DC power source is used to provide power to two or more power supplies in the system, connection polarity must be identical at each power supply. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each backplane must be connected to a common system ground.

The bottom two terminals of the power supply terminal strip provide output connections to the Isolated +24 VDC. This output can be used to provide power for external circuits (within power limitations of the supply).

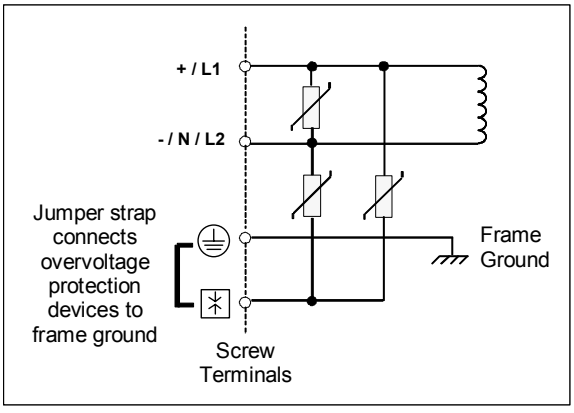
Caution

If the Isolated 24 VDC supply is overloaded or shorted, the PLC will stop operation.

Input Overvoltage Protection

Terminal 4 is normally connected to frame ground (terminal 3) with a factory-installed jumper strap. If overvoltage protection is not required or is supplied upstream, this feature can be disabled by removing the jumper.

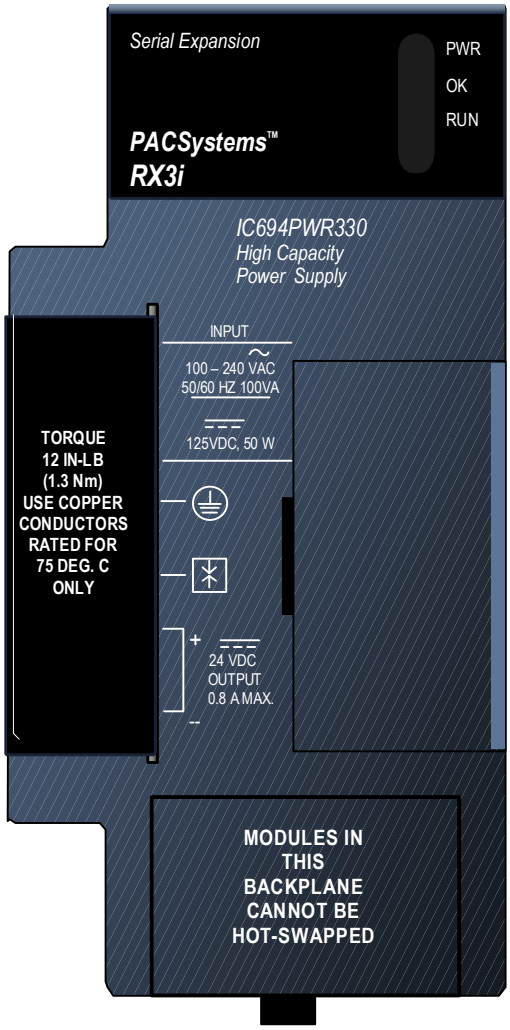
To Hi-pot test this supply, overvoltage protection must be disabled during the test by removing the terminal strip jumper. Re-enable overvoltage protection after testing by reinstalling the strap.



In systems with a floating neutral input (the neutral line is not referenced to Protective Earth Ground), this jumper must NOT be installed. In a floating neutral system, voltage surge protection devices such as MOVs **must** be installed from L1 to earth ground, and from L2 (Neutral) to earth ground.

Power Supply, 120/240 VAC or 125 VDC High Capacity: IC694PWR330

High Capacity Power Supply IC694PWR330 is rated for 30 Watts. It allows all 30 watts to be consumed from the +5 VDC output. This Power Supply operates from an input voltage source in the range of 85 to 264 VAC or 100 to 300 VDC.



PWR330 Power supplies provide the following outputs:

- +5 VDC output.
- Relay +24 VDC which provides power to circuits on Output Relay modules.
- Isolated +24 VDC, which is used internally by some modules, can also be used to provide external power for 24 VDC Input modules.

Power Supply IC694PWR330 must be installed in an Expansion backplane in an RX3i system. The battery backup and serial port functions are not available in Expansion Backplanes.

LEDs

The green PWR LED shows the operating state of the Power Supply. PWR is ON when the Power Supply has a correct source of power and is operating properly. It is OFF when a Power Supply fault occurs or power is not applied.

The green OK LED is steady ON if the PLC is operating properly. It is OFF if a problem is detected by the PLC.

The green RUN LED is ON when the PLC is in Run mode.

Specifications: IC694PWR330

Nominal Rated Voltage **Input Voltage Range** **AC** **DC**	120/240 VAC or 125 VDC 85 VAC to 264 VAC 100 VDC to 300 VDC
Input Power (Maximum with Full Load) **Inrush Current**	100 VA with VAC Input 50 W with VDC Input 4 Amperes peak, 250ms maximum
Output Power	5 VDC: 30 Watts maximum 24 VDC Relay: 15 Watts maximum 24 VDC Isolated: 20 Watts maximum *NOTE: 30 Watts maximum total (all three outputs)*
Output Voltage	5 VDC: 5.0 VDC to 5.2 VDC (5.1 VDC nominal) 24 VDC Relay: 24 VDC to 28 VDC 24 VDC Isolated: 21.5 VDC to 28 VDC
Isolation (input to backplane):	1500 VAC (for 1 minute)
Protective Limits **Overvoltage:** **Overcurrent:**	 5 VDC output: 6.4 VDC to 7 VDC 5 VDC output: 7 Amperes maximum
Ride-through Time:	20 ms minimum. This is the length of time the Power Supply maintains valid outputs if the power source is interrupted.
Fuse	2 Amps, GE Fanuc part number 44A724627-109 (2). See chapter 2 for more information.

Overcurrent Protection

The 5 VDC output is electronically limited to 7 Amps. If an overload (including short circuits) occurs, it is sensed internally and the Power Supply shuts down. The Power Supply continually tries to restart until the overload condition is removed. An internal fuse in the input line is provided as a backup. The Power Supply usually shuts down before the fuse blows. The fuse also protects against internal supply faults.

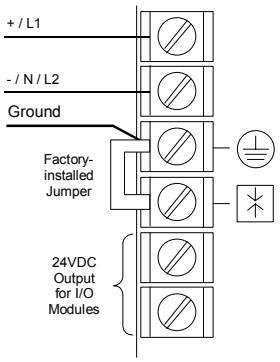
Warning

The power supply's door must be closed. During normal operation with an AC power source either 120 VAC or 240 VAC is present on the AC Power Supply. The door protects against accidental shock hazard that could cause severe or fatal injury to personnel.

Field Wiring: IC694PWR330

AC Power Source Connections

The Hot, Neutral, and Ground wires from the 120 VAC power source or L1, L2, and Ground wires from the 240 VAC power source connect to the top three terminals on the Power Supply.



DC Power Source Connections

Connect the + and - wires from the 125 VDC power source to the top two terminals. These connections are not polarity-sensitive on Power Supply PWR330.

Warning

If the same external DC power source is used to provide power to two or more power supplies in the system, connection polarity must be identical at each power supply. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each backplane must be connected to a common system ground.

The bottom two terminals of the power supply terminal strip provide output connections to the Isolated +24 VDC. This output can be used to provide power for external circuits (within power limitations of the supply).

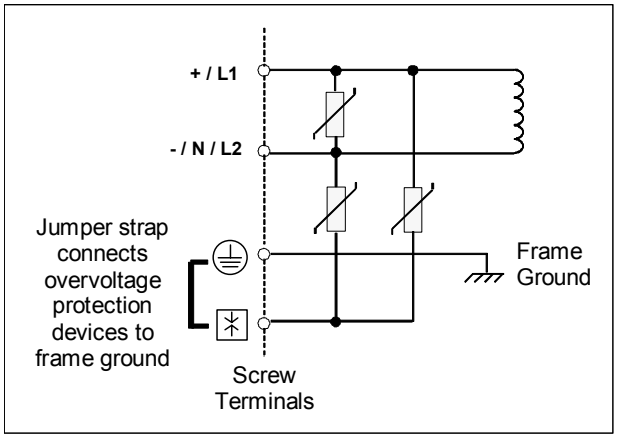
Caution

If the Isolated 24 VDC supply is overloaded or shorted, the PLC will stop operation.

Input Overvoltage Protection

Terminal 4 is normally connected to frame ground (terminal 3) with a factory-installed jumper strap. If overvoltage protection is not required or is supplied upstream, this feature can be disabled by removing the jumper.

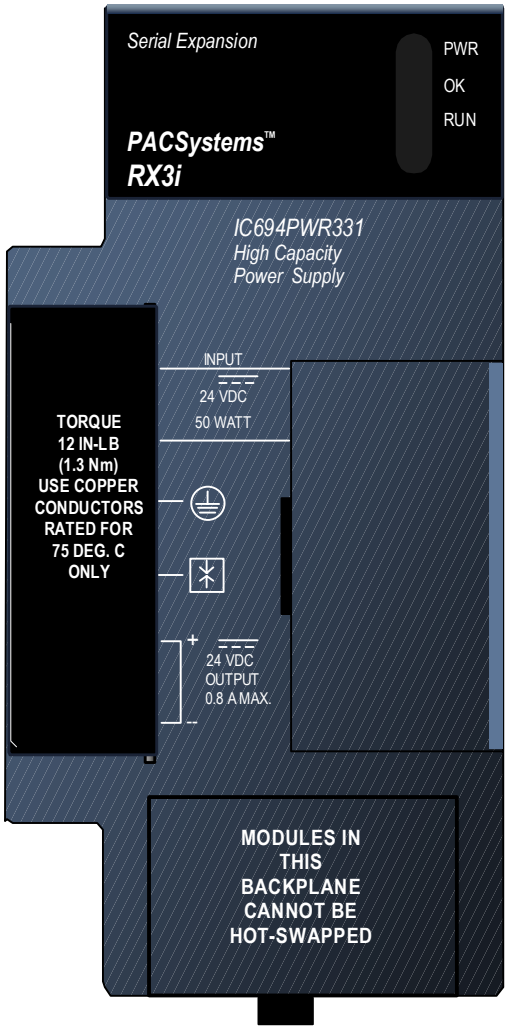
To Hi-pot test this supply, overvoltage protection must be disabled during the test by removing the terminal strip jumper. Re-enable overvoltage protection after testing by reinstalling the strap.



In systems with a floating neutral input (the neutral line is not referenced to Protective Earth Ground), this jumper must NOT be installed. In a floating neutral system, voltage surge protection devices such as MOVs **must** be installed from L1 to earth ground, and from L2 (Neutral) to earth ground.

Power Supply, 24 VDC High-Capacity: IC694PWR331

High Capacity Power Supply IC694 PWR331 is rated for 30 Watts output. For applications requiring greater +5 VDC current capacity than is available with a standard supply (PWR321), a High-Capacity Power Supply allows all 30 watts to be consumed from the +5 VDC supply. This supply can operate from an input voltage source in the range of 12 VDC to 30 VDC. Although it is capable of maintaining all outputs within specifications with input voltages as low as 12 VDC, it requires an initial input voltage of 18 VDC to start up.



PWR331 Power supplies provide the following outputs:

- +5 VDC output.
- Relay +24 VDC, which provides power to circuits on Output Relay modules.
- Isolated +24 VDC, which is used internally by some modules, can also be used to provide external power for 24 VDC Input modules.

Power Supply IC694PWR331 must be installed in an Expansion backplane in an RX3i system. The battery backup and serial port functions are not available in Expansion Backplanes.

LEDs

The green PWR LED shows the operating state of the Power Supply. PWR is ON when the Power Supply has a correct source of power and is operating properly. It is OFF when a Power Supply fault occurs or power is not applied.

The green OK LED is steady ON if the PLC is operating properly. It is OFF if a problem is detected by the PLC.

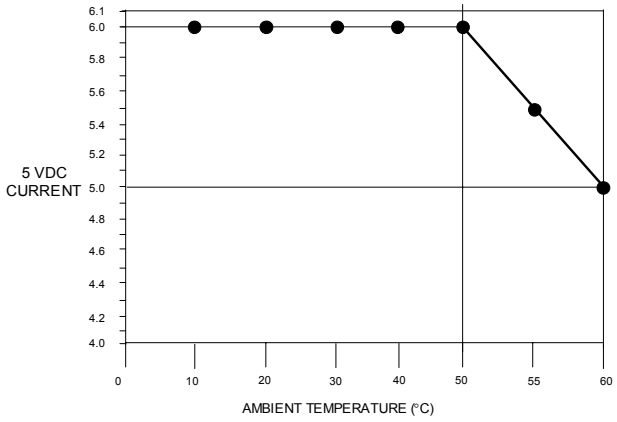
The green RUN LED is ON when the PLC is in Run mode.

Specifications: IC694PWR331

Nominal Rated Voltage **Input Voltage Range** **Start** **Run**	24 VDC 18 VDC to 30 VDC 12 VDC to 30 VDC
Input Power **Inrush Current**	50 Watts maximum at full load 4 Amps peak, 100 milliseconds, maximum
Output Power	5 VDC: 30 Watts maximum * 24 VDC Relay: 15 Watts maximum 24 VDC Isolated: 20 Watts maximum *NOTE: 30 watts maximum total (all three outputs)*
Output Voltage	5 VDC: 5.0 VDC to 5.2 VDC (5.1 VDC nominal) 24 VDC Relay: 19.2 VDC to 28.8 VDC 24 VDC Isolated: 19.2 VDC to 28.8 VDC
Isolation (input to backplane)	1500 VAC (for 1 minute)
Protective Limits **Overvoltage:** **Overcurrent;**	 5 VDC output: 6.4 VDC to 7 VDC 5 VDC output: 7 Amps maximum
Ride-through Time:	10 ms minimum. This is the length of time the Power Supply maintains valid outputs if the power source is interrupted
Fuse	5 Amps, GE Fanuc part number 44A724627-114 (2). See chapter 2 for more information.

* Derate as shown below at ambient temperatures above 50°C (122°F).

Thermal Derating



Overcurrent Protection

The 5 VDC output is electronically limited to 7 Amps. If an overload (including short circuits) occurs, it is sensed internally and the Power Supply shuts down. The Power Supply continually tries to restart until the overload condition is removed. An internal fuse in the input line is provided as a backup. The Power Supply usually shuts down before the fuse blows. The fuse also protects against internal supply faults.

Calculating Input Power Requirements: PWR331

Use the following procedure to determine input power requirements for the 24 VDC High Capacity Power Supply:

- Determine total output power load from typical specifications listed for individual modules in this chapter.
- Multiply the output power by 1.5 to determine the input power value.
- Divide the input power value by the operating source voltage to determine the input current requirements
- Use the lowest input voltage to determine the maximum input current
- Allow for start-up surge current requirements
- Allow margins (10% to 20%) for variations

Field Wiring: IC694PWR331

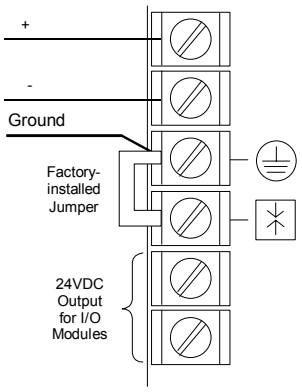
The + wire connects to the top terminal screw, and the - wire connects to the second. These connections are polarity-sensitive for PWR331.

Warning

If the same external DC power source is used to provide power to two or more power supplies in the system, connection polarity must be identical at each power supply. Do not cross the Positive (+) and Negative (-) lines. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each backplane must be connected to a common system ground.

Ground connects to the third screw.

The bottom two terminals of the power supply terminal strip provide connections to the Isolated +24 VDC output. This output can be used to provide power for external circuits (within power limitations of the supply).



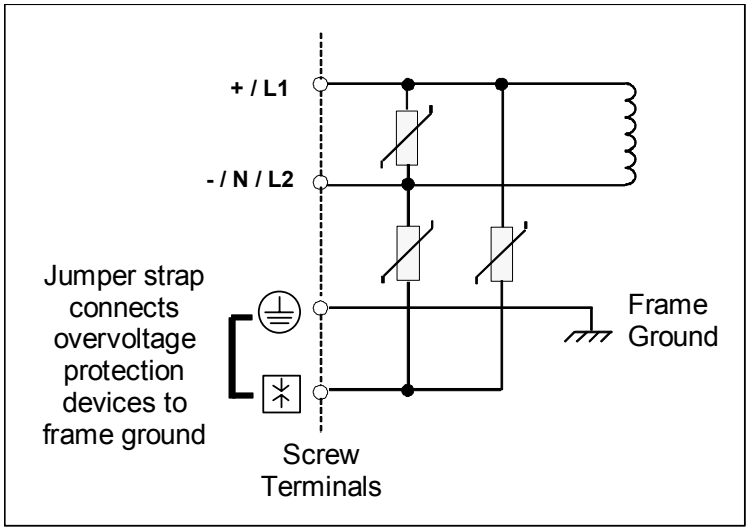
Caution

If the Isolated 24 VDC supply is overloaded or shorted, the PLC will stop operation.

Input Overvoltage Protection

Terminal 4 is normally connected to frame ground (terminal 3) with a factory-installed jumper strap. If overvoltage protection is not required or is supplied upstream, this feature can be disabled by removing the jumper.

To Hi-pot test this supply, overvoltage protection must be disabled during the test by removing the terminal strip jumper. Re-enable overvoltage protection after testing by reinstalling the jumper.

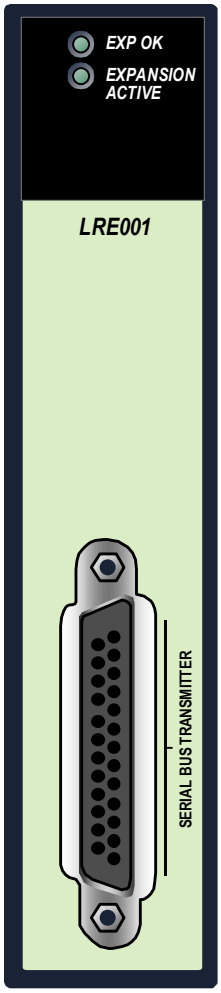


Chapter 5 Serial Bus Transmitter Module & Expansion Cables

This chapter describes the serial expansion module and expansions cables for PACSystems RX3i controllers. It also gives specifications for building custom expansion cables.

Description	***Catalog Number***
Serial Bus Transmitter Module	IC695LRE001
Expansion Cable, Wye, 1 meter (3 feet)	IC693CBL300
Expansion Cable, Wye, 2 meters (6 feet)	IC693CBL301
Expansion Cable, 2 Connectors, Built-inTerminating Resistor, 15 meters (50 feet) Length	IC693CBL302
Expansion Cable, Wye, 0.15 meter (0.5 feet) Length	IC693CBL312
Expansion Cable, Wye, 8 meters (25 feet) Length	IC693CBL313
Expansion Cable, Wye, 15 meters (50 feet) Length	IC693CBL314

Serial Bus Transmitter Module: IC695LRE001



The RX3i Serial Bus Transmitter Module, IC695LRE001, provides communications between a PACSystems RX3i Universal Backplane (IC695-model number), and serial expansion and remote backplanes (IC694- or IC693-model numbers). It translates the signal levels present in the Universal Backplane to the signal levels required by a Serial Expansion Backplane.

The Serial Bus Transmitter Module must reside in the special expansion connector on the right end of the Universal Backplane.

Two green LEDs indicate the operating status of the module and the status of the expansion link.

- The EXP OK LED is lit when backplane 5V power is applied to the module.
- The Expansion Active LED indicates the status of the expansion bus. This LED is ON when the Expansion module is communicating with expansion backplanes. It is OFF when they are not communicating.

The connector on the front of the module is used to attach the expansion cable.

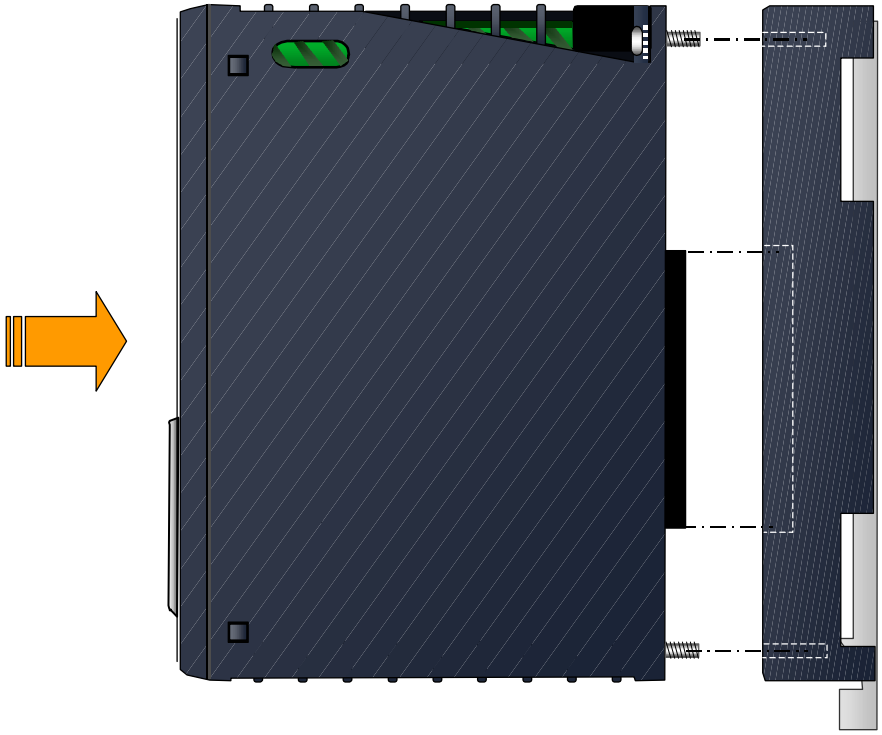
Specifications: LRE001

Current Required from Backplane	5.0V: 132mA 3.3V: 0 mA
Maximum Total Expansion Cable Length	15 meters (50 feet) – Expansion Backplanes 213 meters (700 feet) – Remote Backplanes
Effective Data Rate	500k Bytes per second if the expansion bus includes Remote backplanes.
Electrical Isolation	Non-isolated differential communications

Refer to Appendix A for product standards and general specifications.

Expansion Module Installation

The Serial Bus Transmitter Module must reside in the special expansion connector on the right end of the Universal Backplane. This module may NOT be hot-inserted in the backplane; power must be removed before installing or removing the Expansion Module. In addition, the expansion cable may not be attached or removed if the expansion rack has power applied.



Powering Down Individual Expansion or Remote Backplanes

Expansion and Remote Backplanes can be powered-down individually without affecting the operation of other backplanes; however, powering off a backplane generates a loss of module (LOSS_OF_MODULE) fault in the PLC Fault Table for each module in the backplane. When this fault condition occurs, and until the backplane is powered back on and all modules recovered, the lost I/O modules are not scanned.

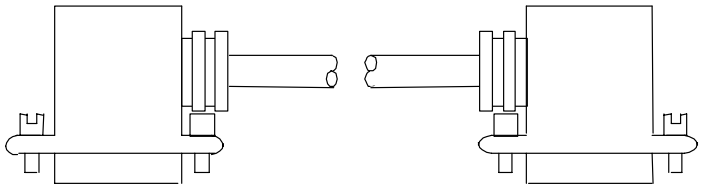
I/O Bus Expansion Cables: IC693CBL300, 301, 302 ,312, 313, 314

I/O Bus Expansion Cables are used to connect a Serial Bus Transmitter Module (IC695LRE001) in a Universal Backplane (IC695CHS012 or IC695CHS016) to a Serial Expansion Backplane (IC694/693CHS392 or IC694/693CHS398). These cables are also used to interconnect additional expansion and remote backplanes in the system. Several lengths of prefabricated cables are available (part numbers IC693CBL300, 301, 302, 312, 313, 314).

The prefabricated cables described in this section are made with a *continuous*, 100% shield. The braided cable shield is connected to the metal shell of the connector around the entire perimeter of the connector. That provides a low-impedance path to frame ground for any noise energy that is coupled onto the cable shield.

Cable with Two Connectors: IC693CBL302

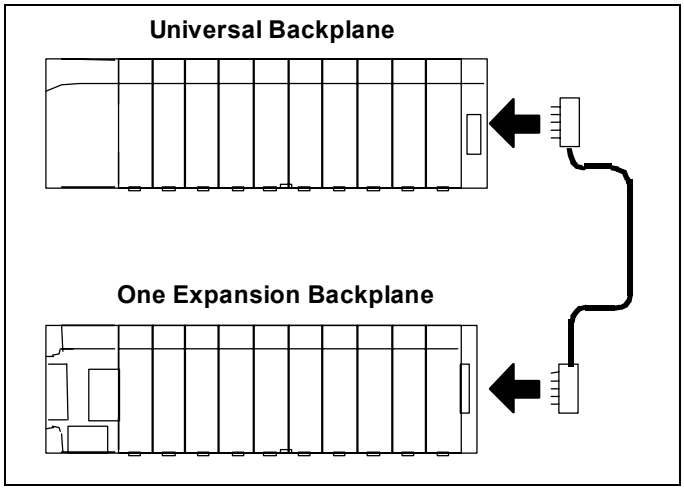
Cable IC693CBL302 is 15 meters (50 feet) long and has one male connector on each end. This cable has I/O bus terminating resistors built into the end connector on the cable.



Male Connector to Expansion Module in CPU Baseplate

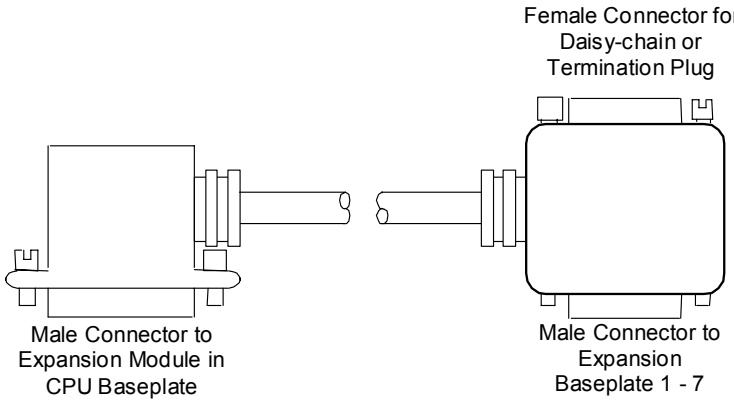
Male Connector to Single Expansion Baseplate

This cable does not require a separate termination block. It can only be used in a system with just one expansion backplane.



Cables with Three Connectors: IC693CBL300, 301, 312, 313, 314

Cables IC693CBL300, 301, 312, 313, and 314 have a male and female connector on one end and a male connector on the other end ("wye" cables).



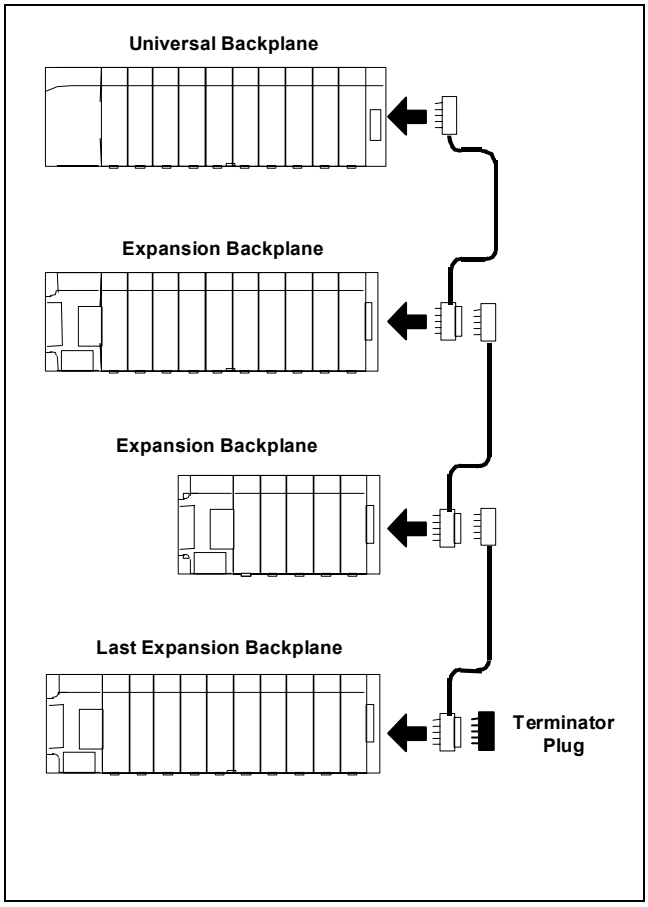
These cables are the same except for their lengths:

- IC693CBL312: 0.15 meter (0.5 feet)
- IC693CBL300: 1 meter (3 feet)
- IC693CBL301: 2 meters (6 feet)
- IC693CBL313: 8 meters (25 feet)
- IC693CBL314: 15 meters (50 feet)

Combinations of these cables can be used to daisy-chain up to seven expansion backplanes to the main backplane. Custom cables can also be made. Wiring information is given in this section.

These cables can also be used to provide connection points for custom point-to-point cables (IC693CBL300 is often used for this).

These cables do not have built-in termination. The last cable in the expansion system must be terminated as shown. Terminator Plug IC693ACC307 can be used for this purpose.



The maximum number of cables that can be included in an I/O expansion system is seven, and the total maximum cable length between the Universal Backplane and the last expansion backplane is 50 feet (15 meters). Failure to observe these limits could result in erratic system operation.

Specifications: IC693CBL300, 301, 302, 312, 313, 314

Cable	Belden 8107 only (no substitutes): Computer cable, overall braid over foil shield, twisted–pair 30 volt/80°C (176°F) 24 AWG (.22mm^2) tinned copper, 7 x 32 stranding Velocity of propagation = 70% Nominal impedance = 100 Ohms
25 Pin Male Connector	Crimp Plug = Amp 207464–1; Pin = Amp 66506–9 Solder Plug = Amp 747912–2
25 Pin Female Connector	Crimp Receptacle = Amp 207463–2; Pin = Amp 66504–9 Solder Receptacle = Amp 747913–2
Connector Shell	Kit – Amp 745833–5: Metal–plated plastic (plastic with nickel over copper) [Crimp ring – Amp 745508–1, split ring ferrule

Connector part numbers are provided for reference only. Any part meeting the same specifications could be used for making custom cables.

Expansion Port Pin Assignments

All connections between cables are point–to point, that is, pin 2 of one end to pin 2 of the opposite end, pin 3 to pin 3, etc.

Pin Number	Signal Name	Function
16	DIODT	I/O Serial Data Positive
17	DIODT/	I/O Serial Data Negative
24	DIOCLK	I/O Serial Clock Positive
25	DIOCLK/	I/O Serial Clock Negative
20	DRSEL	Remote Select Positive
21	DRSEL/	Remote Select Negative
12	DRPERR	Parity Error Positive
13	DRPERR/	Parity Error Negative
8	DRMRUN	Remote Run Positive
9	DRMRUN/	Remote Run Negative
2	DFRAME	Cycle Frame Positive
3	DFRAME/	Cycle Frame Negative
1	FGND	Frame Ground for Cable Shield
7	0V	Logic Ground

The I/O expansion bus *must be terminated* at the last backplane in an expansion system. Each signal pair must be terminated with 120 ohm, 1/4 watt resistors wired between the appropriate pins: 16 – 17; 24 – 25; 20 – 21; 12 – 13; 8 – 9; 2 – 3

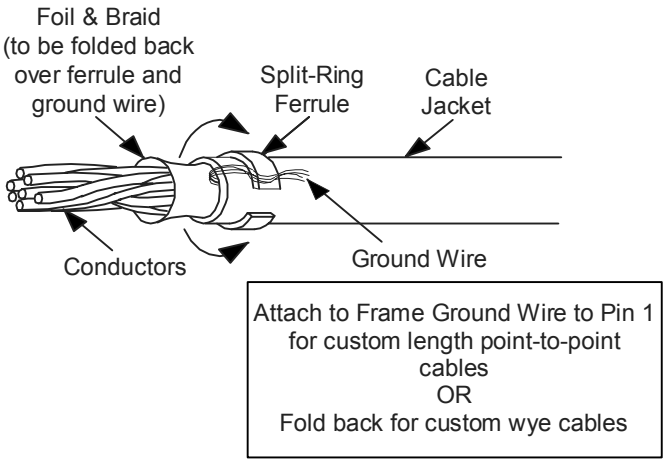
Building Cables

For custom length cables, the best noise immunity is achieved when using a metalized connector cover that makes contact with the cable's braided and foil shielding and with the connector shell on the terminating end. *It is not sufficient* to only solder the drain wire to the connector shell. The cable's shield must be continuous across the entire length of the cable, including at the terminations.

When using 100% shielded cables all CPU and expansion backplanes in the system must be solidly referenced to the same ground point or a potential difference between backplanes could disturb signal transmission.

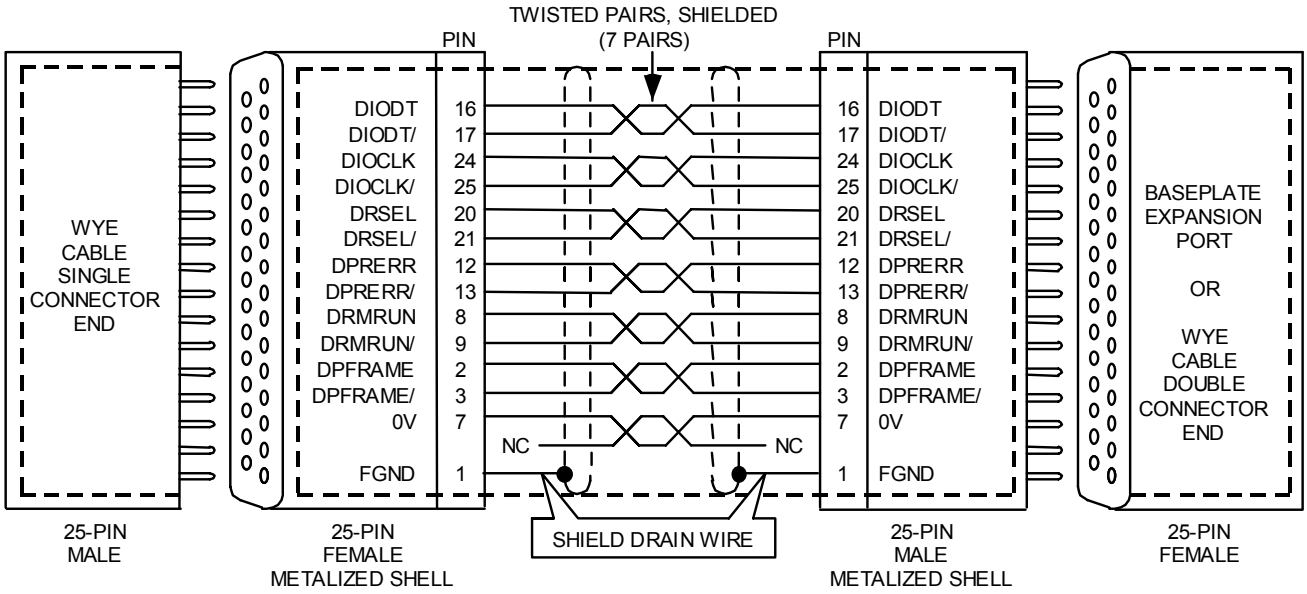
Use the following steps to build a 100% shielded cable:

1. Strip approximately 5/8 inch of insulation from the cable to expose the shield.
2. Put a split–ring ferrule over the cable insulation.
3. Fold the shield back over the top of the cable insulation and ferrule.



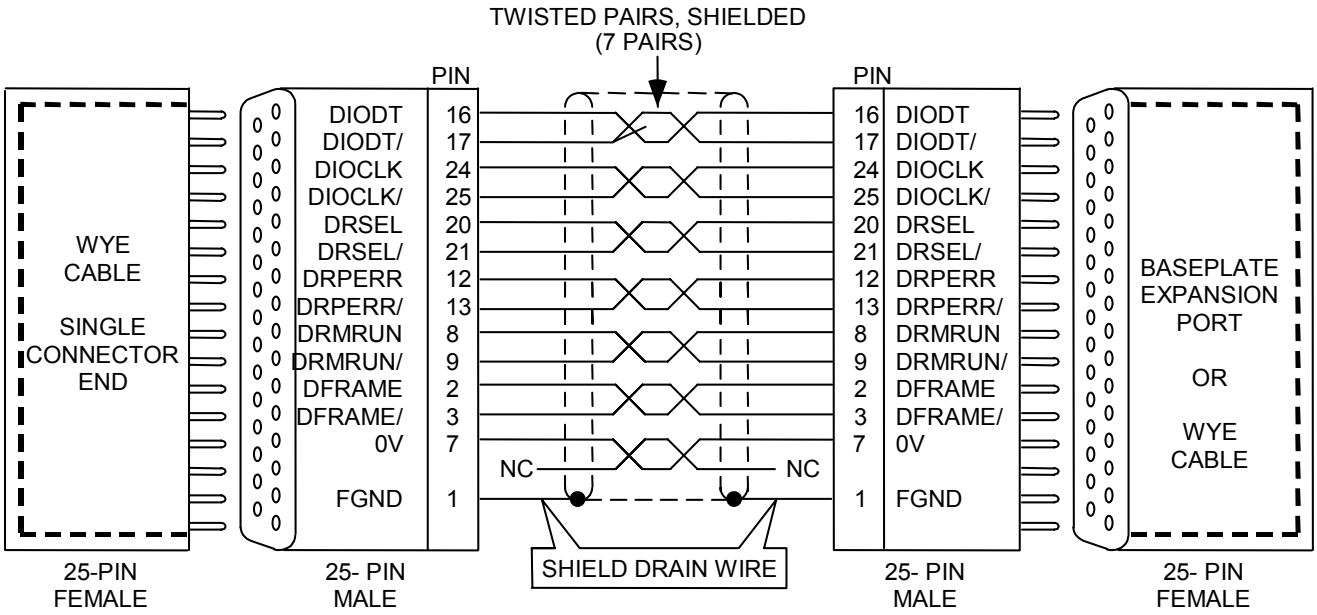
4. Place the collar of the metal hood over the top of the folded shield, and securely clamp the hood.
5. Test the cable for continuity between both connector shells. Connect an ohmmeter between the shells and flex the cable at both ends. If the metalized connector hood is not making proper contact with the cable shield at either end, the connection will show intermittent continuity on the ohmmeter.
6. Plug the metal hooded cable into an expansion port and securely tighten the two screws. Installing and tightening the screws electrically connects the shield to the backplane frame ground, which should be connected to earth ground.

Cable with Continuous Shielding



NOTE:
Bold dashed line shows continuous (100%) shielding when metallized shell connectors are plugged together.

Cable for Applications Requiring Less Noise Immunity



Termination Requirement for Expansion or Remote System

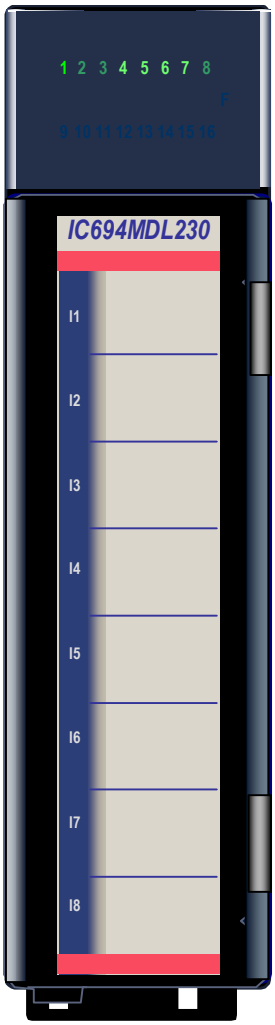
When two or more backplanes are connected via the I/O Bus Expansion System, the I/O Expansion Bus must be properly terminated. The most common method of terminating the I/O Expansion Bus is by installing a termination resistor pack (IC693ACC307) on the open connector on the last (most distant from the CPU) Expansion or Remote backplane in the system. The resistor pack is physically mounted inside of a connector. Although a termination resistor pack is shipped with each backplane, only the last backplane in the chain needs to have this termination connector installed. Unused termination packs can be discarded. The prewired 50 foot (15 meter) cable (IC693CBL302) has termination resistors wired inside the connector on one end of the cable. This cable can be used if only one expansion rack is needed in a system and a 50 foot cable link is required (the IC693ACC307 resistor pack is not needed in this case). Also, a custom-built cable with built-in resistors would eliminate the need for the IC693ACC307 resistor pack.

Chapter 6 Discrete Input Modules

This chapter describes discrete input modules for PACSystems RX3i systems.

Discrete Input Module	*Catalog Number*
Input 120 VAC 8 Point Isolated	IC694MDL230
Input 240 VAC 8 Point Isolated	IC694MDL231
Input 120 VAC 16 Point	IC694MDL240
Input 24 VAC/VDC 16 Point Pos/Neg Logic	IC694MDL241
Input 125 VDC 8 Point Pos/Neg Logic	IC694MDL632
Input 24 VDC 8 Point Pos/Neg Logic	IC694MDL634
Input 24 VDC 16 Point Pos/Neg Logic	IC694MDL645
Input 24 VDC 16 Point Pos/Neg Logic Fast	IC694MDL646
Input 5/12 VDC (TTL) 32 Point Pos/Neg Logic	IC694MDL654
Input 24 VDC 32 point Pos/Neg Logic	IC694MDL655
Input Simulator Module	IC694ACC300

Input Module, 120 Volt AC, 8 Point Isolated: IC694MDL230



The ***120 volt AC Isolated Input*** module, IC694MDL230, provides 8 isolated input points, each with a common power input terminal. Because the inputs are isolated, each input can be powered by a separate AC power source.

The input circuits are reactive (resistor/capacitor) inputs. Current into an input point results in a logic 1 in the input status table (%I). Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied by the user. This module requires an AC power source; *it cannot be used with a DC power source.*

Eight green LEDs indicate the ON/OFF status of points 1 through 8. The red bands on the label show that MDL230 is a high-voltage module.

This module can be installed in any I/O slot in an RX3i system.

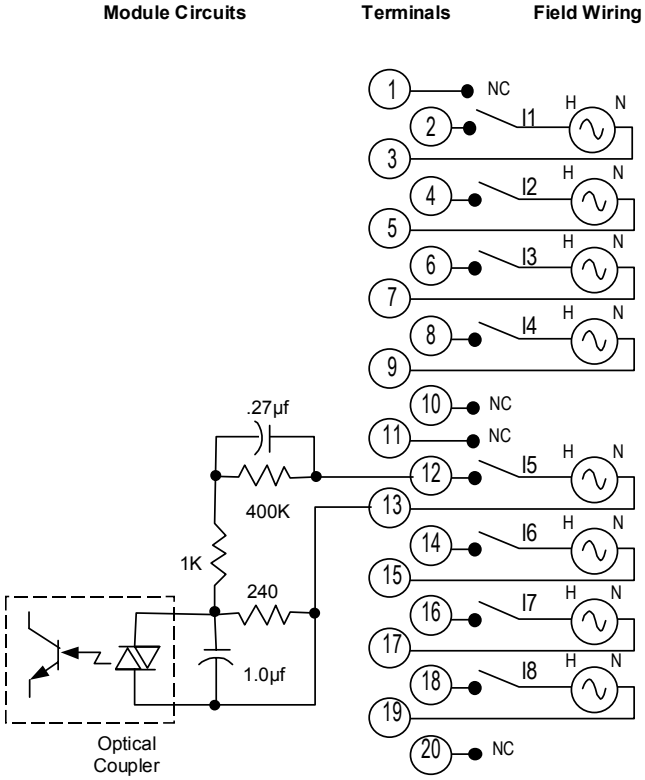
Specifications: MDL230

Rated Voltage **Input Voltage Range**	120 volts AC, 50/60 Hz 0 to 132 volts AC, 50/60 Hz
Inputs per Module	8 (each input point has a separate common)
Isolation	
Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Point to Point	250 VAC continuous; 1500 VAC for one minute
Input Current	14.5 mA (typical) at rated voltage
Input Characteristics:	
On–state Voltage	74 to 132 volts AC
Off–state Voltage	0 to 20 volts AC
On–state Current	6mA minimum
Off–state Current	2.2mA maximum
On response Time	30ms maximum
Off response Time	45ms maximum
Power Consumption	60mA (all inputs on) from 5 volt bus on backplane

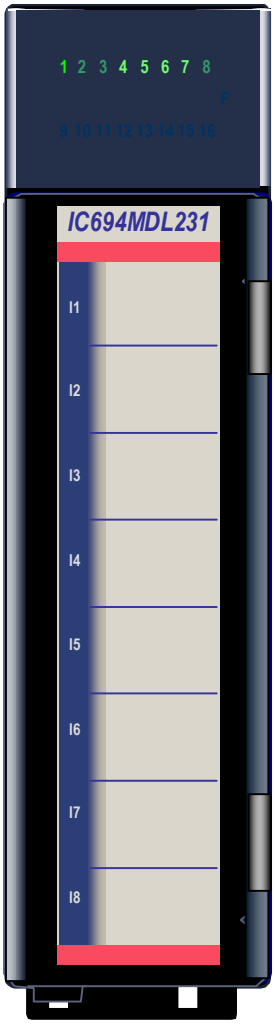
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL230

Terminals	Connections
1	No connection
2	Input 1
3	Input 1 Return
4	Input 2
5	Input 2 Return
6	Input 3
7	Input 3 Return
8	Input 4
9	Input 4 Return
10	No connection
11	No connection
12	Input 5
13	Input 5 Return
14	Input 6
15	Input 6 Return
16	Input 7
17	Input 7 Return
18	Input 8
19	Input 8 Return
20	No connection



Input Module, 240 Volt AC, 8 Point Isolated: IC694MDL231



The ***240 volt AC Isolated Input*** module, IC694MDL231, provides 8 isolated input points, each with a common power input terminal. The input circuits are reactive (resistor/capacitor) inputs. Current into an input point results in a logic 1 in the input status table (%I). Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Because the inputs are isolated, each input can be powered by a separate AC power source. Power to operate the field devices must be supplied by the user. This module requires an AC power source; *it cannot be used with a DC power source*.

Eight green LEDs indicate the ON/OFF status of points 1 through 8. The red bands on the label show that MDL231 is a high-voltage module.

This module can be installed in any I/O slot in an RX3i system.

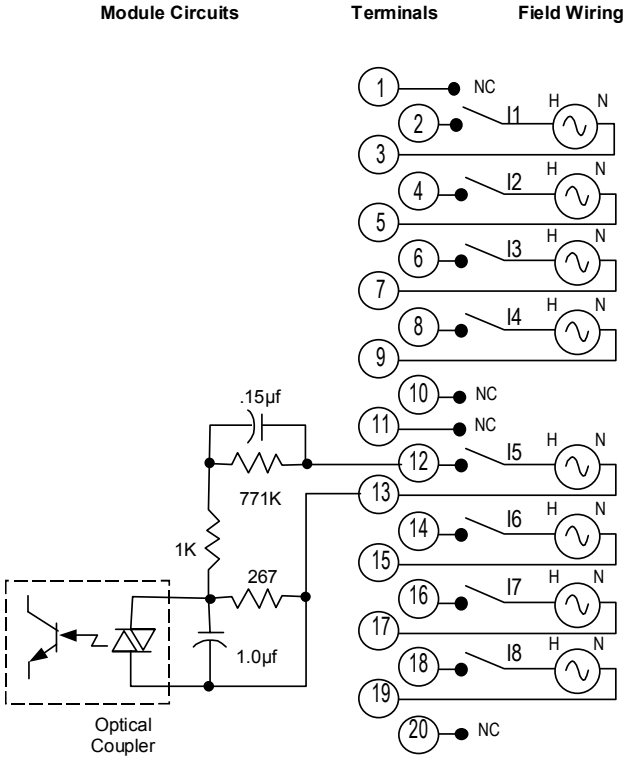
Specifications: MDL231

Rated Voltage	240 volts AC, 50/60 Hz
Input Voltage Range	0 to 264 volts AC, 50/60 Hz
Inputs per Module	8 (each input point has a separate common)
Isolation	
Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Point to Point	250 VAC continuous; 1500 VAC for one minute
Input Current	15 mA (typical) at rated voltage
Input Characteristics:	
On–state Voltage	148 to 264 volts AC
Off–state Voltage	0 to 40 volts AC
On–state Current	6mA minimum
Off–state Current	2.2mA maximum
On response Time	30ms maximum
Off response Time	45ms maximum
Power Consumption	60mA (all inputs on) from 5 volt bus on backplane

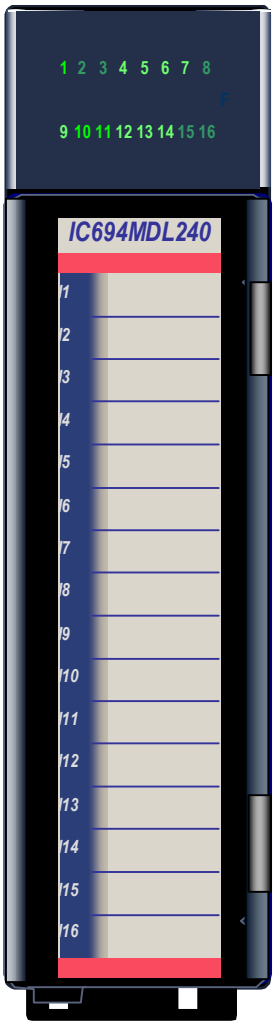
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL231

Terminals	Connections
1	No connection
2	Input 1
3	Input 1 Return
4	Input 2
5	Input 2 Return
6	Input 3
7	Input 3 Return
8	Input 4
9	Input 4 Return
10	No connection
11	No connection
12	Input 5
13	Input 5 Return
14	Input 6
15	Input 6 Return
16	Input 7
17	Input 7 Return
18	Input 8
19	Input 8 Return
20	No connection



Input Module, 120 Volt AC, 16 Point: IC694MDL240



The ***120 volt AC Input*** module, IC694MDL240, provides 16 input points with one common power input terminal. The input circuits are reactive (resistor/capacitor) inputs. Current into an input point results in a logic 1 in the input status table (%I). Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied by the user. This module requires an AC power source; *it cannot be used with a DC power source.*

Sixteen green LEDs indicate the ON/OFF status of points 1 through 16. The red bands on the label show that MDL240 is a high-voltage module.

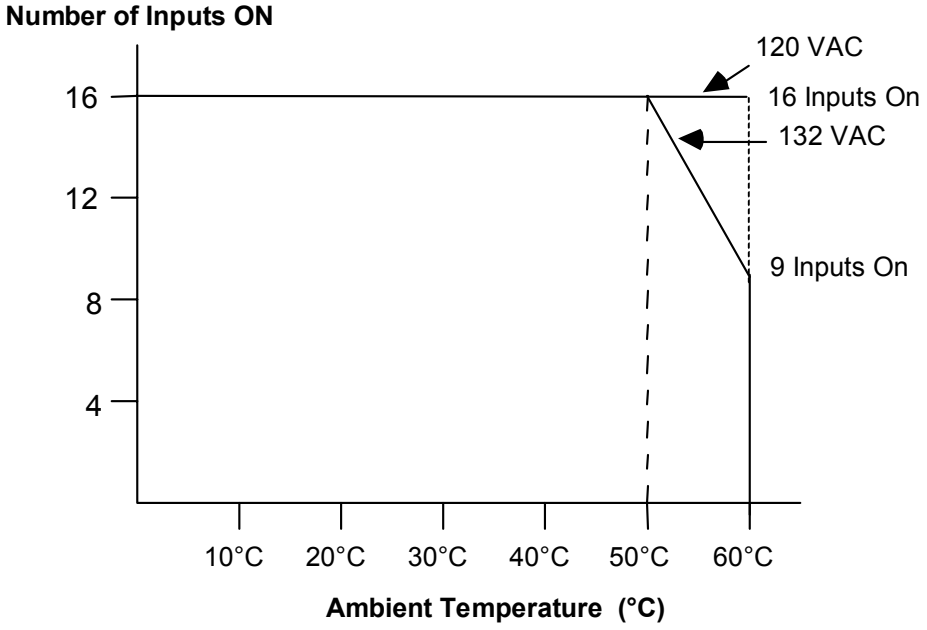
This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL240

Rated Voltage	120 volts AC
Input Voltage Range	0 to 132 volts AC, 50/60 Hz
Inputs per Module	16 (one group with a single common) The maximum number of inputs on at the same time depends on the ambient temperature as shown below.
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Input Current	12 mA (typical) at rated voltage
Input Characteristics:	
On–state Voltage	74 to 132 volts AC
Off–state Voltage	0 to 20 volts AC
On–state Current	6mA minimum
Off–state Current	2.2mA maximum
On response Time	30ms maximum
Off response Time	45ms maximum
Power Consumption	90mA (all inputs on) from 5 volt bus on backplane

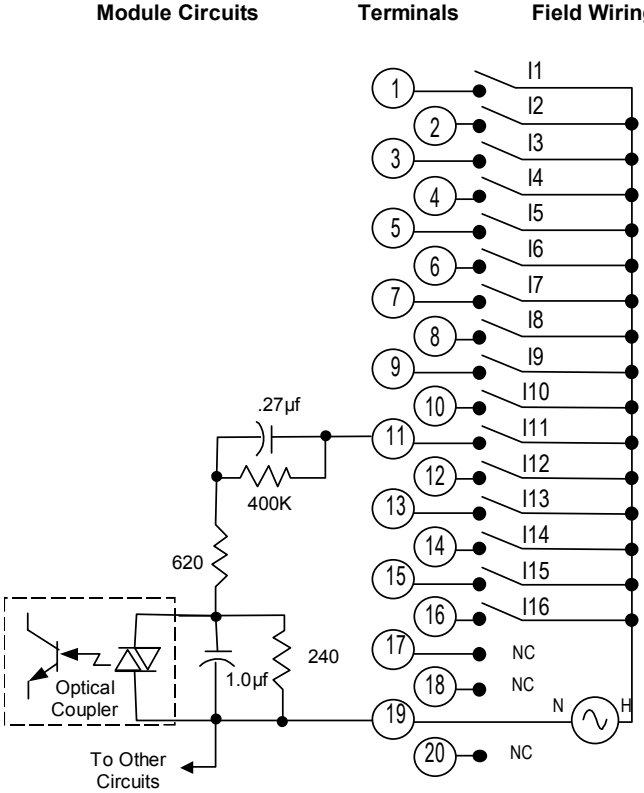
Refer to Appendix A for product standards and general specifications.

Input Points vs. Temperature

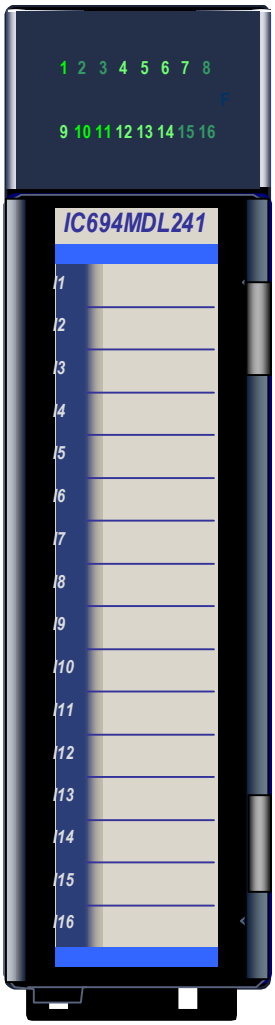


Field Wiring: MDL240

Terminals	Connections
1	Input 1
2	Input 2
3	Input 3
4	Input 4
5	Input 5
6	Input 6
7	Input 7
8	Input 8
9	Input 9
10	Input 10
11	Input 11
12	Input 12
13	Input 13
14	Input 14
15	Input 15
16	Input 16
17	No connection
18	No connection
19	Inputs 1-16 Common (Return)
20	No connection



Input Module, 24 VAC/ VDC 16 Point Pos/NegLogic: IC694MDL241



The ***24VAC/VDC 16 Point C Positive/Negative Logic Input*** module, IC694MDL241, provides 16 input points in one group with a common power input terminal. This module can be used with AC or DC field inputs. In DC mode, it can be wired for either positive or negative logic. Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Current into an input point results in a logic 1 in the input status table (%I). Power to operate AC input devices must be supplied by the user. DC Inputs can be powered by the backplane 24V supply.

Sixteen green LEDs indicate the ON/OFF status of points 1 through 16. The blue bands on the label show that MDL241 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

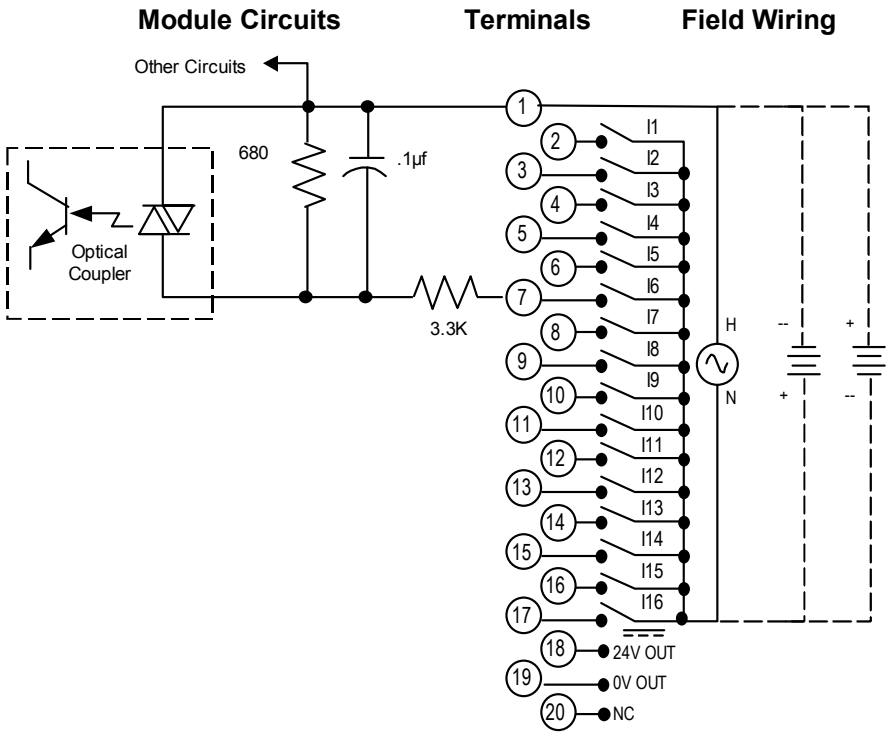
Specifications: MDL241

Rated Voltage	24 volts AC or 24 volts DC
Input Voltage Range	0 to +30 volts DC or 0 to +30 volts AC, 50/60Hz
Inputs per Module	16 (one group with a single common)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Input Current	7 mA (typical) at rated voltage
Input Characteristics	
On–state Voltage	11.5 to 30 volts AC or DC
Off–state Voltage	0 to +4 volts AC or DC
On–state Current	3.2mA minimum
Off–state Current	1 mA maximum
On response Time	12ms typical
Off response Time	28ms typical
Power Consumption: 5V	80mA (all inputs on) from 5 volt bus on backplane
Power Consumption: 24V	125mA from the Isolated 24 volt backplane bus or from user supplied power

Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL241

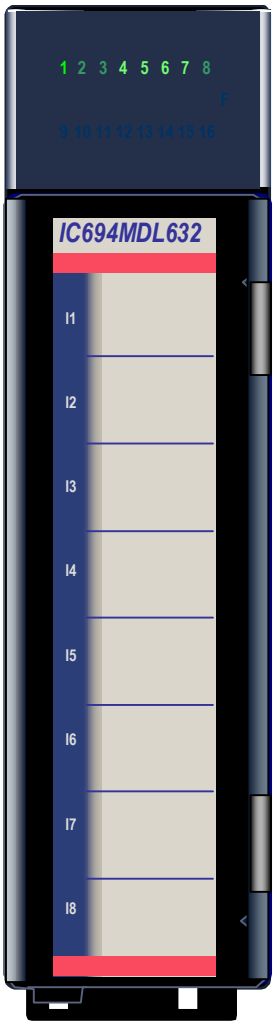
Terminals	Connections
1	Inputs 1-16 Common (Return)
2	Input 1
3	Input 2
4	Input 3
5	Input 4
6	Input 5
7	Input 6
8	Input 7
9	Input 8
10	Input 9
11	Input 10
12	Input 11
13	Input 12
14	Input 13
15	Input 14
16	Input 15
17	Input 16
18	24VDC for input devices
19	0V for input devices
20	No connection



Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to:

Field to Backplane (optical) and to frame ground: 50 VAC continuous; 500 VAC for 1 minute

Input Module, 125 Volt DC Pos/Neg, 8 Point: IC694MDL632



The ***125 volt DC Positive/Negative Logic Input*** module, IC694MDL632, provides 8 input points in two isolated groups with four points in each group. Each group has a separate common (the two commons are not tied together inside the module). Each group can be wired for either positive or negative logic. Current into an input point results in a logic 1 in the input status table (%I). Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate field devices must be supplied by the user.

Eight green LEDs indicate the ON/OFF status of points 1 through 8. The red bands on the label show that MDL632 is a high-voltage module.

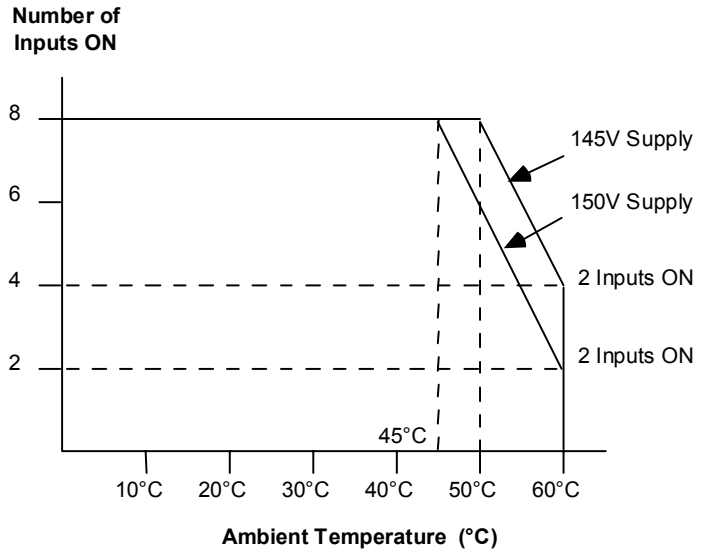
This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL632

Rated Voltage	125 volts DC (Positive or Negative Logic)
Input Voltage Range	0 to +150 volts DC
Inputs per Module	8 (two groups of four inputs) Maximum number of inputs on at the same time depends on ambient temperature as shown.
Isolation	
Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Group to Group	250 VAC continuous; 1500 VAC for one minute
Input Current	4.5 mA typical
Input Characteristics	
On–state Voltage	90 to 150 volts DC
Off–state Voltage	0 to 30 volts DC
On–state Current	3.1mA
Off–state Current	1.1mA maximum
On response Time	7ms typical
Off response Time	7ms typical
Power Consumption	40mA from the 5 volt bus on the backplane 36mA (typical) from user input supply (all inputs ON)

Refer to Appendix A for product standards and general specifications.

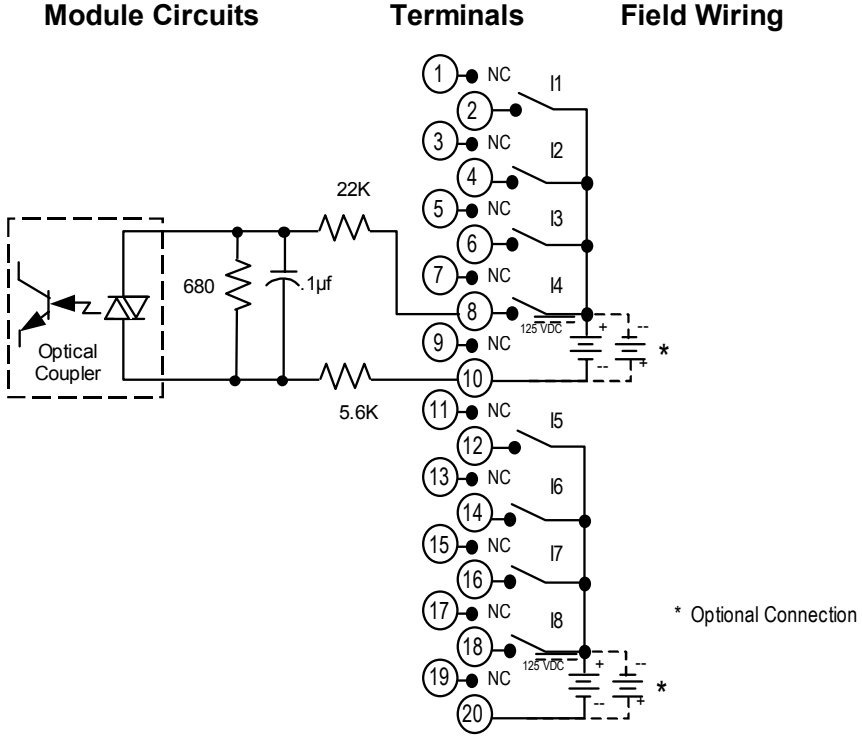
Input Points vs. Temperature



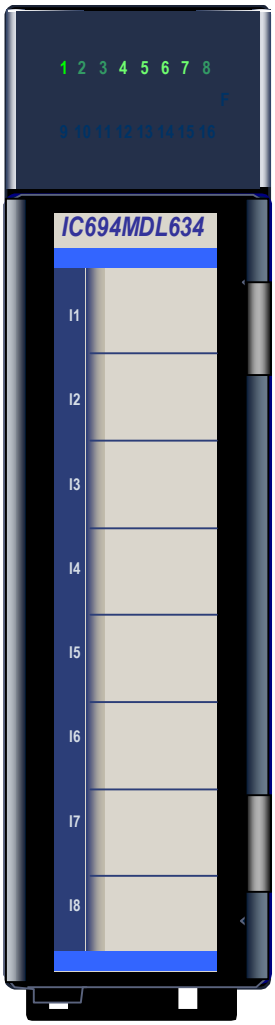
Field Wiring: MDL632

Terminals	Connections
1	No connection
2	Input 1
3	No connection
4	Input 2
5	No connection
6	Input 3
7	No connection
8	Input 4
9	No connection
10	Inputs 1-4 Common
11	No connection
12	Input 5
13	No connection
14	Input 6
15	No connection
16	Input 7
17	No connection
18	Input 8
19	No connection
20	Inputs 5-8 Common

Negative logic connections are shown with dashed lines in the diagram below.



Input Module, 24 Volt DC Pos/Neg, 8 Point: IC694MDL634



The ***24 volt DC Positive/Negative Logic Input*** module, IC694MDL634, provides 8 input points in one group with a common power input terminal. This input module can be wired for either positive logic or negative logic. Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Current into an input point results in a logic 1 in the input status table (%I). Field devices can be powered from an external supply. Depending on their requirements, some input devices can be powered from the module's +24V OUT and 0V OUT terminals.

Eight green LEDs indicate the ON/OFF status of points 1 through 8. The blue bands on the label show that MDL634 is a low-voltage module. This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL634

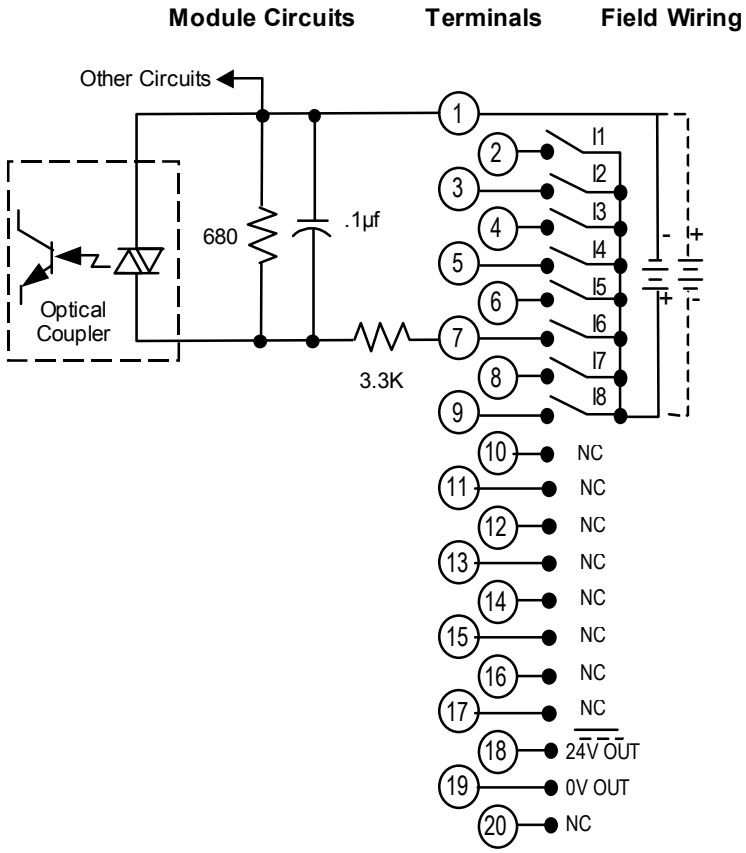
Rated Voltage	24 volts DC
Input Voltage Range	0 to +30 volts DC
Inputs per Module	8 (one group with a single common)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Input Current	7mA (typical) at rated voltage
Input Characteristics	
On–state Voltage	11.5 to 30 volts DC
Off–state Voltage	0 to +5 volts DC
On–state Current	3.2mA minimum
Off–state Current	1.1mA maximum
On response Time	7ms typical
Off response Time	7ms typical
Power Consumption: 5V	45mA (all inputs on) from 5 volt bus on backplane
Power Consumption: 24V	62mA from the Isolated 24 volt backplane bus or from user supplied power

Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL634

Terminals	Connections
1	Inputs 1-8 Common
2	Input 1
3	Input 2
4	Input 3
5	Input 4
6	Input 5
7	Input 6
8	Input 7
9	Input 8
10	No connection
11	No connection
12	No connection
13	No connection
14	No connection
15	No connection
16	No connection
17	No connection
18	24VDC for input devices
19	0V for input devices
20	No connection

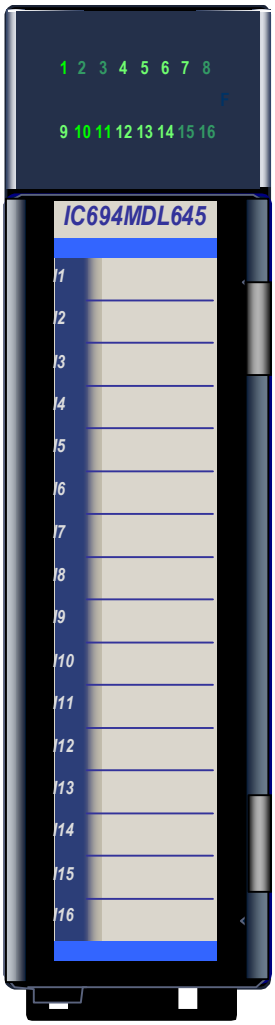
Negative logic connections are shown with dashed lines in the diagram below.



Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to:

Field to Backplane (optical) and to frame ground: 50 VAC continuous; 500 VAC for 1 minute

Input Module, 24 Volt DC Pos/Neg, 16 Point: IC694MDL645



The ***24 volt DC Positive/Negative Logic Input*** module, IC694MDL645, provides 16 input points in one group with a common power input terminal. This input module can be wired for either positive logic or negative logic. Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Current into an input point results in a logic 1 in the input status table (%I). Field devices can be powered from an external supply. Depending on their requirements, some input devices can be powered from the module's +24V OUT and 0V OUT terminals.

Sixteen green LEDs indicate the ON/OFF status of points 1 through 16. The blue bands on the label show that MDL645 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

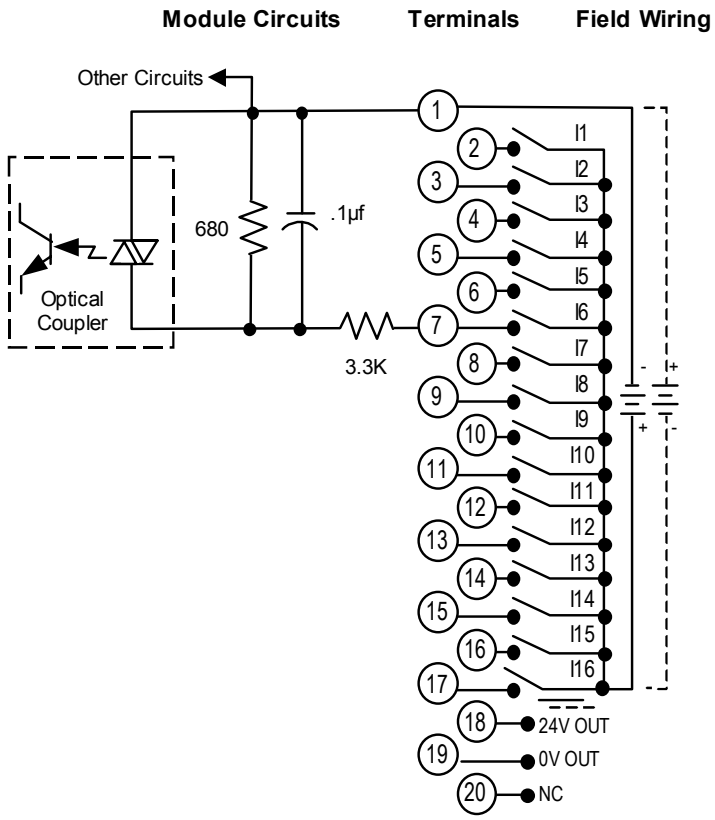
Specifications: MDL645

Rated Voltage	24 volts DC
Input Voltage Range	0 to +30 volts DC
Inputs per Module	16 (one group with a single common)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Input Current	7mA (typical) at rated voltage
Input Characteristics	
On–state Voltage	11.5 to 30 volts DC
Off–state Voltage	0 to +5 volts DC
On–state Current	3.2mA minimum
Off–state Current	1.1mA maximum
On response Time	7ms typical
Off response Time	7ms typical
Power Consumption: 5V	80mA (all inputs on) from 5 volt bus on backplane
Power Consumption: 24V	125mA from the Isolated 24 volt backplane bus or from user supplied power

Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL645

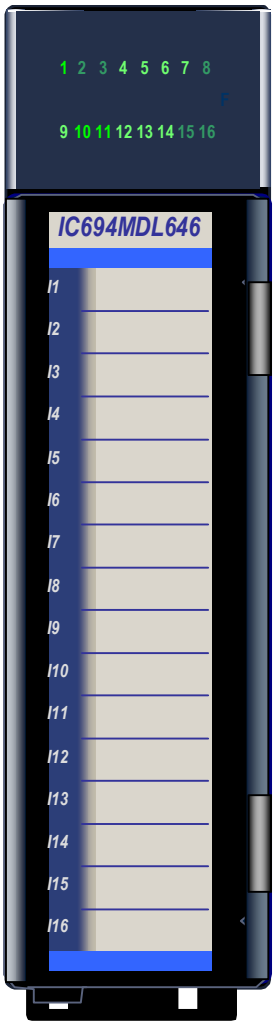
Terminals	Connections
1	Inputs 1-16 Common
2	Input 1
3	Input 2
4	Input 3
5	Input 4
6	Input 5
7	Input 6
8	Input 7
9	Input 8
10	Input 9
11	Input 10
12	Input 11
13	Input 12
14	Input 13
15	Input 14
16	Input 15
17	Input 16
18	24VDC for input devices
19	0V for input devices
20	No connection



Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to:

Field to Backplane (optical) and to frame ground: 50 VAC continuous; 500 VAC for 1 minute

Input Module: 24 Volt DC 16 Point Pos/Neg Logic: IC694MDL646



The ***24VDC Positive/Negative Logic 16 Point Input*** module, IC694MDL646, provides 16 input points in one group with a common power input terminal. *The on and off response times for this module are typically 1 ms.* This input module can be wired for either positive logic or negative logic. Input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Current into an input point results in a logic 1 in the input status table (%I). Field devices can be powered from an external supply. Depending on their requirements, some input devices can be powered from the module's +24V OUT and 0V OUT terminals.

Sixteen green LEDs indicate the ON/OFF status of points 1 through 16. The blue bands on the label show that MDL646 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

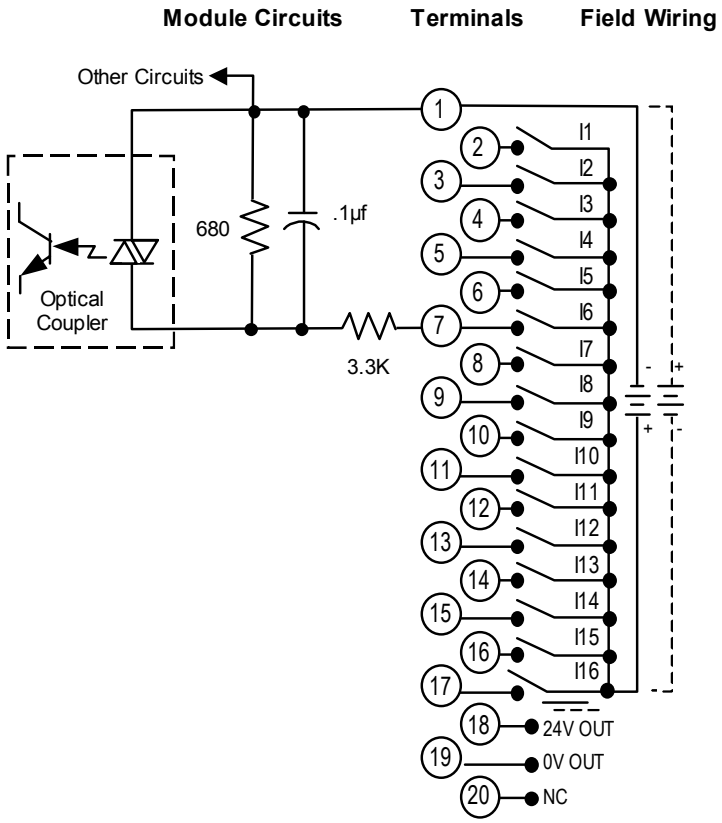
Specifications: MDL646

Rated Voltage	24 volts DC
Input Voltage Range	0 to +30 volts DC
Inputs per Module	16 (one group with a single common)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Input Current	7mA (typical) at rated voltage
Input Characteristics	
On–state Voltage	11.5 to 30 volts DC
Off–state Voltage	0 to +5 volts DC
On–state Current	3.2mA minimum
Off–state Current	1.1mA maximum
On response Time	1ms typical
Off response Time	1ms typical
Power Consumption: 5V	80mA (all inputs on) from 5 volt bus on backplane
Power Consumption: 24V	125mA from the Isolated 24 volt backplane bus or from user supplied power

Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL646

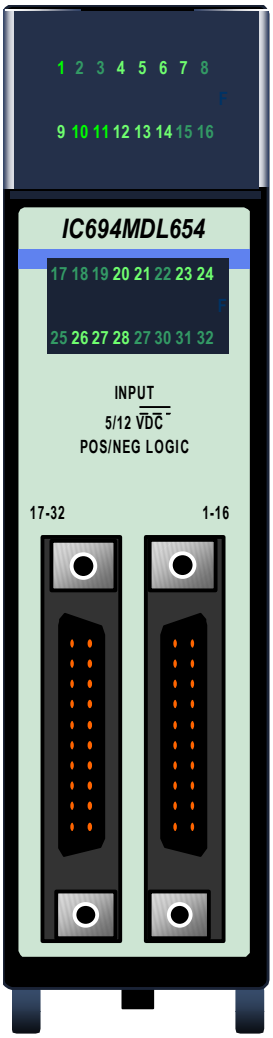
Terminals	Connections
1	Inputs 1-16 Common
2	Input 1
3	Input 2
4	Input 3
5	Input 4
6	Input 5
7	Input 6
8	Input 7
9	Input 8
10	Input 9
11	Input 10
12	Input 11
13	Input 12
14	Input 13
15	Input 14
16	Input 15
17	Input 16
18	24VDC for input devices
19	0V for input devices
20	No connection



Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to:

Field to Backplane (optical) and to frame ground: 50 VAC continuous; 500 VAC for 1 minute

Input Module, 5/12 VDC (TTL) 32 Point Pos/Neg Logic: IC694MDL654



The ***5/12VDC (TTL) 32 Point Positive/Negative Logic Input*** module, IC694MDL654 provides 32 discrete TTL voltage threshold input points. The inputs are arranged in four isolated groups of eight. Each group has its own common. The inputs are positive or negative logic inputs that operate at levels up to 15V.

A single, regulated +5V supply (current limited to approximately 150mA) is available through the I/O connectors on the front of the module. This supply is generated on the module and is isolated from the backplane. Its power input comes from the +5V logic supply on the PLC backplane. By installing jumpers on the I/O connector, you can choose to power the inputs from this internal supply instead of powering them with an external user provided supply.

This module does not report special fault or alarm diagnostics. Green LEDs indicate the ON/OFF status of each input point. The blue band on the front label shows that MDL654 is a low-voltage module.

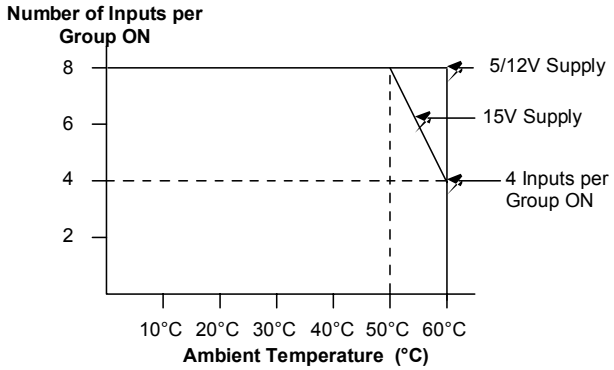
This module can be installed in any I/O slot in the RX3i system.

Specifications: MDL654

Rated Voltage	5 to 12 volts DC, Positive or Negative Logic
Input Voltage Range	0 to 15 volts DC
Inputs per Module	32 (four groups of eight inputs each) *98.4 feet (30 meters), maximum cable length* Maximum number of inputs per group on at the same time depends on the ambient temperature as shown below.
Isolation	
Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Group to Group	50 VAC continuous; 500 VAC for one minute
Input Current	3.0mA (typical ON current @ 5VDC) 8.5mA (typical ON current @ 12VDC)
Input Characteristics	
On–state Voltage	4.2 to 15 volts DC
Off–state Voltage	0 to 2.6 volts DC
On–state Current	2.5mA (minimum)
Off–state Current	1.2mA (maximum)
On response Time	1ms maximum
Off response Time	1ms maximum
Internal Power Consumption	195mA (maximum) from +5V bus on backplane; (29mA + 0.5mA/point ON + 4.7mA/LED ON) 440mA (maximum) from +5V bus on backplane (if module isolated +5V supply used to power inputs and all 32 inputs ON) 96mA (typical) from user input supply @ 5VDC and 32 inputs ON) 272mA (typical) from user input supply @ 12VDC and 32 inputs ON)
Isolated +5V Supply	+5 volts DC +/-5%
Current limit	150mA (typical)

Refer to Appendix A for product standards and general specifications.

Input Points vs. Temperature

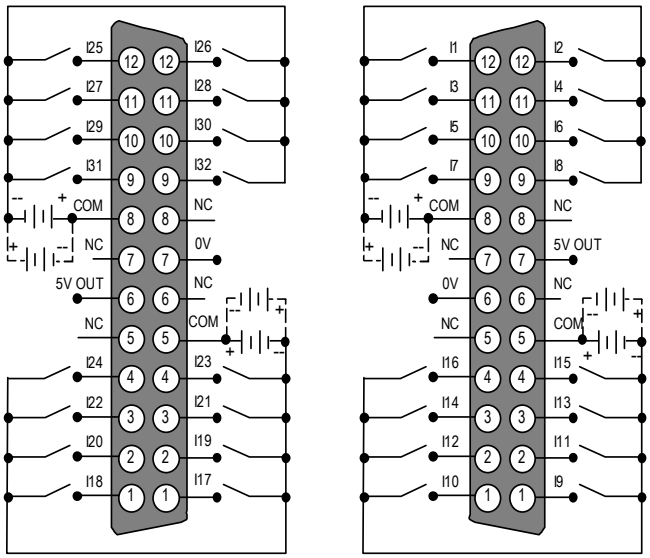


Field Wiring: MDL654

The blue band on the label shows that MDL654 is a low-voltage module.

Connections are made to two male 24–pin connectors (Fujitsu FCN–365P024–AU) on the front of the module. Wiring from the connectors to field devices is made through a cable having a mating female connector on one end and stripped and tinned wires on the other end. You can purchase a pair of pre–wired cables, catalog numbers IC693CBL327 and IC693CBL328 or build cables. See Appendix B for more information.

Conventional TTL wiring practices should be followed when installing this module. For noise immunity, I/O control lines connected to the module must be less than 30 meters in length (signal attenuation limits wiring length to less than this maximum).

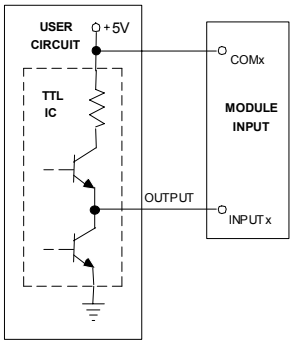


Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to: Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to:

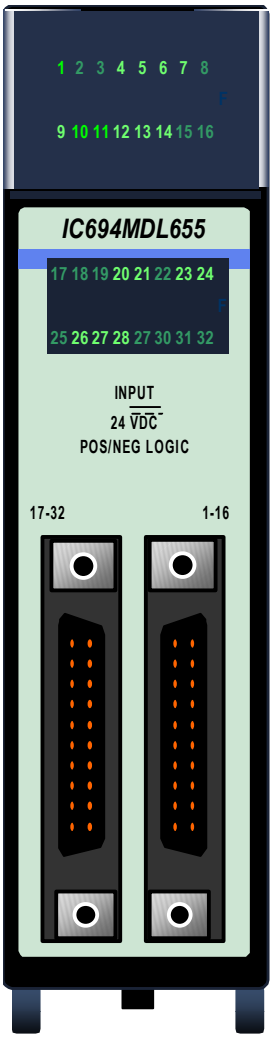
Field to Backplane (optical) and to frame ground: 50 VAC continuous; 500 VAC for 1 minute

TTL Wiring

To be compatible with TTL outputs, the negative logic configuration should be used as shown below.



Input Module, 24 VDC Pos/Neg Logic, 32 Point: IC694MDL655



The ***24VDC Positive/Negative Logic Input*** module, IC694MDL655, provides 32 discrete input points. The inputs are positive or negative logic inputs and will operate at levels up to 30V.

The inputs are arranged in four isolated groups of eight; each group has its own common. Isolation is provided between the four groups of inputs, however each group of eight inputs is referenced to the same user common connection. This module reports no special fault or alarm diagnostics.

Power to operate field devices can come from an external supply or from the module's isolated +24 VDC output.

Green LEDs indicate the ON/OFF status of each point. The blue band on the front shows that MDL655 is a low-voltage module.

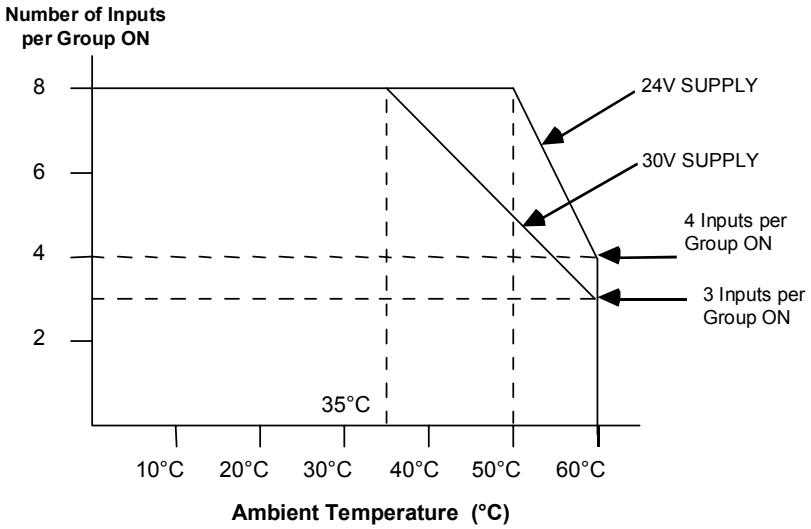
This module can be installed in any I/O slot in the RX3i system.

Specifications: MDL655

Rated Voltage	24 volts DC, Positive or Negative Logic
Input Voltage Range	0 to 30 volts DC
Inputs per Module	32 (four groups of eight inputs each) The maximum number of inputs on at the same time depends on the ambient temperature, as shown below.
Isolation	
Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for one minute
Group to Group	50 VAC continuous; 500 VAC for one minute
Input Current	7.0mA (typical ON current @ 24 VDC)
Input Characteristics	
On–state Voltage	11.5 to 30 volts DC
Off–state Voltage	0 to 5 volts DC
On–state Current	3.2mA (minimum)
Off–state Current	1.1mA (maximum)
On response Time	2ms maximum
Off response Time	2ms maximum
Internal Power Consumption	195mA (maximum) from +5V bus on backplane; (29mA +0.5mA/point ON +4.7mA/LED ON) 224mA (typical) from isolated +24V bus on backplane or from user input supply @ 24VDC and all 32 inputs ON)

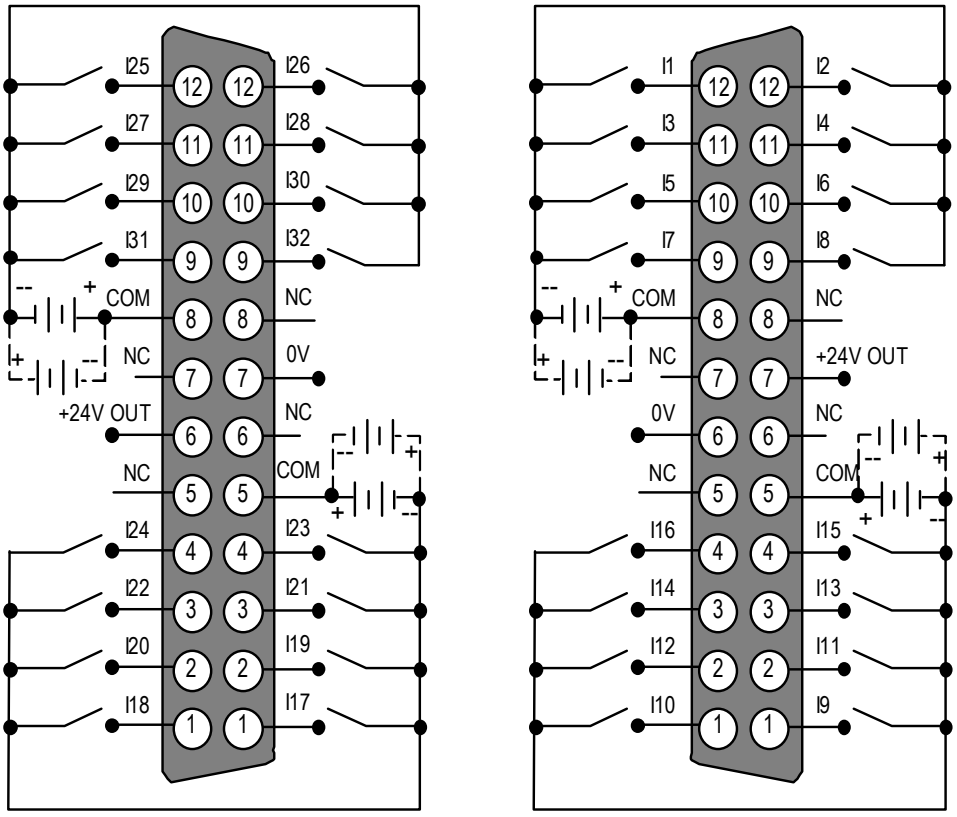
Refer to Appendix A for product standards and general specifications.

Input Points vs. Temperature



Field Wiring: MDL655

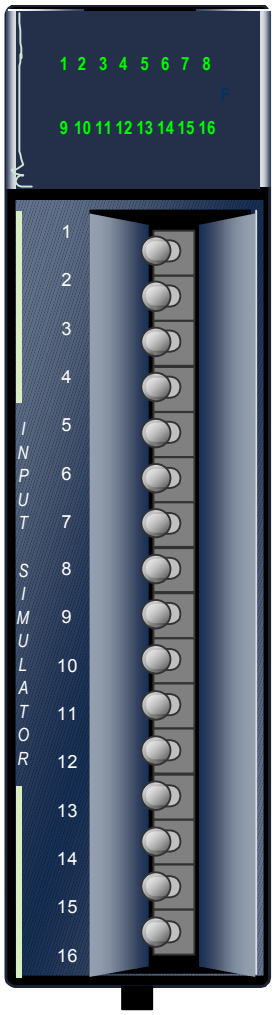
Connections are made to two male 24–pin connectors (Fujitsu FCN–365P024–AU) on the front of the module. Wiring from the module's connectors to field devices is made through a cable having a mating female connector on one end and stripped and tinned wires on the other end. You can purchase a pair of pre–wired cables, catalog numbers IC693CBL327 and IC693CBL328 or build cables. See appendix B for more information.



Note: If the 24V OUT pin is used to connect to input devices in the field, the isolation specification for this module changes to:

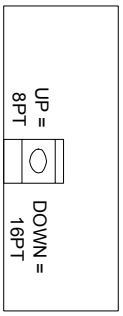
Field to Backplane (optical) and to frame ground: 50 VAC continuous; 500 VAC for 1 minute

Input Simulator, 8/16 Point: IC694ACC300



The ***Input Simulator*** module, IC694ACC300, can be used to simulate the operation of 8-point or 16-point discrete input modules. The Input Simulator has no field connections.

The Input Simulator can be substituted for actual inputs until the program or system is debugged. It can also remain permanently installed to provide either 8 or 16 conditional input contacts for manual control of output devices.



Before the Input Simulator module is installed, a switch in the back of the module can be used to set it up for either 8 point- or 16 point-operation. When this switch is set for 8 points, only the first 8 toggle switches on the front of the Input Simulator can be used.

Toggle switches on the front of the Input Simulator simulate the operation of discrete input devices. A switch in the ON position results in a logic 1 in the input table (%I).

Individual green LEDs indicate the ON or OFF position of each toggle switch. This module can be installed in any I/O slot in an RX3i system.

Specifications: ACC300

Inputs per Module	8 or 16 (switch selectable)
Off Response Time	20 milliseconds maximum
On Response Time	30 milliseconds maximum
Internal Power Consumption	120mA (all inputs on) from 5 volt bus on backplane

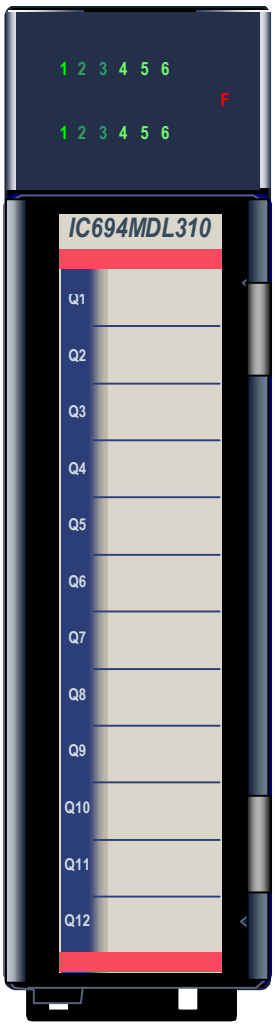
Refer to Appendix A for product standards and general specifications.

Chapter 7 Discrete Output Modules

This chapter describes discrete output modules for PACSystems RX3i controllers.

Discrete Output Module	*Catalog Number*
Output 120 VAC 0.5 A 12 Point	IC694MDL310
Output 120/240 VAC 2 A 8 Point	IC694MDL330
Output 120 VAC 0.5 A 16 Point	IC694MDL340
Output 120/240 VAC 2 A 5 Point Isolated	IC694MDL390
Output 12/24 VDC 0.5 A 8 Point Positive Logic	IC694MDL732
Output 125 VDC 1 A 6 Point Isolated Pos/Neg Logic	IC694MDL734
Output 12/24 VDC 0.5 A 16 Point Positive Logic	IC694MDL740
Output 12/24 VDC 0.5 A 16 Point Negative Logic	IC694MDL741
Output 12/24 VDC 1 A 16 Point Positive Logic ESCP	IC694MDL742
Output 5/24 VDC (TTL) 0.5 A 32 Point Negative Logic	IC694MDL752
Output 12/24 VDC 0.5 A 32 Point Positive Logic	IC694MDL753
Output Isolated Relay N.O. 4 A 8 Point	IC694MDL930
Output Isolated Relay N.C. and Form C 3 A 8 Point	IC694MDL931
Output Relay N.O. 2 A 16 Point	IC694MDL940

Output Module, 120 Volt AC, 0.5 Amp, 12 Point: IC694MDL310



The ***120 volt, 0.5 Amp AC Output*** module, IC694MDL310, provides 12 output points in two isolated groups of six points. Each group has a separate common. The two commons are not tied together inside the module. The groups can be used on different phases of the AC supply or powered from the same supply. Each group is protected with a 3 Amp fuse. An RC snubber for each output protects against transient electrical noise on the power line. This module provides a high degree of inrush current (10x the rated current) so the outputs can control a wide range of inductive and incandescent loads. AC power to operate loads connected to outputs must be user supplied. This module requires an AC power source; *it cannot be used with a DC power source*.

Individual numbered LEDs show the ON/OFF status of each output point. The red LED (F) turns ON if an output fuse blows. The red bands on the label show that MDL310 is a high-voltage module.

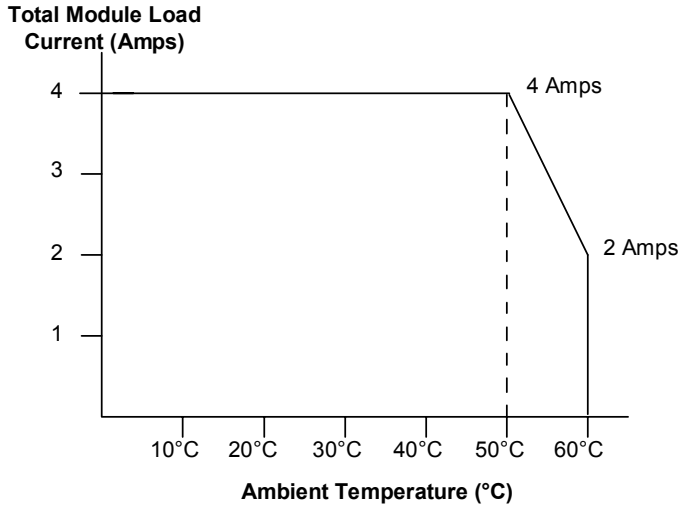
This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL310

Rated Voltage	120 volts AC
Output Voltage Range	85 to 132 volts AC, 50/60 Hz
Outputs per Module	12 (two groups of six outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	250 VAC continuous; 1500 VAC for 1 minute
Output Current	0.5 Amp maximum per point 1 Amp maximum per group at 60°C (140°F) 2 Amps maximum per group at 50°C (122°F) Maximum load current depends on ambient temperature as shown below
Output Characteristics	
Inrush Current	5 Amps maximum for one cycle
Minimum Load Current	50mA
Maximum Load Current	
Output Voltage Drop	1.5 volts maximum
Output Leakage Current	3mA maximum at 120 volts AC
On Response Time	1ms maximum
Off Response Time	1/2 cycle maximum
Power Consumption	210mA (all outputs on) from 5 volt bus on backplane
Fuses (quantity 2)	3 Amps, GE Fanuc part #44A724627-111(1). See chapter 2 for more information.

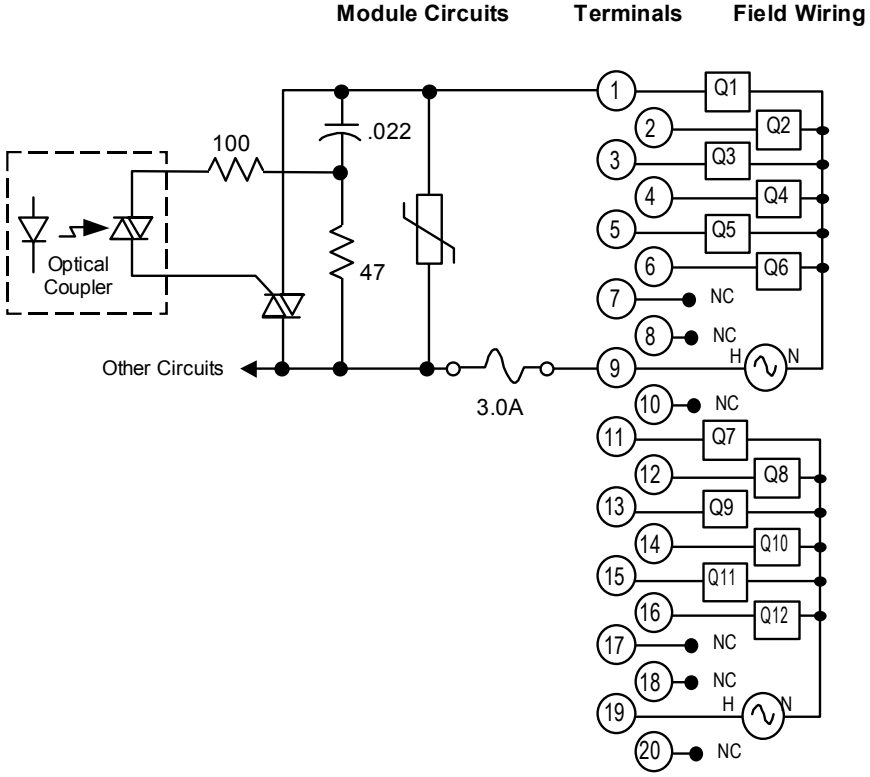
Refer to Appendix A for product standards and general specifications.

Load Current versus Temperature

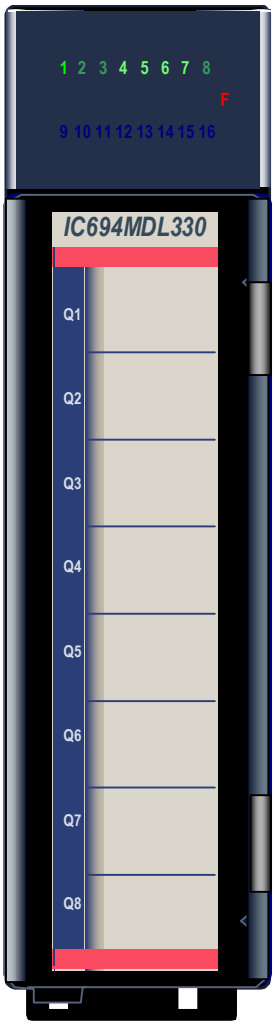


Field Wiring: MDL310

Terminal	Connection
1	Output 1
2	Output 2
3	Output 3
4	Output 4
5	Output 5
6	Output 6
7	No connection
8	No connection
9	Outputs 1 - 6 common (return)
10	No connection
11	Output 7
12	Output 8
13	Output 9
14	Output 10
15	Output 11
16	Output 12
17	No connection
18	No connection
19	Outputs 7-10 common (return)
20	No connection



Output Module, 120/240 Volt AC, 2 Amp, 8 Point: IC694MDL330



The ***120/240volt, 2 Amp AC Output*** module, IC694MDL330, provides eight output points in two isolated groups of four points. Each group has a separate common. The two commons are not tied together inside the module. The groups can be used on different phases of the AC supply or powered from the same supply. AC power to operate loads connected to outputs must be user supplied. This module requires an AC power source; *it cannot be used with a DC power source*.

Each group is protected with a 5 Amp fuse for each common. An RC snubber for each output protects against transient electrical noise on the power line. This module provides a high degree of inrush current (10 times the rated current) so the outputs can control a wide range of inductive and incandescent loads.

Individual numbered LEDs show the ON/OFF status of each output point. The red LED (F) turns ON if an output fuse blows. The red bands on the label show that MDL330 is a high-voltage module.

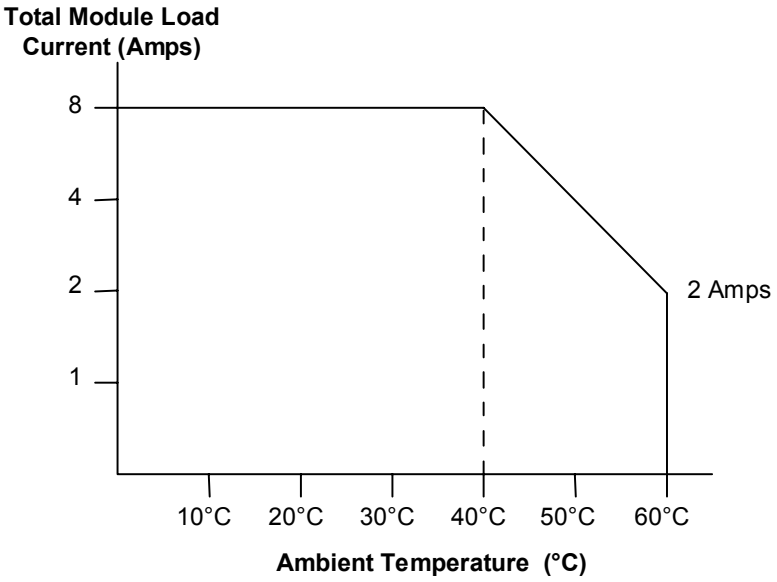
This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL330

Rated Voltage	120/240 volts AC
Output Voltage Range	85 to 264 volts AC, 50/60 Hz
Outputs per Module	8 (two groups of four outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	250 VAC continuous; 1500 VAC for 1 minute
Output Current	2 Amp maximum per point 4 Amps maximum per group at 40°C (104°F) Maximum load current depends on ambient temperature as shown below
Output Characteristics	
Inrush Current	20 Amps maximum for one cycle
Minimum Load Current	100mA
Output Voltage Drop	1.5 volts maximum
Output Leakage Current	3mA maximum at 120 volts AC 6mA maximum at 240 volts AC
On Response Time	1ms maximum
Off Response Time	1/2 cycle maximum
Power Consumption	160mA (all outputs on) from 5 volt bus on backplane
Fuses (quantity 2)	5 Amp, GE Fanuc part number 44A724627-114(1). See chapter 2 for more information.

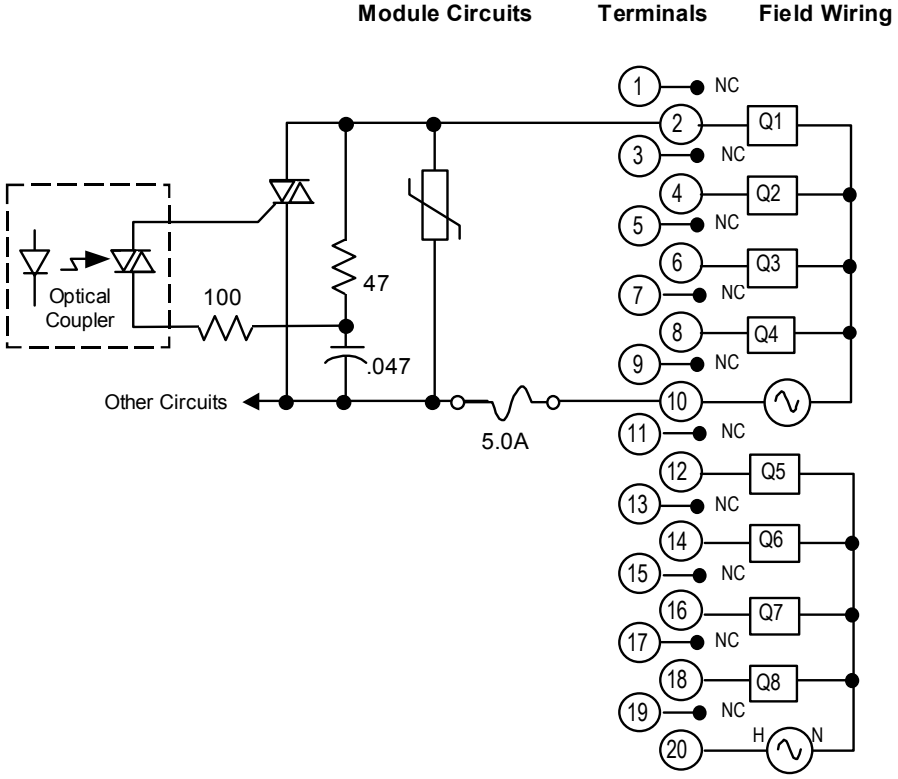
Refer to Appendix A for product standards and general specifications.

Load Current versus Temperature

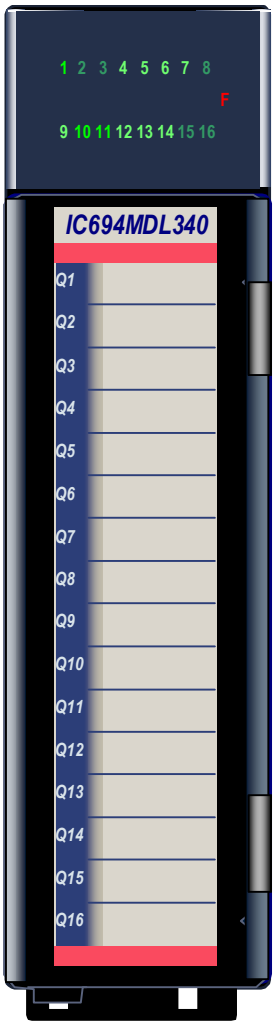


Field Wiring: MDL330

Terminal	*Connection*
1	No connection
2	Output 1
3	No connection
4	Output 2
5	No connection
6	Output 3
7	No connection
8	Output 4
9	No connection
10	Outputs 1 - 4 common (return)
11	No connection
12	Output 5
13	No connection
14	Output 6
15	No connection
16	Output 7
17	No connection
18	Output 8
19	No connection
20	Outputs 5 - 8 common (return)



Output Module, 120 Volt AC, 0.5 Amp, 16 Point: IC694MDL340



The ***120 volt, 0.5 Amp AC Output*** module, IC694MDL340, provides 16 output points in two isolated groups of eight points. Each group has a separate common. The two commons are not tied together inside the module. The groups can be used on different phases of the AC supply or powered from the same supply. Each group is protected with a 3 Amp fuse. An RC snubber protects each output against transient electrical noise on the power line. This module provides a high degree of inrush current; so the outputs can control a wide range of inductive and incandescent loads. AC Power to operate loads connected to outputs must be supplied by the user. This module requires an AC power source.

Individual numbered LEDs show the ON/OFF status of each output point. The red LED (F) turns ON if either of the fuses blows. A load must be connected to the blown fuse for the indicator to light. The red bands on the label show that MDL340 is a high-voltage module.

This module can be installed in any I/O slot in an RX3i system.

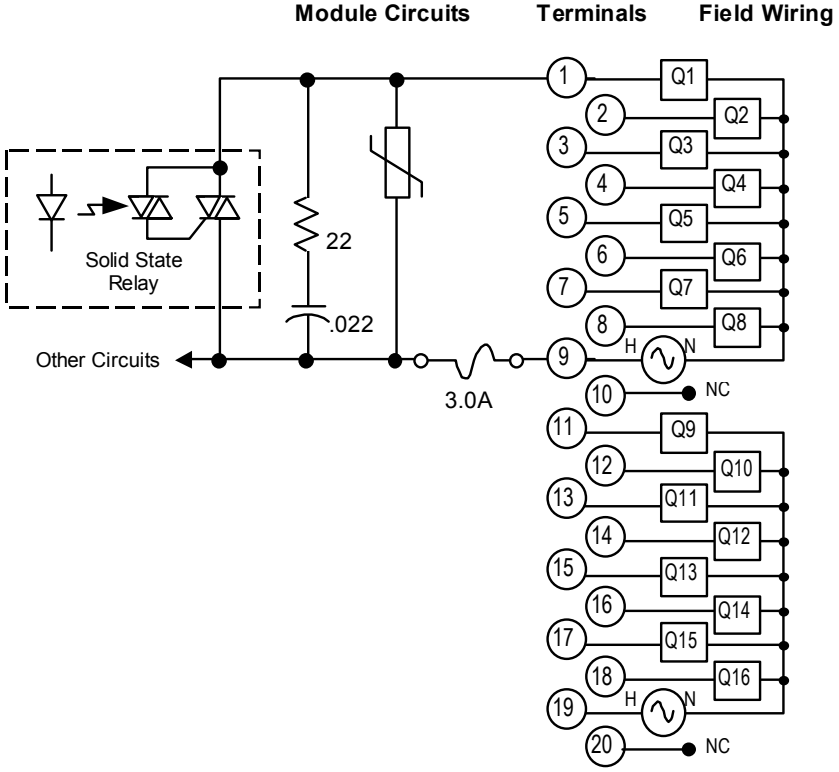
Specifications: MDL340

Rated Voltage	120 volts AC
Output Voltage Range	85 to 132 volts AC, 50/60 Hz
Outputs per Module	16 (two groups of eight outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	250 VAC continuous; 1500 VAC for 1 minute
Output Current	0.5 amp maximum per point 3 amps maximum per group
Output Characteristics	
Inrush Current	20 amps maximum for one cycle
Minimum Load Current	50 mA
Output Voltage Drop	1.5 volts maximum
Output Leakage Current	2 mA maximum at 120 volts AC
On Response Time	1 ms maximum
Off Response Time	1/2 cycle maximum
Power Consumption	315 mA (all outputs ON) from 5 volt bus on backplane
Fuses (quantity 2)	3 Amps, GE Fanuc part number 44A724627-111(1). See chapter 2 for more information.

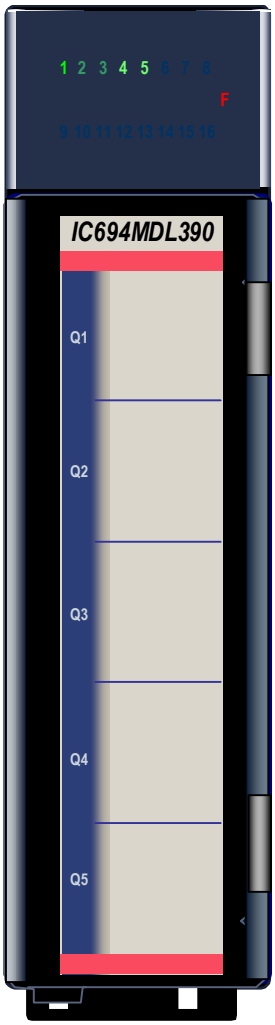
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL340

Terminal	Connection
1	Output 1
2	Output 2
3	Output 3
4	Output 4
5	Output 5
6	Output 6
7	Output 7
8	Output 8
9	Outputs 1 – 8 common (return)
10	No connection
11	Output 9
12	Output 10
13	Output 11
14	Output 12
15	Output 13
16	Output 14
17	Output 15
18	Output 16
19	Outputs 9 - 16 common (return)
20	No connection



Output Module, 120/240 Volt AC Isolated, 2 Amp, 5 Pt: IC694MDL390



The ***120/240 volt, 2 Amp Isolated AC Output*** module, IC694MDL390, provides five isolated output points, each with a separate common. Each output circuit is isolated from the others relative to the AC power source. The commons are not tied together inside the module. The output circuits can be used on different phases of the AC supply or powered from the same supply. AC Power to operate the loads connected to the outputs must be supplied by the user. *This module requires an AC power source, it cannot be used with a DC power source.*

Outputs are individually fused with a 3 Amp fuse. An RC snubber protects each output against transient electrical noise on the power line. This module provides a high degree of inrush current (greater than 10 times the rated current) so the outputs can control a wide range of inductive and incandescent loads.

Individual numbered LEDs show the ON/OFF status of each output point. The red LED (F) turns ON if an output fuse blows. The red bands on the label show that MDL390 is a high-voltage module.

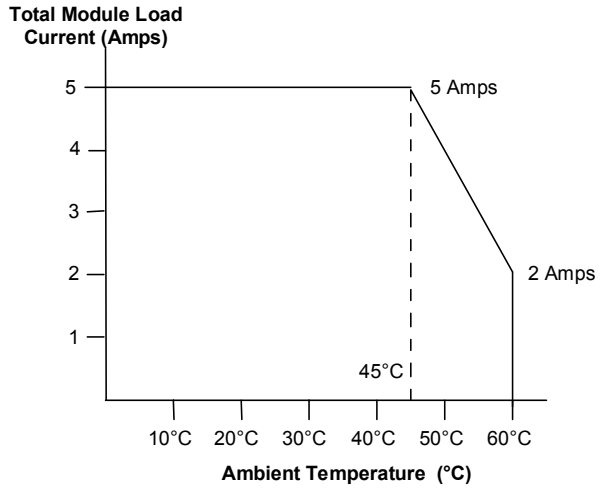
This module can be installed in any I/O slot in an RX3i system. It should be configured as an 8-point output module with programs referencing the five least significant bits.

Specifications: MDL390

Rated Voltage	120/240 volts AC
Output Voltage Range	85 to 264 volts AC, 50/60 Hz
Outputs per Module	5 (each output isolated from the others)
Isolation, Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Point to Point	250 VAC continuous; 1500 VAC for 1 minute
Output Current	2 Amps maximum per point 5 Amps maximum per module at 45°C (113°F) 2 Amps maximum per module at 60°C (140°F) Maximum load current depends on ambient temperature as shown below
Output Characteristics	
Inrush Current	25 Amps maximum for one cycle
Minimum Load Current	100mA
Maximum Load Current	
Output Voltage Drop	1.5 volts maximum
Output Leakage Current	3mA maximum at 120 volts AC 6mA maximum at 240 volts AC
On Response Time	1ms maximum
Off Response Time	1/2 cycle maximum
Power Consumption	110mA (all outputs on) from 5 volt bus on backplane
Fuses (quantity 5)	3 Amps, GE Fanuc part number 44A724627-111(1). See chapter 2 for more information.

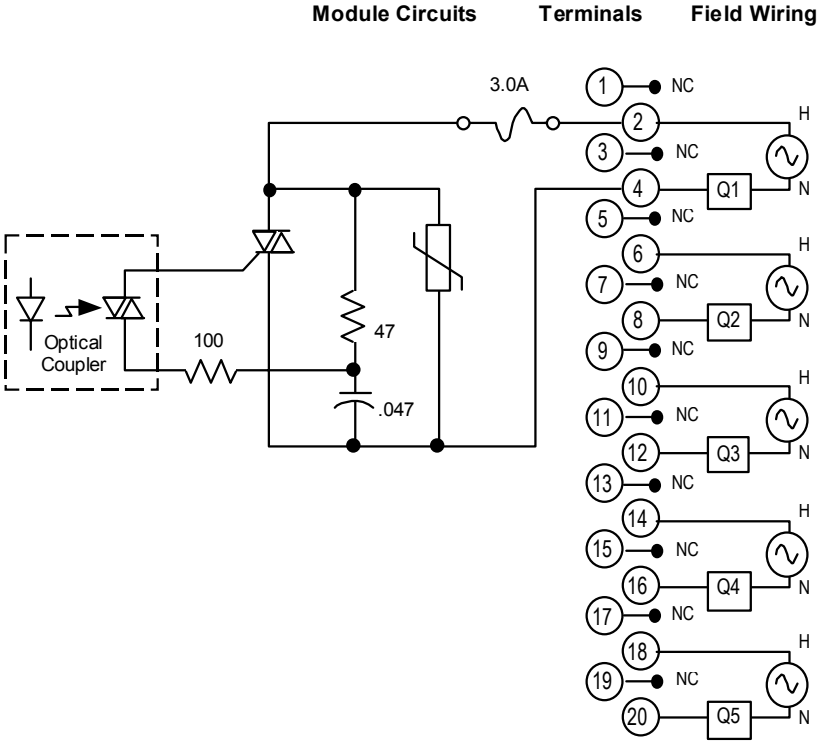
Refer to Appendix A for product standards and general specifications.

Load Current versus Temperature

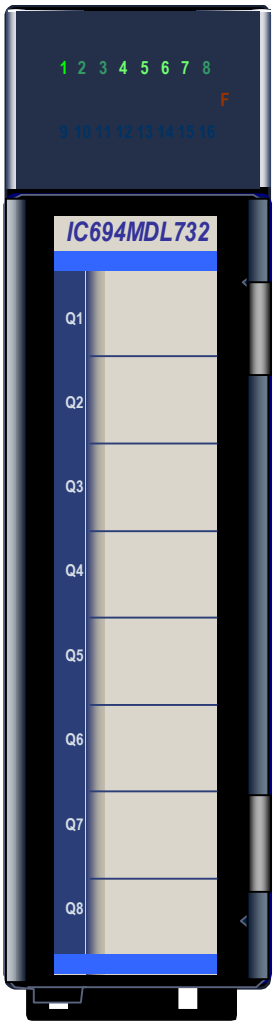


Field Wiring: MDL390

Terminal	Connection
1	No connection
2	Output 1 return
3	No connection
4	Output 1
5	No connection
6	Output 2return
7	No connection
8	Output 2
9	No connection
10	Output 3 return
11	No connection
12	Output 3
13	No connection
14	Output 4 return
15	No connection
16	Output 4
17	No connection
18	Output 5 return
19	No connection
20	Output 5



Output Module, 12/24 Volt DC Positive Logic 0.5A 8 Pt, IC694MDL732



The ***12/24 volt DC Positive Logic 0.5 Amp Output*** module, IC694MDL732, provides one group of eight outputs with a common power output terminal. This module has positive logic characteristics; it sources current to the loads from the user common or positive power bus. The output device is connected between the negative power bus and the module output. The output characteristics are compatible with a wide range of load devices, such as: motor starters, solenoids, and indicators. Power to operate the field devices must be supplied by the user.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The blue bands on the label show that MDL732 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

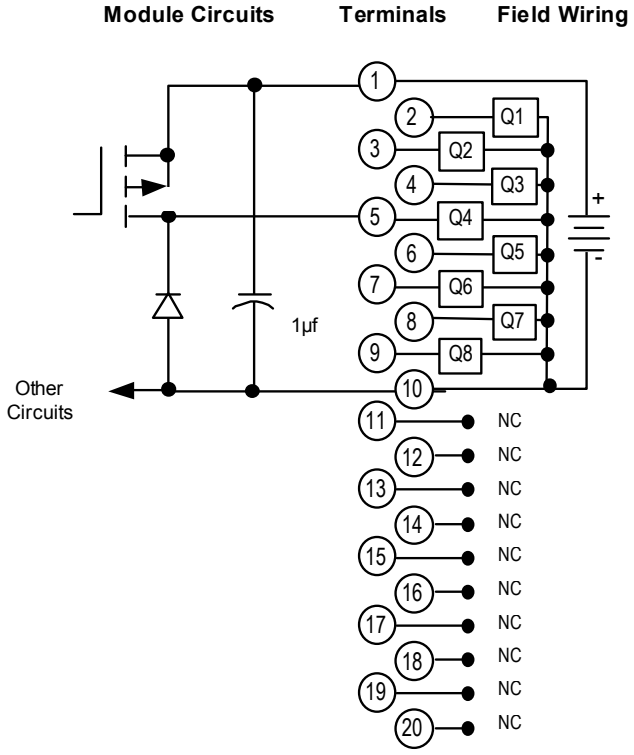
Specifications: MDL732

Rated Voltage	12/24 volts DC
Output Voltage Range	12 to 24 volts DC (+20%, -15%)
Outputs per Module	8 (one group of eight outputs)
Isolation, Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Output Current	0.5 Amps maximum per point 2 Amps maximum per common
Output Characteristics	
Inrush Current	4.78 Amps for 10 ms
Output Voltage Drop	1 volt maximum
Off–state Leakage	1mA maximum
On Response Time	2ms maximum
Off Response Time	2ms maximum
Power Consumption	50mA (all outputs on) from 5 volt bus on backplane

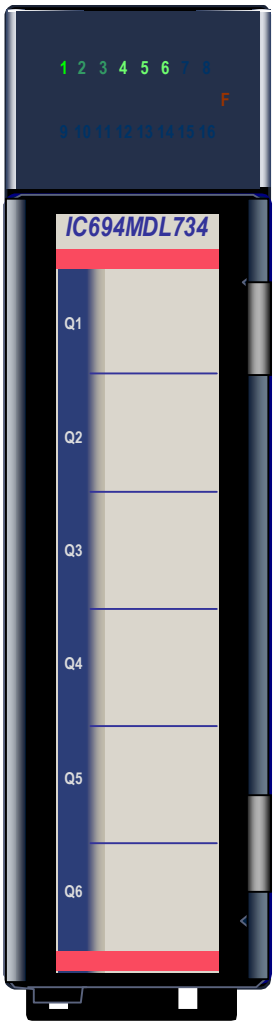
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL732

Terminal	Connection
1	DC+
2	Output 1
3	Output 2
4	Output 3
5	Output 4
6	Output 5
7	Output 6
8	Output 7
9	Output 8
10	Outputs 1 - 8 common (return)
11	No connection
12	No connection
13	No connection
14	No connection
15	No connection
16	No connection
17	No connection
18	No connection
19	No connection
20	No connection



Output Module 125VDC Pos/Neg, 1 Amp, Isolated 6 Pt: IC694MDL734



The ***125 volt DC Positive/Negative Logic 1 Amp Output*** module, IC694MDL734, provides six isolated output points. Each output point has a separate common terminal. This output module can be wired to have either *positive logic* characteristics so that it sources current to the loads from the user common or positive power bus; or *negative logic* characteristics so that it sinks current from the loads to the user common or negative power bus. The output characteristics are compatible with a wide range of load devices, such as: motor starters, solenoids, and indicators. Power to operate the field devices must be supplied by the user. External fusing is recommended. Two Amp loads can be driven by wiring and driving two outputs in parallel.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The red bands on the label show that MDL734 is a high-voltage module.

This module can be installed in any I/O slot in an RX3i system.

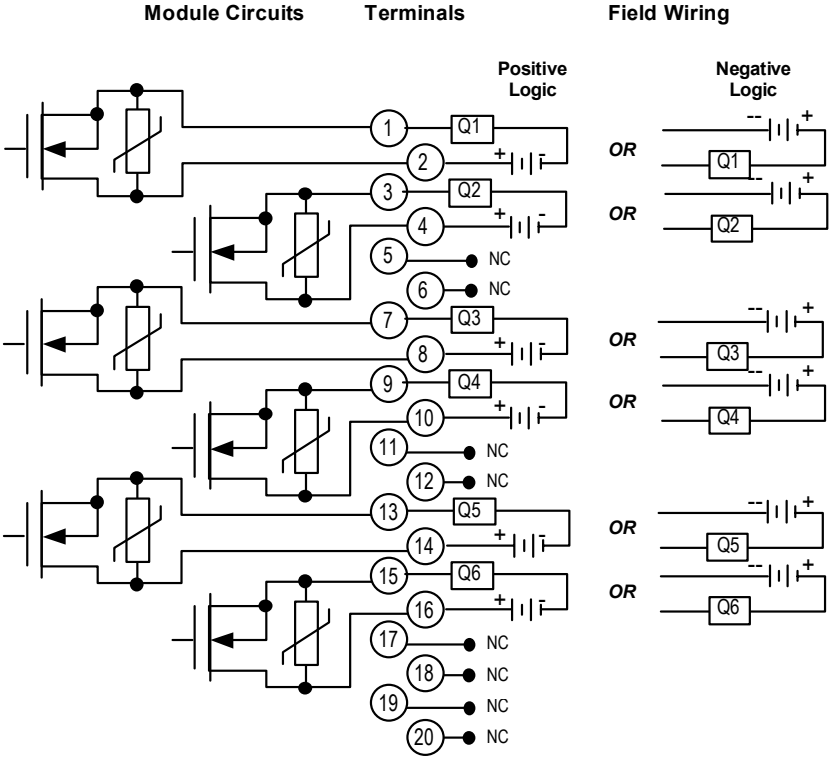
Specifications: MDL734

Rated Voltage	125 volts DC
Output Voltage Range	+10.8 to +150 volts DC
Outputs per Module	6 (isolated)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Point to Point	250 VAC continuous; 1500 VAC for 1 minute
Output Current	1 Amp maximum per point
Output Characteristics	
Inrush Current	15.89 Amps for 10 ms
Output Voltage Drop	1 volt maximum
Off–state Leakage	1mA maximum
On Response Time	7ms maximum
Off Response Time	5ms maximum
Power Consumption	90 mA (all outputs on) from 5 volt bus on backplane

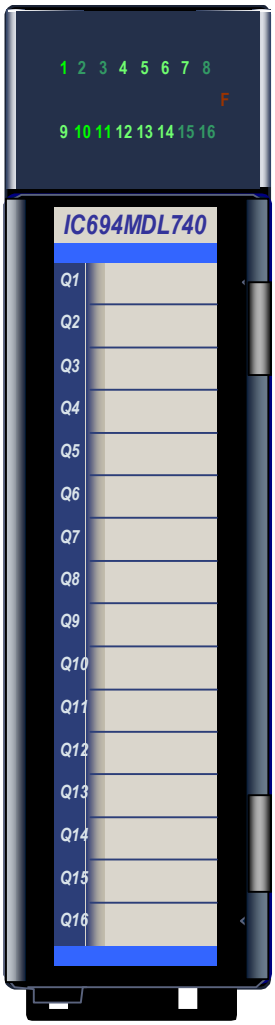
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL734

Terminal	Positive Logic Connection	Negative Logic Connection
1	Output 1	Output 1 return (DC+)
2	Output 1 return (DC+)	Output 1
3	Output 2	Output 2 return (DC+)
4	Output 2 return (DC+)	Output 2
5	No connection	No connection
6	No connection	No connection
7	Output 3	Output 3 return (DC+)
8	Output 3 return (DC+)	Output 3
9	Output 4	Output 4 return (DC+)
10	Output 4 return (DC+)	Output 4
11	No connection	No connection
12	No connection	No connection
13	Output 5	Output 5 return (DC+)
14	Output 5 return (DC+)	Output 5
15	Output 6	Output 6 return (DC+)
16	Output 6 return (DC+)	Output 6
17	No connection	No connection
18	No connection	No connection
19	No connection	No connection
20	No connection	No connection



Output Module, 12/24VDC Pos. Logic, 0.5 Amp, 16 Pt: IC694MDL740



The ***12/24 volt DC Positive Logic 0.5 Amp Output*** module, IC694MDL740, provides 16 output points in two groups of eight. Each group has a common power output terminal. The module has positive logic characteristics; it sources current to the loads from the user common or positive power bus. Output devices are connected between the negative power bus and the module terminals. The module's output characteristics are compatible with a wide range of load devices, such as: motor starters, solenoids, and indicators. Power to operate the field devices must be supplied by the user.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The blue bands on the label show that MDL740 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

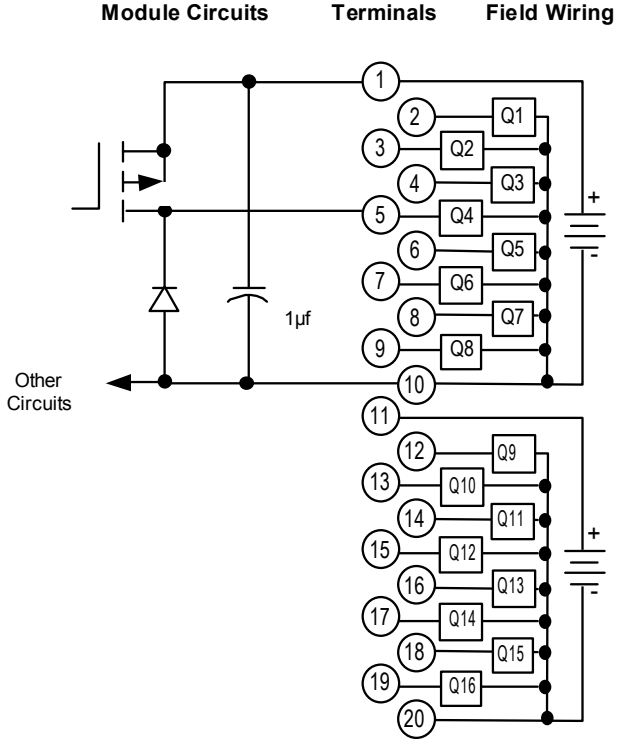
Specifications: MDL740

Rated Voltage	12/24 volts DC
Output Voltage Range	12 to 24 volts DC (+20%, -15%)
Outputs per Module	16 (two groups of eight outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	250 VAC continuous; 1500 VAC for 1 minute
Output Current	0.5 Amps maximum per point 2 Amps maximum per common
Output Characteristics	
Inrush Current	4.78 Amps for 10 ms
Output Voltage Drop	1 volt maximum
Off–state Leakage	1mA maximum
On Response Time	2ms maximum
Off Response Time	2ms maximum
Power Consumption	110mA (all outputs on) from 5 volt bus on backplane

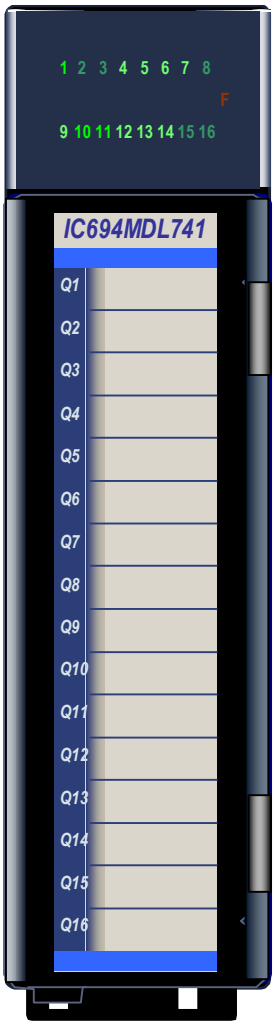
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL740

Terminal	Connection
1	DC +
2	Output 1
3	Output 2
4	Output 3
5	Output 4
6	Output 5
7	Output 6
8	Output 7
9	Output 8
10	Outputs 1 – 8 common (return)
11	DC +
12	Output 9
13	Output 10
14	Output 11
15	Output 12
16	Output 13
17	Output 14
18	Output 15
19	Output 16
20	Outputs 9 - 16 common (return)



Output Module, 12/24VDC Neg. Logic 0.5 Amp, 16 Pt: IC694MDL741



The ***12/24 volt DC Negative Logic 0.5 Amp Output*** module, IC694MDL741, provides 16 output points in two groups. Each group has a common power output terminal. This output module has negative logic characteristics; it sinks current from the loads to the user common or negative power bus. Output devices are connected between the positive power bus and the output terminals. The module's output characteristics are compatible with a wide range of load devices, such as: motor starters, solenoids, and indicators. Power to operate the field devices must be supplied by the user.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module.

The blue bands on the label show that MDL741 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

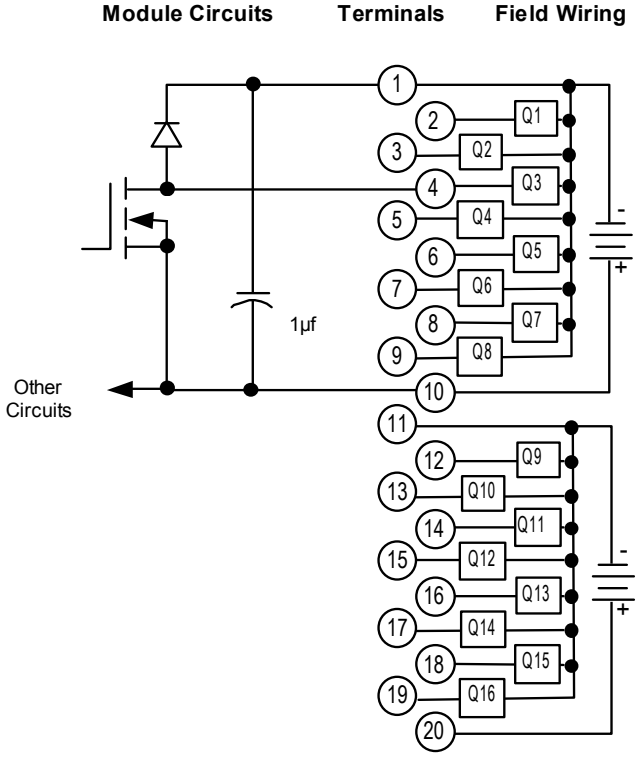
Specifications: MDL741

Rated Voltage	12/24 volts DC
Output Voltage Range	12 to 24 volts DC (+20%, -15%)
Outputs per Module	16 (two groups of eight outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	250 VAC continuous; 1500 VAC for 1 minute
Output Current	0.5 Amps maximum per point 2 Amps maximum per common
Output Characteristics	
Output Voltage Drop	0.5 volts maximum
Off–state Leakage	1mA maximum
On Response Time	2ms maximum
Off Response Time	2ms maximum
Power Consumption	110mA (all outputs on) from 5 volt bus on backplane

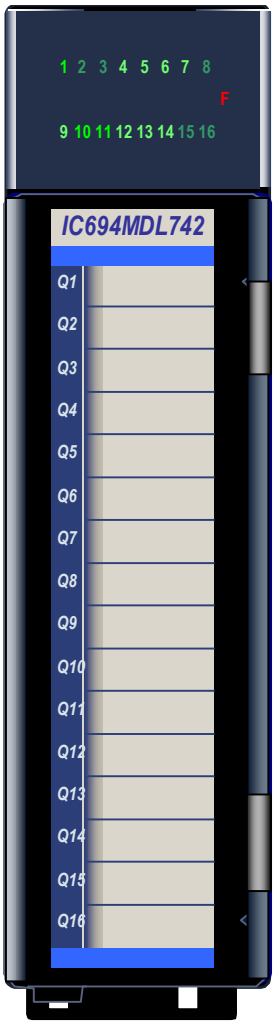
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL741

Terminal	Connection
1	Outputs 1 – 8 common (return)
2	Output 1
3	Output 2
4	Output 3
5	Output 4
6	Output 5
7	Output 6
8	Output 7
9	Output 8
10	DC +
11	Outputs 9 - 16 common (return)
12	Output 9
13	Output 10
14	Output 11
15	Output 12
16	Output 13
17	Output 14
18	Output 15
19	Output 16
20	DC +



Output Module, 12/24VDC Positive Logic ESCP, 1A, 16 Pt: IC694MDL742



The ***12/24 volt DC Positive Logic 1 Amp Electronic Short Circuit Protection (ESCP) Output*** module, IC694MDL742, provides 16 output points in two groups of eight. Each group has a common power output terminal. This output module has positive logic characteristics: it sources current to the loads from the user common or positive power bus. Output devices are connected between the negative power bus and the output terminals. The nodule's output characteristics are compatible with a wide range of load devices, such as: motor starters, solenoids, and indicators. Power to operate the field devices must be supplied by the user.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The module's red LED (F) indicates electronic short circuit protection trips. The blue bands on the label show that MDL742 is a low-voltage module.

This module can be installed in any I/O slot in an RX3i system.

Electronic Short Circuit Protection

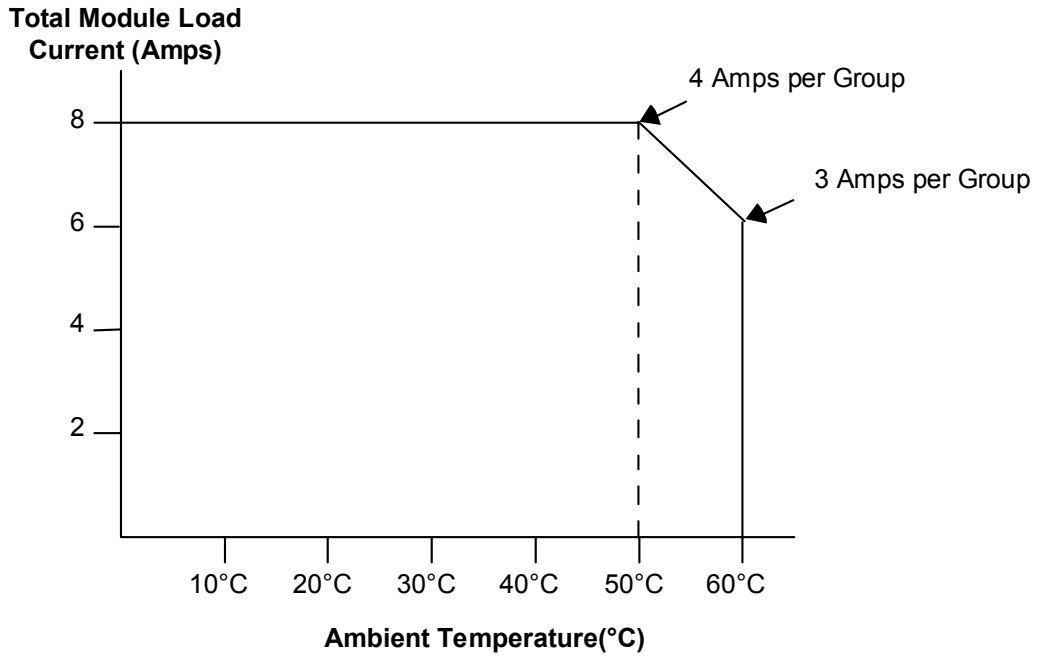
Module MDL742 has two Electronic Short Circuit Protection circuits. The first circuit protects points 1 to 8 and the second protect points 9 to 16. The module electronically monitors the common signal for each group. If a short circuit occurs, the module turns off the output points in that group, and turns on the red LED (F). The point LEDs do not turn off. Electronic Short Circuit Protection does not prevent individual outputs from exceeding their ratings, but it protects the module in case of a short-circuited load. Electronic Short Circuit Protection is reset by cycling the 12/24 VDC user power to the module.

Specifications: MDL742

Rated Voltage	12/24 volts DC
Output Voltage Range	12 to 24 volts DC (+20%, -15%)
Outputs per Module	16 (two groups of eight outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	250 VAC continuous; 1500 VAC for 1 minute
Output Current	1 Amp maximum per point 4 Amps maximum per group at @ 50°C 3 Amps maximum per group @ 60°C Maximum total load current depends on the ambient temperature as shown below
Output Characteristics	
Inrush Current	5.2 Amps for 10 ms
Output Voltage Drop	1.2 volts maximum
Off–state Leakage	1mA maximum
On Response Time	2ms maximum
Off Response Time	2ms maximum
Power Consumption	130mA (all outputs on) from 5 volt bus on backplane

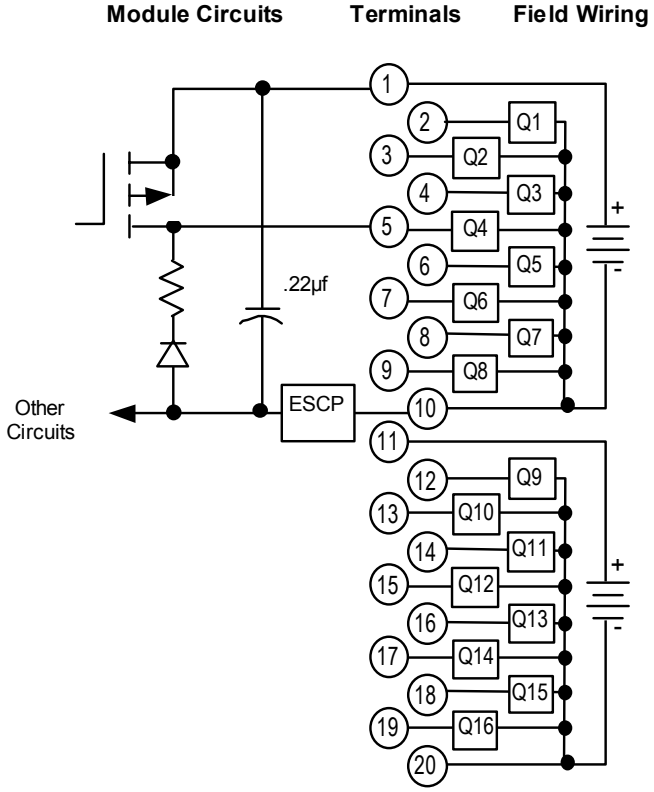
Refer to Appendix A for product standards and general specifications.

Load Current vs. Temperature

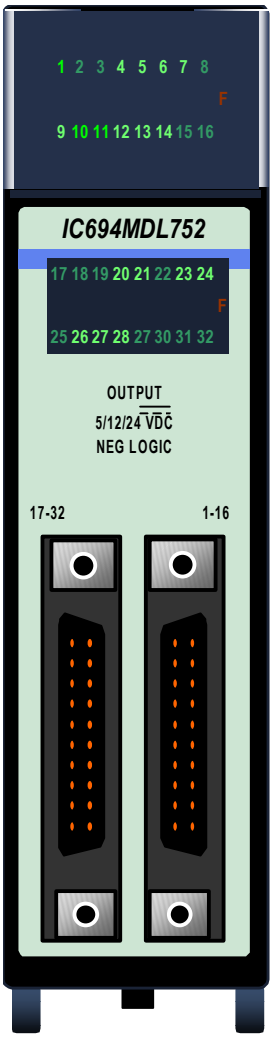


Field Wiring: MDL742

Terminal	Connection
1	DC +
2	Output 1
3	Output 2
4	Output 3
5	Output 4
6	Output 5
7	Output 6
8	Output 7
9	Output 8
10	Outputs 1 – 8 common (return)
11	DC +
12	Output 9
13	Output 10
14	Output 11
15	Output 12
16	Output 13
17	Output 14
18	Output 15
19	Output 16
20	Outputs 9 - 16 common (return)



Output Module, 5/24 VDC (TTL) Negative Logic, 32 Pt: IC694MDL752



The ***5/24 volt DC (TTL) Negative Logic Output*** module, IC694MDL752, provides 32 discrete outputs arranged in four isolated groups of eight. Each group has its own common. The outputs are negative logic or sinking-type outputs (the ON state for a point results in an active low output).

The module has two modes of operation. In TTL mode, the outputs can switch loads across +5 VDC (±5%) and are capable of sinking a maximum current of 25mA per point. In 12/24V mode, the outputs can switch loads over the range of +12 to -24 VDC (+20%, -15%) and are capable of sinking a maximum current of 0.5A per point.

There are two pins on the I/O connectors for each group common. Each pin has a current-handling capacity of 3 Amps. It is recommended that connections be made to both pins when connecting the common; however, it is required for high-current applications (between 3 and 4 Amps).

Each group can be used to drive different loads. For example, the module can drive TTL loads, 12 VDC loads, and 24 VDC loads on different groups. It is important to consider the effects of electrical noise when mixing TTL and inductive-type loads.

Each point has an internal pull–up resistor. The resistor passively pulls up the output to the user positive side power input (typically +5V for TTL mode) when the output point FET is OFF, providing a high logic level for TTL applications. All 32 outputs are forced OFF when the CPU is stopped. Power to provide current to the loads must be provided by the user. The module also draws a minimum amount of power from the user supply to provide gate drive to the output devices

Backplane isolation between the field side and logic side is provided by opto–couplers on the module. No special fault or alarm diagnostics are reported. Individual numbered LEDs show the ON/OFF status of each output.

This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL752

Rated Voltage	5, and 12 through 24 volts DC, negative logic (active low)
Output Voltage Range	4.75 to 5.25 volts DC (TTL mode) 10.2 to 28.8 volts DC (12/24V mode)
Outputs per Module	32 (four groups of eight outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	50 VAC continuous; 500 VAC for 1 minute
Output Current	25mA per point (maximum in TTL mode) 0.5 Amps per point (maximum in 12/24V mode); with 4 Amps maximum per group and 3 Amps maximum per group common pin
Output Characteristics	
Inrush Current	4.6 Amps for 10ms
On–state (active low)	0.4 volts DC (maximum in TTL mode)
Voltage Drop	0.24 volts DC (maximum in 12/24V mode)
Off–state Leakage Current	0.1mA maximum
On Response Time	0.5ms maximum
Off Response Time	0.5ms maximum
Power Consumption	260mA (maximum) from 5 volt bus on backplane; (13mA + 3 mA/point ON + 4.7 mA/LED) 12 mA (maximum) per group from user supply @ 5VDC and all eight outputs in group ON 25 mA (maximum) per group from user supply @ 12 VDC and all eight outputs in group ON 44 mA (maximum) per group from user supply @ 24 VDC and all eight outputs in group ON

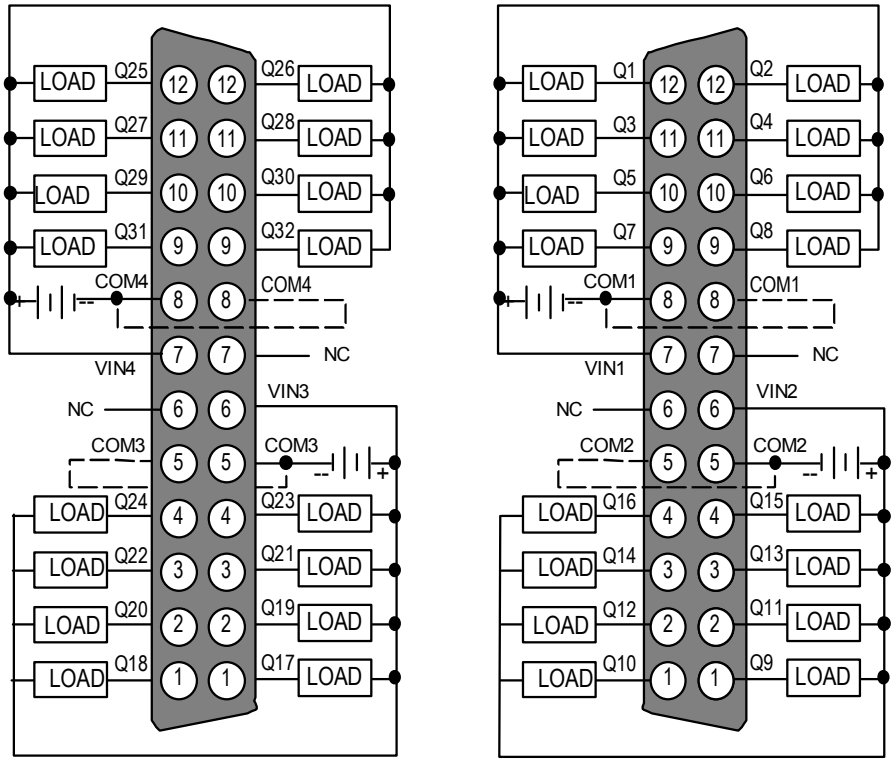
Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL752

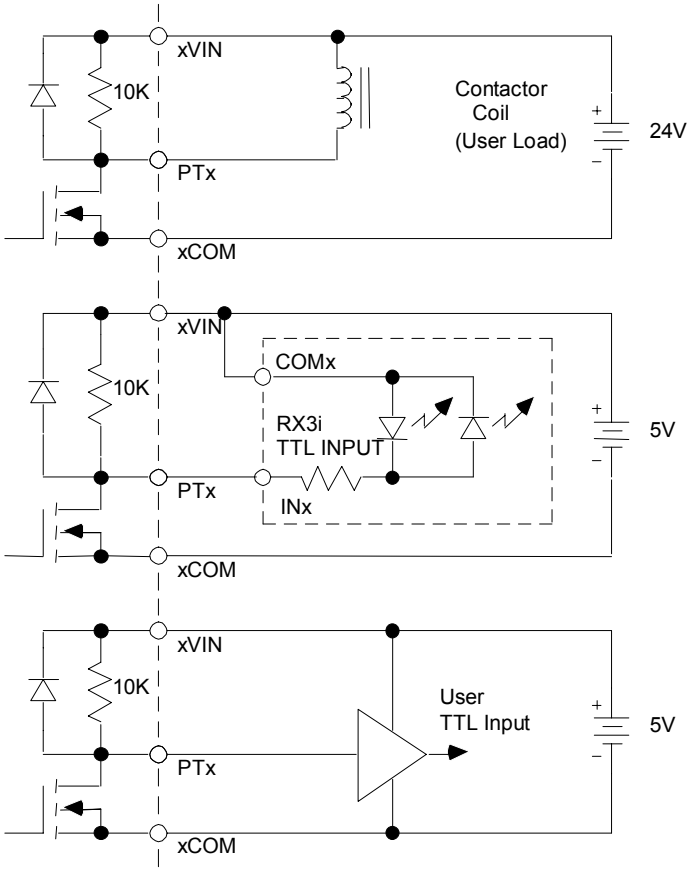
Connections to the output circuits are made from the load devices to two male 24–pin connectors (Fujitsu FCN–365P024–AU) on the front of the module.

The module's connectors can be connected directly to field devices using a cable having a mating female connector on one end and stripped and tinned wires on the other end. You can purchase a pair of pre–wired cables, catalog numbers IC694CBL327 and IC694CBL328 or build cables. Refer appendix B of this manual for more information.

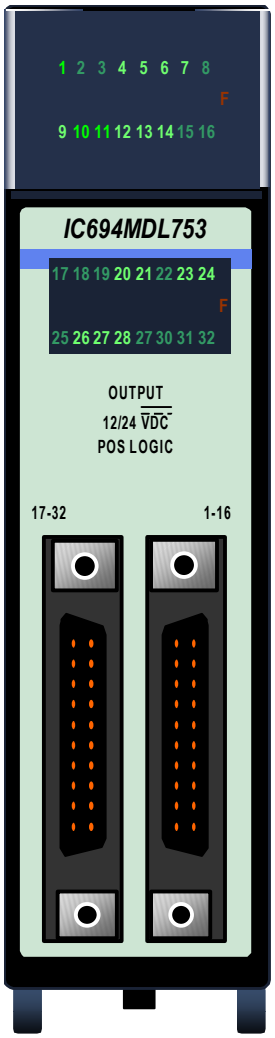
Connections can also be made a pair of cables with connectors on each end. These cables connect the module with DIN-rail mounted terminal blocks as described in appendix B.



Typical Connections: MDL752



Output Module, 12/24VDC, 0.5A Positive Logic, 32 Pt: IC694MDL753



The ***12/24 volt DC, 0.5A Positive Logic Output*** module, IC694MDL753, provides 32 discrete outputs in four isolated groups of eight. Each group has its own common. The outputs are positive logic or sourcing type outputs; they switch the loads on the positive side of the power supply, and supply current to the load. The outputs can switch user loads over the range of +12 to +24 VDC (+20%, -15%) and can source a maximum current of 0.5 Amps per point. There are two pins on the I/O connectors for each group common. Each pin has a current handling capacity of 3 Amps. It is recommended that connections be made to both pins when connecting the common; however, it is required for high-current applications (between 3 and 4 Amps).

Each group can be used to drive different loads. For example, three groups might drive 24 VDC loads, while the fourth was reserved for driving 12 VDC loads. Power to provide current to the loads must be provided by the user. The module also draws a minimum amount of power from the user supply to provide gate drive to the output devices. Backplane isolation between the field side and logic side is provided by opto–couplers on the module.

All 32 outputs are forced OFF when the CPU is stopped. There are no special fault or alarm diagnostics reported. Individual numbered LEDs show the ON/OFF status of each output.

This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL753

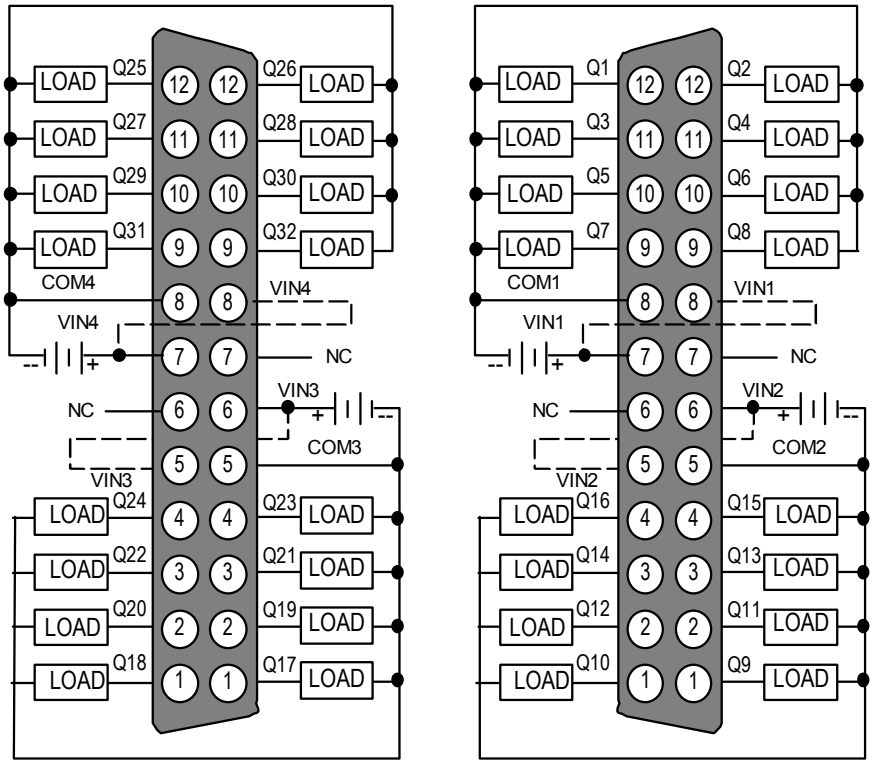
Rated Voltage **Output Voltage Range**	12 through 24 volts DC, positive logic 10.2 to 28.8 volts DC
Outputs per Module	32 (four groups of eight outputs each)
Isolation	
Field to Backplane (optical) and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Group to Group	50 VAC continuous; 500 VAC for 1 minute
Output Current	0.5 Amps per point with 4 Amps maximum per group and 3 Amps maximum per group common pin
Output Characteristics	
Inrush Current	5.4 Amps for 10 ms
On–state Voltage Drop	0.3 volt DC
Off–state Leakage Current	0.1mA maximum
On Response Time	0.5ms maximum
Off Response Time	0.5ms maximum
Power Consumption	260 mA (maximum) from 5 volt bus on backplane; (13mA + 3mA/point ON + 4.7mA/LED) 16.5mA (maximum) per group from user supply @ 24VDC and all eight outputs in group ON 9.6mA (maximum) per group from user supply @ 12VDC and all eight outputs in group ON

Refer to Appendix A for product standards and general specifications.

Field Wiring: MDL753

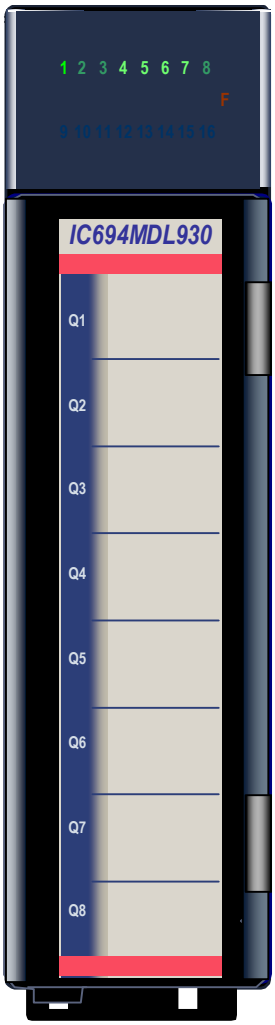
Connections to the output circuits are made from the load devices to two male 24–pin connectors (Fujitsu FCN–365P024–AU) on the front of the module. The module's connectors can be wired directly to field devices using a cable having a mating female connector on one end and stripped and tinned wires on the other end. You can purchase a pair of pre–wired cables, catalog numbers IC694CBL327 and IC694CBL328 or build cables. Refer to appendix B of this manual for more information.

Connections can also be made a pair of cables with connectors on each end. These cables connect the module with DIN-rail mounted terminal blocks as described in appendix B.



If the total current is greater than 3 Amps for a group, use both V_{IN} pins for the group by adding a second wire (shown by dashed lines above).

Output Module, Isolated Relay, N.O., 4 Amp, 8 Point: IC694MDL930



The ***4 Amp Isolated Relay Output*** module, IC694MDL930, provides eight normally–open relay circuits for controlling output loads. The output switching capacity of each circuit is 4 Amps. Each output point is isolated from the other points, and each point has a separate common power output terminal. The relay outputs can control a wide range of output devices, such as: motor starters, solenoids, and indicators. The user must supply the AC or DC power to operate the field devices connected to this module.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The red bands on the label show that MDL930 is a high-voltage module.

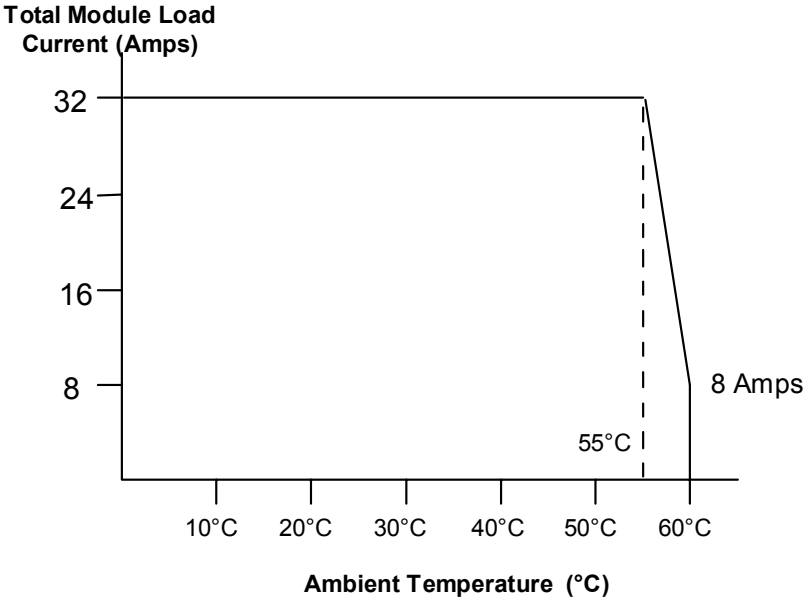
This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL930

Rated Voltage	24 volts DC, 120/240 volts AC (nominal - see the following table for exceptions)
Operating Voltage	5 to 30 volts DC
	5 to 250 volts AC, 50/60 Hz
Outputs per Module	8 isolated outputs
Isolation	
Field to Backplane and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Point to Point	250 VAC continuous; 1500 VAC for 1 minute
Maximum Load	4 Amps resistive maximum per output
	2 Amps pilot duty per output
	20 Amps maximum per module for UL installations
	Maximum Load depends on the ambient temperature as shown below
Minimum Load	10mA
Maximum Inrush	5 Amps
On Response Time	15ms maximum
Off Response Time	15ms maximum
Power Consumption	6mA (all outputs on) from 5 volt bus on backplane
	70mA (all outputs on) from relay 24V bus on backplane

Refer to Appendix A for product standards and general specifications.

Load Current vs. Temperature



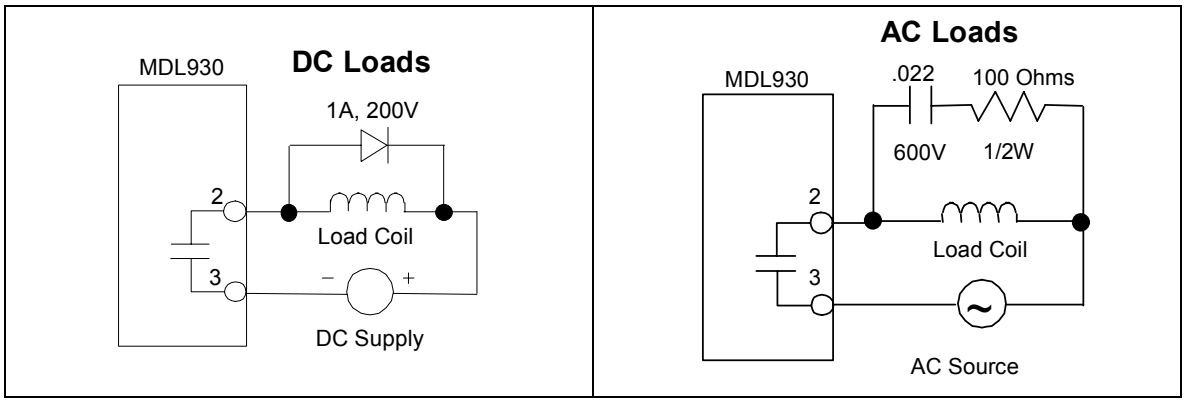
Load Current Limitations

Operating Voltage	Maximum Current for Load Type		Typical Contact Life (Number of Operations)
	Resistive	Lamp or Solenoid *	
24 to 120 VAC	4 Amps	2 Amps	150,000
24 to 120 VAC	1 Amp	0.5 Amp	500,000
24 to 120 VAC	0.1 Amp	0.05 Amp	1,000,000
240 VAC	4 Amps	2 Amps	50,000
240 VAC	0.1 Amp	0.05 Amp	500,000
240 VAC	1 Amp	0.5 Amp	200,000
24 VDC	–	3 Amps	50,000
24 VDC	4 Amps	2 Amps	100,000
24 VDC	1 Amp	0.5 Amp	500,000
24 VDC	0.1 Amp	0.05 Amp	1,000,000
125 VDC	0.2 Amp	0.1 Amp	300,000

* Assumes a 7ms time constant

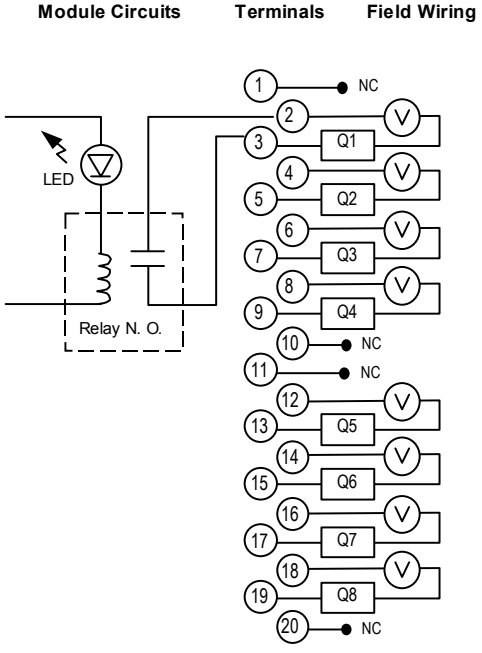
Relay contact life, when switching inductive loads, will approach resistive load contact life if suppression circuits are used. Examples of typical suppression circuits for AC and DC loads are shown below. The 1A, 200V diode shown in the DC load typical suppression example is an industry standard 1N4935. The resistor and capacitor shown for AC load suppression are standard components, available from most electronics distributors.

Load Suppression Examples for Output Module IC694MDL930

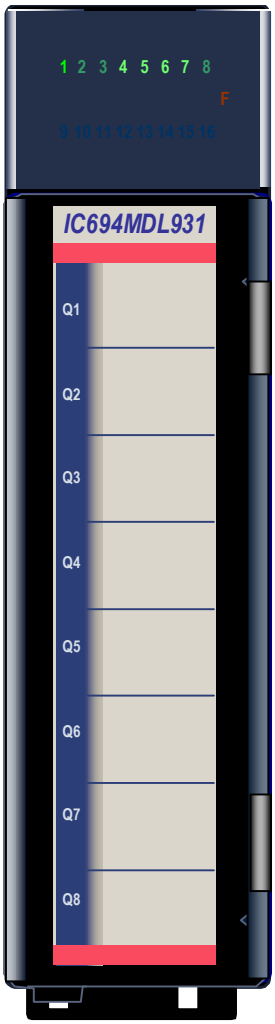


Field Wiring: MDL930

Terminal	Connection
1	No connection
2	Output 1-1
3	Output 1-2
4	Output 2-1
5	Output 2-2
6	Output 3-1
7	Output 3-2
8	Output 4-1
9	Output 4-2
10	No connection
11	No connection
12	Output 5-1
13	Output 5-2
14	Output 6-1
15	Output 6-2
16	Output 7-1
17	Output 7-2
18	Output 8-1
19	Output 8-2
20	No connection



Output Module, Isolated Relay, N.C. and Form C, 8A , 8 Pt: IC694MDL931



The ***8 Amp* Isolated Relay Output** module, IC694MDL931, provides 4 normally-closed and 4 Form C relay circuits for controlling output loads provided by the user. The output switching capacity of each circuit is 8 Amps. Each output relay is isolated from the other relays, and each relay has a separate common power output terminal. The relay outputs can control a wide range of load devices, such as: motor starters, solenoids, and indicators. The user must supply the AC or DC power to operate the field devices.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The red bands on the label show that MDL931 is a high-voltage module.

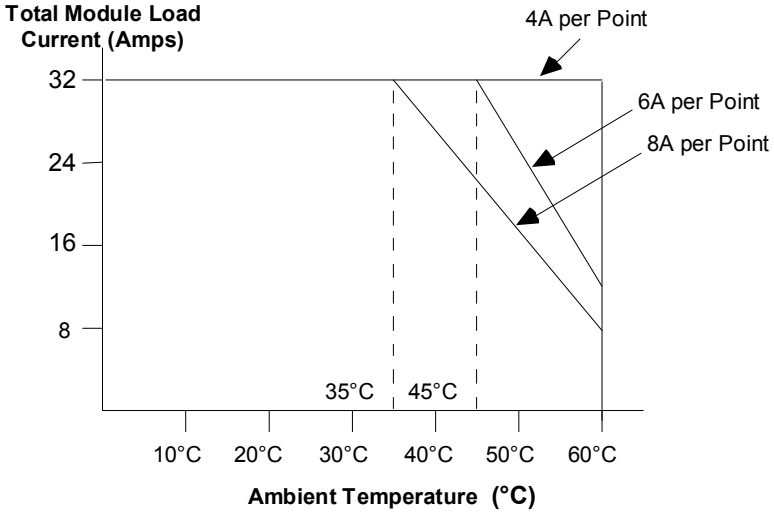
This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL931

Rated Voltage	24 volts DC, 120/240 volts AC, 50/60 Hz (nominal - see the following table for exceptions)
Output Voltage Range	5 to 30 volts DC
	5 to 250 volts AC, 50/60 Hz
Outputs per Module	8 isolated outputs
Isolation	
Field to Backplane and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Point to Point	250 VAC continuous; 1500 VAC for 1 minute
Maximum Load	8 Amps resistive maximum per output
	20 Amps maximum per module for UL installations
	Maximum load depends on ambient temperature as shown.
Minimum Load	10mA
Inrush Current	8 Amps maximum for one cycle
On Response Time	15ms maximum
Off Response Time	15ms maximum
Output Leakage Current	1mA maximum at 250 volts AC, (25°C (77°F))
Power Consumption	6mA (all outputs on) from 5 volt bus on backplane
	110mA (all outputs on) from relay 24V bus on backplane

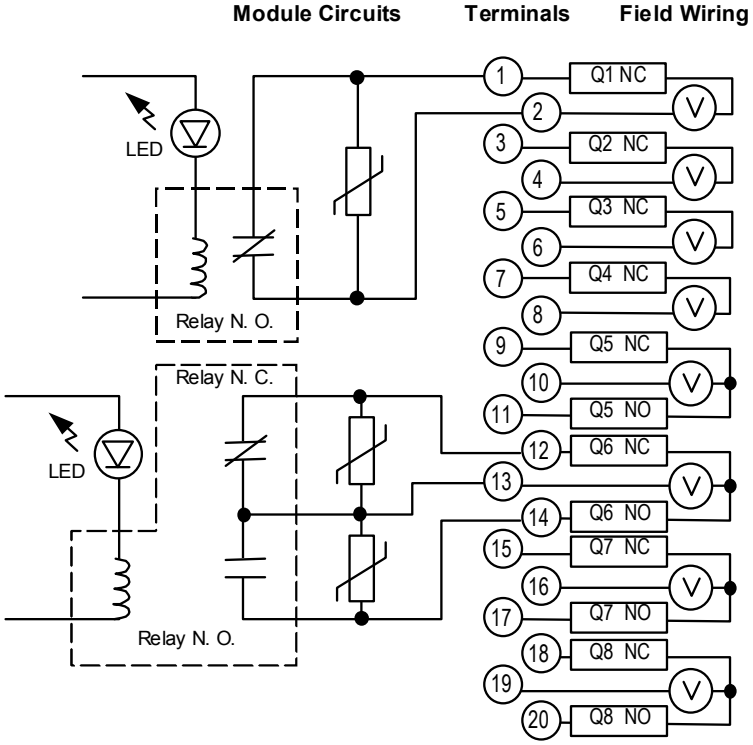
Refer to Appendix A for product standards and general specifications.

Load Current vs. Temperature



Field Wiring: MDL931

Terminal	Connection
1	Output 1
2	Output 1 return
3	Output 2
4	Output 2 return
5	Output 3
6	Output 3 return
7	Output 4
8	Output 4 return
9	Output 5 (if normally-closed relay)
10	Output 5 return
11	Output 5 (if normally-open relay)
12	Output 6 (if normally-closed relay)
13	Output 6 return
14	Output 6 (if normally-open relay)
15	Output 7 (if normally-closed relay)
16	Output 7 return
17	Output 7 (if normally-open relay)
18	Output 8 (if normally-closed relay)
19	Output 8 return
20	Output 8 (if normally-open relay)



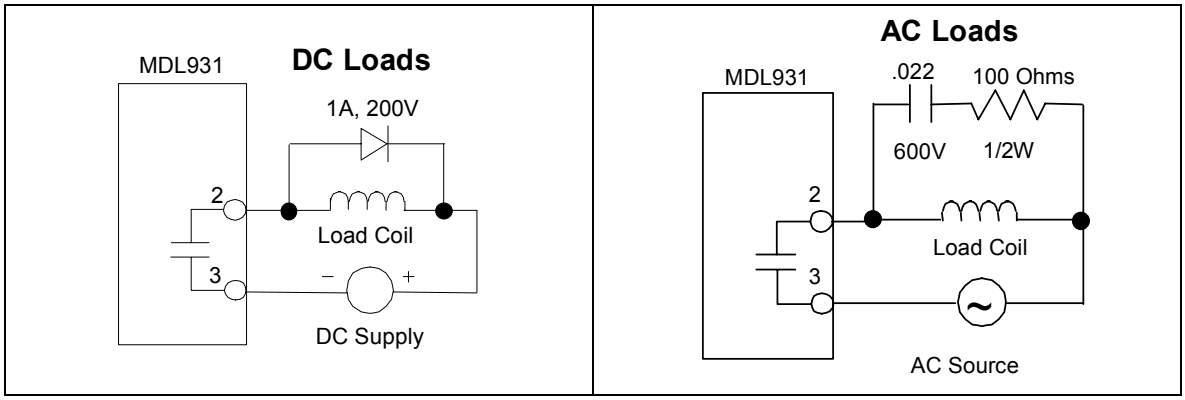
Load Current Limitations for MDL931

Operating Voltage	Maximum Current for Load Type		Typical Contact Life (Number of operations)
	Resistive	Lamp or Solenoid *	
5 to 120 VAC	8 Amps	3 Amps	200,000
	6 Amps	2.5 Amps	300,000
	4 Amps	1.5 Amps	400,000
	1 Amp	0.5 Amp	1,100,000
240 VAC	8 Amps	3 Amps	100,000
	6 Amps	2.5 Amps	150,000
	4 Amps	1.5 Amps	200,000
	1 Amp	0.5 Amp	800,000
24 VDC	8 Amps	3 Amps	100,000
	6 Amps	2.5 Amps	150,000
	4 Amps	1.5 Amps	200,000
	1 Amp	0.5 Amp	800,000
48 VDC	1.5 Amps	–	100,000
100 VDC	0.5 Amp	–	100,000
125 VDC	0.38 Amp	0.12 Amp	100,000
150 VDC	0.30 Amp	0.10 Amp	100,000

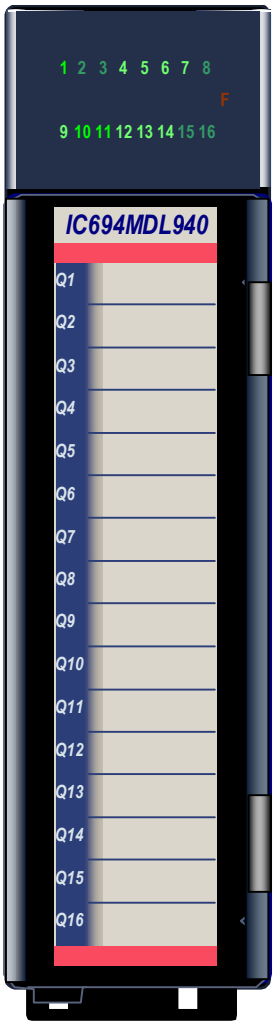
* For inductive loads

Relay contact life, when switching inductive loads, will approach resistive load contact life if suppression circuits are used. The examples below show typical suppression circuits for AC and DC loads. The 1A, 200V diode shown in the DC load typical suppression circuit is an industry standard 1N4935. The resistor and capacitor shown for AC load suppression are standard components.

Load Suppression Examples for Output Module IC694MDL931



Output Module, Relay Output, N.O., 2 Amp, 16 Point: IC694MDL940



The ***2 Amp Relay Output*** module, IC694MDL940, provides 16 normally–open relay circuits for controlling output loads. The output switching capacity of each output is 2 Amps. The output points are in four groups of four points each. Each group has a common power output terminal. The relay outputs can control a wide range of load devices, such as: motor starters, solenoids, and indicators. Power for the internal relay circuits is provided by the +24 volt DC bus on the backplane. The user must supply the AC or DC power to operate field devices.

Individual numbered LEDs show the ON/OFF status of each output point. There are no fuses on this module. The red bands on the label show that MDL940 is a high-voltage module.

This module can be installed in any I/O slot in an RX3i system.

Specifications: MDL940

Rated Voltage	24 volts DC, 120/240 volts AC (nominal - see the following table for exceptions)
Operating Voltage	5 to 30 volts DC 5 to 250 volts AC, 50/60 Hz
Outputs per Module	16 (four groups of four outputs each)
Isolation	
Field to Backplane and to Frame Ground	250 VAC continuous; 1500 VAC for 1 minute
Point to Point	250 VAC continuous; 1500 VAC for 1 minute
Maximum Load	2 Amps pilot duty maximum per output 4 Amps maximum per common
Minimum Load	10mA
Maximum Inrush	5 Amps
On Response Time	15ms maximum
Off Response Time	15ms maximum
Power Consumption	7mA (all outputs on) from 5 volt bus on backplane 135mA (all outputs on) from relay 24V bus on backplane

Refer to Appendix A for product standards and general specifications.

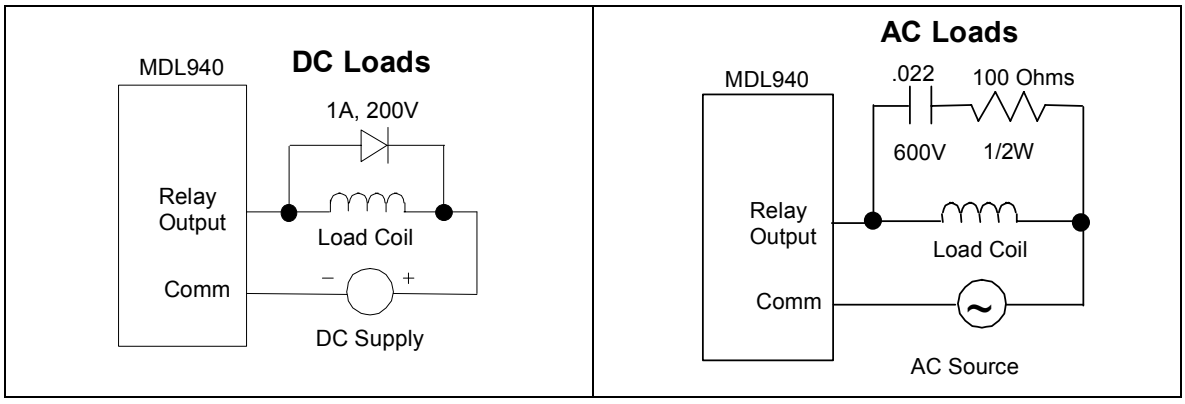
Load Current Limitations: MDL940

Operating Voltage	Maximum Current for Load Type		Typical Contact Life (Number of Operations)
	Resistive	Lamp or Solenoid *	
24 to 120 VAC	2 Amps	1 Amp	300,000
24 to 120 VAC	1 Amp	0.5 Amp	500,000
24 to 120 VAC	0.1 Amp	0.05 Amp	1,000,000
240 VAC	2 Amps	1 Amp	150,000
240 VAC	1 Amp	0.5 Amp	200,000
240 VAC	0.1 Amp	0.05 Amp	500,000
24 VDC	–	2 Amps	100,000
24 VDC	2 Amps	1 Amp	300,000
24 VDC	1 Amp	0.5 Amp	500,000
24 VDC	0.1 Amp	0.05 Amp	1,000,000
125 VDC	0.2 Amp	0.1 Amp	300,000

* Assumes a 7 ms time constant

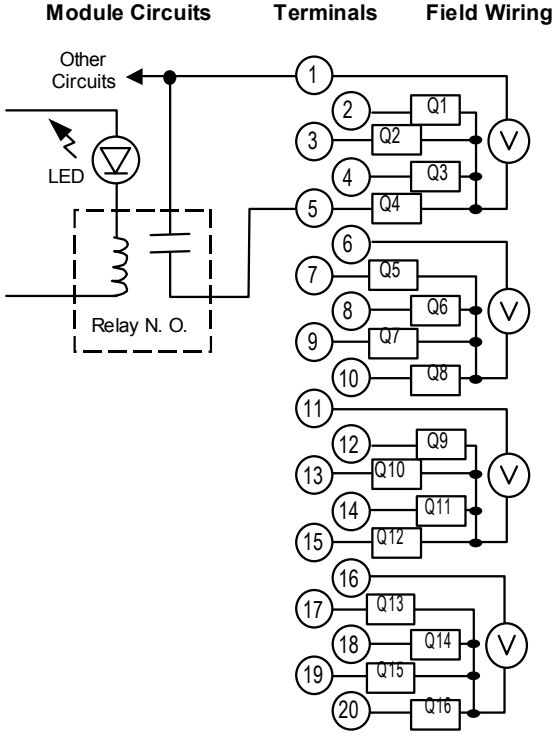
Relay contact life, when switching inductive loads, will approach resistive load contact life if suppression circuits are used. The following figures are examples of typical suppression circuits for AC and DC loads. The 1A, 200V diode shown in the DC load suppression circuit is an industry standard 1N4935. The resistor and capacitor shown for AC load suppression are standard components.

Load Suppression Examples for Output Module IC694MDL940



Field Wiring: MDL940

Terminal	*Connection*
1	Outputs 1 – 4 common (return)
2	Output 1
3	Output 2
4	Output 3
5	Output 4
6	Outputs 5 -8 common (return)
7	Output 5
8	Output 6
9	Output 7
10	Output 8
11	Outputs 9 - 12 common (return)
12	Output 9
13	Output 10
14	Output 11
15	Output 12
16	Outputs 13 – 16 common (return)
17	Output 13
18	Output 14
19	Output 15
20	Output 16

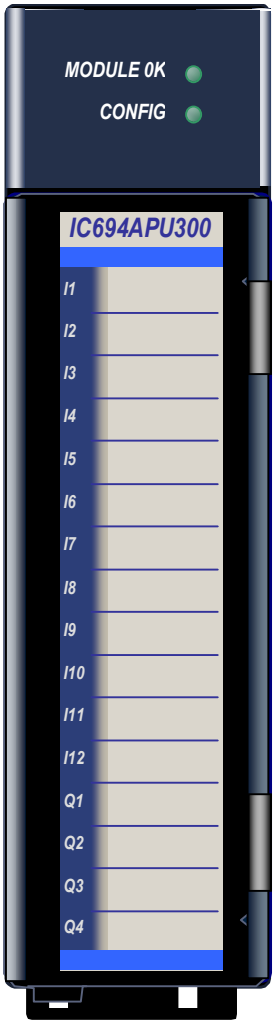


Chapter 8 Discrete Mixed Module

This chapter describes the following discrete mixed input/output module for RX3i PACSystems:

Discrete Mixed Module	***Catalog Number***
High Speed Counter	IC694APU300

High-speed Counter Module: IC694APU300



The High-speed Counter module, IC694APU300, provides direct processing of rapid pulse signals up to 80 kHz. The module senses inputs, processes the input count information, and controls the outputs without needing to communicate with a CPU.

The High Speed Counter uses 16 bits of discrete input memory (%I), 15 words of analog input memory (%AI), and 16 bits of discrete output memory (%Q) in the CPU. The High-speed Counter can be configured to have:

- 4 identical, independent simple counters
- 2 identical, independent more complex counters
- 1 complex counter

Two green LEDs indicate the operating status of the module and the status of configuration parameters. Additional module features include:

- 12 positive logic (source) inputs with input voltage range selection of either 5 VDC or 10 to 30 VDC
- 4 positive logic (source) outputs
- Counts per timebase register for each counter
- Internal module diagnostics
- A removable terminal board for field wiring

Inputs can be used as count signals, direction, disable, edge-sensitive strobe, and preload inputs depending on the counter type selected by the user. Outputs can be used to drive indicating lights, solenoids, relays, and other devices.

Power for the module is drawn from the backplane's 5VDC bus. Power sources for input and output devices must be supplied by the user or by the +24 VDC Isolated output of the power supply. The module also provides a selectable threshold voltage to allow the inputs to respond to either 5VDC signal levels or 10 to 30VDC signal levels.

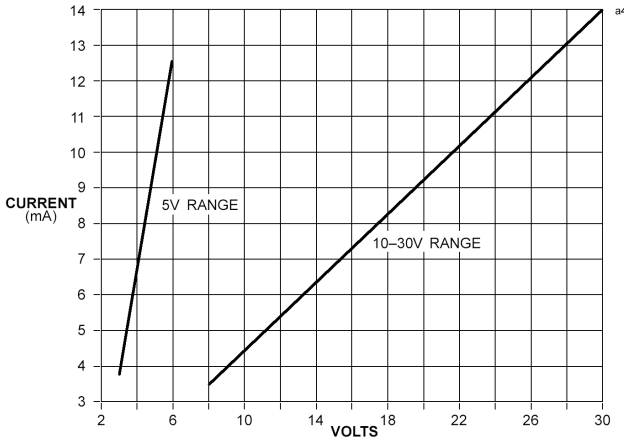
The blue bands on the label show that APU300 is a low-voltage module. This module can be installed in any I/O slot in an RX3i system.

Specifications: APU300

Inputs		
Voltage Range	5VDC (TSEL jumpered to INCOM) 10 to 30 VDC (TSEL open)	
Positive Logic Inputs	12	
Input Thresholds (I1 to I12)	**5VDC Range**	**10 to 30VDC Range**
Von	3.25V Range	8.0V minimum
Ion	3.2mA minimum	3.2mA minimum
Voff	1.5V maximum	2.4V maximum
Ioff	0.8mA maximum	0.8mA maximum
Survivable Peak Voltage	± 500V for 1mSec	
Transient Common Mode Noise Rejection	1000 volts per mSec minimum	
Input Impedance	See below	
Outputs		
Voltage Range	10 to 30VDC @ 500mA maximum	
Voltage Range	4.75 to 6VDC @ 20mA maximum	
Off State Leakage Current	10mA maximum per point	
Output Voltage Drop at 500 mA	0.5V maximum	
CMOS Load Drive Capability	Yes	
Positive Logic Outputs	4	
Output protection	Outputs are short circuit protected by a 3A pico fuse common to all 4 outputs	
Power Consumption	250mA from 5V bus on the backplane	
Isolation		
Field to Backplane (optical) and to frame ground	250 VAC continuous, 1500 VAC for one minute	
Group to Group	250 VAC continuous, 1500 VAC for one minute	

Refer to Appendix A for product standards and general specifications.

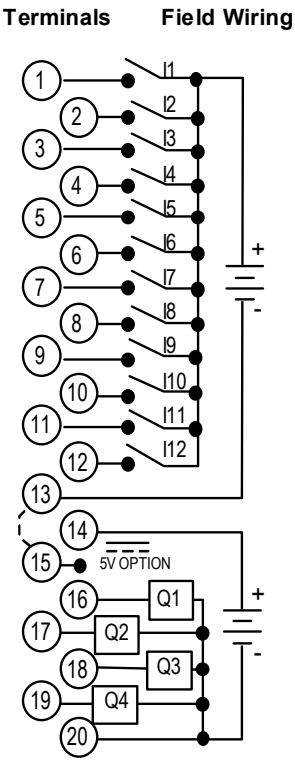
Input Impedance



Field Wiring: APU300

Wiring information for APU300 is shown below.

Shielded cable must be used for connecting to the High Speed Counter module. The shield for the cable must have a high frequency ground within 6 inches (15.24 cm) of the module to meet the IEC 1000-4-4 levels specified in Appendix A. The cable's length is limited to 30 meters.



All 12 High Speed Counter inputs are single-ended positive logic (source) type inputs. Transducers with CMOS buffer outputs (74HC04 equivalent) can directly drive the High-speed Counter inputs using the 5V input range. Transducers using TTL totem pole or open-collector outputs must include a 470 ohm pull-up resistor (to 5V) to guarantee compatibility with the High-speed Counter inputs. Transducers using high voltage open collector (sink) type outputs must have a 1K pull-up resistor to + 12V for compatibility with the High-speed Counter 10 to 30 volt input range.

The 5VDC threshold is selected by connecting a jumper between two terminals on the detachable terminal board connector. Leaving the threshold selection terminals unconnected places the inputs in the default 10 to 30 VDC voltage range.

Caution

Do not connect 10 to 30 VDC to the module inputs when the 5 VDC input range (pins 13 to 15 jumpered) is selected. Doing so will damage the module.

Terminal Assignments for Each Counter Type

The following table shows which terminals to use for the type of counter selected during module configuration.

Terminal	Signal Name	Pin Definition	Use in Counter Type		
			Type A	Type B (1)	Type C (2)
1	I1	Positive Logic Input	A1	A1	A1
2	I2	Positive Logic Input	A2	B1	B1
3	I3	Positive Logic Input	A3	A2	A2
4	I4	Positive Logic Input	A4	B2	B2
5	I5	Positive Logic Input	PRELD1	PRELD1	PRELD1.1 *
6	I6	Positive Logic Input	PRELD2	PRELD2	PRELD1.2
7	I7	Positive Logic Input	PRELD3	DISAB1	DISAB1
8	I8	Positive Logic Input	PRELD4	DISAB2	HOME
9	I9	Positive Logic Input	STRB1	STRB1.1 *	STRB1.1 *
10	I10	Positive Logic Input	STRB2	STRB1.2	STRB1.2
11	I11	Positive Logic Input	STRB3	STRB2.1	STRB1.3
12	I12	Positive Logic Input	STRB4	STRB2.2	MARKER
13	INCOM	Common for positive logic inputs	INCOM	INCOM	INCOM
14	OUTPWR (3) DC+	Power for positive logic outputs	OUTPWR	OUTPWR	OUTPWR
15	TSEL	Threshold select, 5V or 10 to 30V	TSEL	TSEL	TSEL
16	O1	Positive Logic Output	OUT1	OUT1.1 *	OUT1.1 *
17	O2	Positive Logic Output	OUT2	OUT1.2	OUT1.2
18	O3	Positive Logic Output	OUT3	OUT2.1	OUT1.3
19	O4	Positive Logic Output	OUT4	OUT2.2	OUT1.4
20	OUTCOM DC-	Common for positive logic outputs	OUTCOM	OUTCOM	OUTCOM

(1). Type B counter:

A1, B1 are the A and B inputs for counter 1.
A2, B2 are the A and B inputs for counter 2.

(2) Type C Counter:

A1, B1 are the A and B count inputs for (+) loop
A2, B2 are the A and B count inputs for (–) loop

(3) OUTPWR ***does not*** source power for user loads. Output power ***must be supplied*** from an external supply.

* Inputs and outputs identified by two numbers separated by a decimal point indicate the counter number to the left of the decimal point and the element number on the right. For example, STRB1.2 indicates Counter 1, Strobe 2 input.

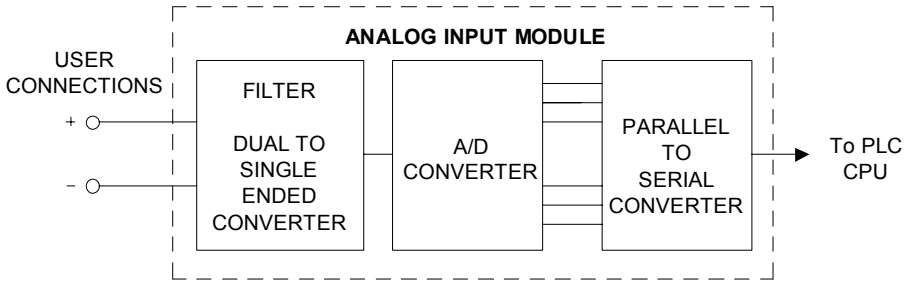
Chapter 9 Analog Input Modules

This chapter describes Analog Input modules for PACSystems RX3i controllers.

Discrete Output Module	***Catalog Number***
Analog Input Module, 4 channel Voltage	IC694ALG220
Analog Input Module, 4 channel Current	IC694ALG221
Analog Input Module, 16/8 channel Voltage	IC694ALG222
Analog Input Module, 16 channel Current	IC694ALG223

Analog Input Operation

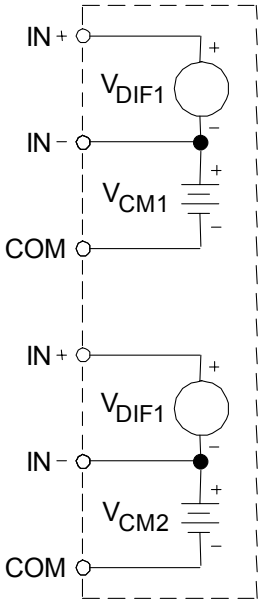
Analog input modules convert input current or voltage levels into digital data internally, then provide the resulting digital data to the PLC CPU.



Differential Inputs

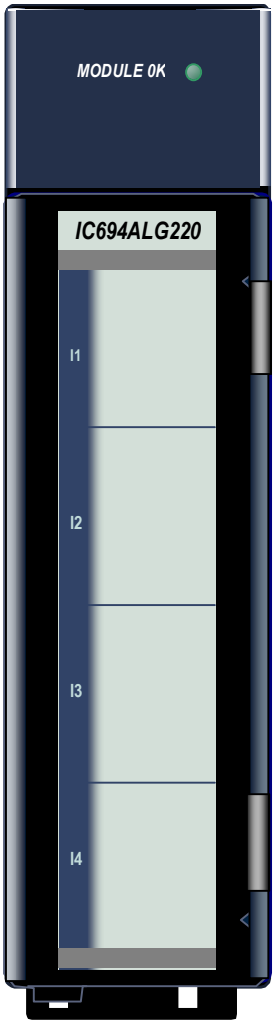
Some analog module inputs can be either single-ended or differential.

For differential analog inputs, the converted data is the difference between the voltages IN+ and IN-. Differential inputs are less sensitive to noise and ground currents. Both differential inputs of a pair are referenced to a common voltage (COM). The average voltage of the two IN terminals with respect to COM is referred to as *Common Mode Voltage*. Different signal sources may have different common mode voltages, as shown at right: V (CM1) and V (CM2). This common mode voltage may be caused by differences in location of circuit grounds or by the nature of the input signal itself.



To reference floating sources and limit common mode voltages, the COM terminal should be connected to either side of the input at the source itself. Without special design considerations, the total of the common mode voltage, the differential input voltage and noise on the lines referenced to the COM terminals should be limited to ±11 volts, or module damage may result.

Analog Input Module, 4 Channel Differential Voltage: IC694ALG220



The ***4–Channel Analog Voltage Input*** module, IC694ALG220, provides four analog input channels. This module accepts inputs in the range of -10 to +10 volts. Individual channels can be used with 4 to 20 mA inputs by jumpering the input terminals.

Conversion speed for each of the four channels is one millisecond. This provides an update rate of four milliseconds for any channel.

This module can be installed in any I/O slot of an RX3i PLC system.

Isolated +24 VDC Power

If the module is located in an RX3i Universal Backplane, an external source of Isolated +24 VDC is required to provide power for the module. The external source must be connected via the TB1 connector on the left side of the backplane.

If this module is located in an Expansion Backplane, the backplane's power supply provides the Isolated +24 VDC output for the module.

LEDs

The **Module OK** LED is ON when the module's power supply is operating.

Specifications: ALG220

Voltage Range	-10 to +10 volts *
Calibration	Factory calibrated
Update Rate	4 milliseconds (all four channels)
Resolution	5 mV/20 µA, (1 LSB = 5 mV)
Absolute Accuracy **	+/-10 mV/40 µA (typical) over operating temperature +/-30 mV/160 µA (maximum) over operating temperature
Linearity	<1 Least Significant Bit
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Cross–Channel Rejection	> 80dB
Input Impedance	> 9 Megohms (voltage mode) 250 Ohms (current mode)
Input Filter Response	17 Hz
Internal Power Consumption	27 mA from +5 VDC bus on the backplane 98 mA from the isolated +24 VDC backplane bus

Refer to Appendix A for product standards and general specifications.

* Both inputs must be within ± 11 volts of COM, including any noise present on the inputs.

** In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to +/-100 mV/400 µA.

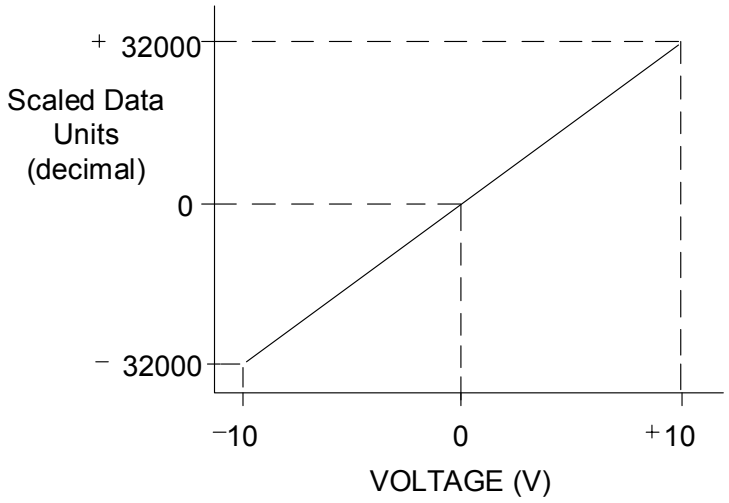
Data Format: ALG220

Module data is stored in the PLC CPU in 16–bit 2's complement format as shown below.

MSB															LSB
+/-	10	9	8	7	6	5	4	3	2	1	0	X	X	X	X

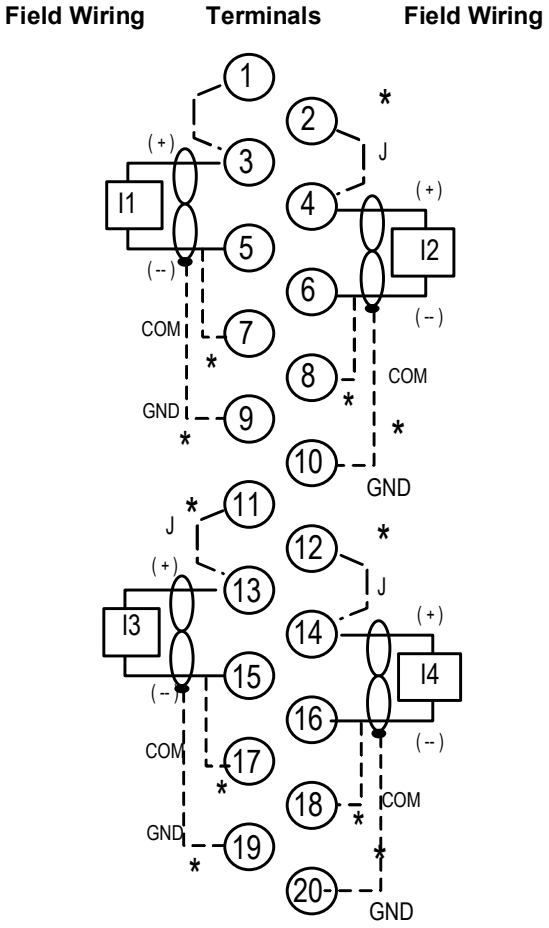
Scaling and Resolution

The module scales input data so that –10 V corresponds to –32000 and +10 V corresponds to +32000. Resolution per bit is 5 mV or 20 mA per bit.



A 4 to 20 mA input corresponds to a 1 to 5 Volt input to the module; therefore, the resolution of the 4 to 20 mA input signal is approximately 10 bits binary (1 part in 1024). The resolution can be increased to approximately 11 bits (1 part in 2048) by using a precision 250 Ohm resistor instead of the jumper. The resistor causes the voltage input module to see a 4 to 20 mA input as 2 to 10 volts.

Field Wiring: ALG220



*Optional Connection
J = Current Mode Input Jumpers

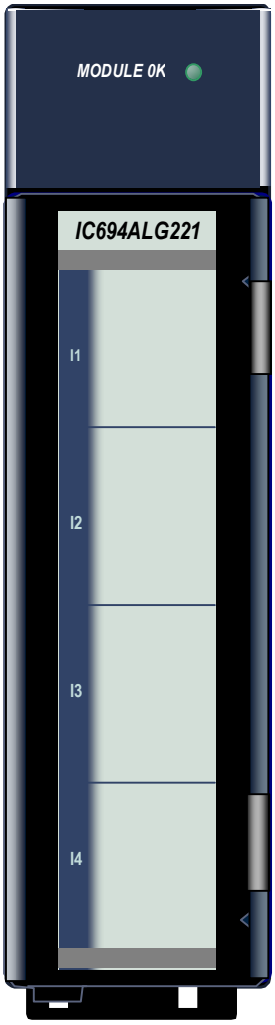
Terminal	*Connection*
1-3	Current mode input jumper for channel 1
2-4	Current mode input jumper for channel 2
3	Channel 1 +
4	Channel 2+
5	Channel 1-
6	Channel 2 -
7	Common
8	Common
9	Shield Termination Point for Channel 1
10	Shield Termination Point for Channel 2
11 - 13	Current mode input jumper for channel 3
12 - 14	Current mode input jumper for channel 4
13	Channel 3 +
14	Channel 4+
15	Channel 3-
16	Channel 4 -
17	Common
18	Common
19	Shield Termination Point for Channel 3
20	Shield Termination Point for Channel 4

To minimize the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to either COM or GND. The COM connection provides access to the common of the analog circuitry in the module. The GND connection provides access to the backplane (frame ground). The (-) side of the voltage source can also be tied to the COM terminal if the source is floating to limit common-mode voltages.

The optional jumpers shown can be used to configure a channel for use with 4 to 20 mA inputs. The resolution of 4 to 20 mA inputs can be increased from 10 bits to approximately 11 bits by installing a 250 Ohm resistor instead of the jumper

Connect the **+** and **-** terminals together for all unused inputs to minimize any fluctuations in the analog input table for the unused points.

Analog Input Module, 4 Channel Differential Current: IC694ALG221



The ***4–Channel Analog Current Input*** module, IC694ALG221, provides four analog input channels. This module has two possible input ranges:

- 4 to 20 mA
- 0 to 20 mA

Two range jumpers are provided with the module; one for channels one and two, and the other for channels three and four.

Conversion speed for each of the four channels is one–half millisecond. This provides an update rate of two milliseconds for any channel. Resolution of the converted signal is 12 bits binary (1 part in 4096) over either range.

Input protection for the module is sufficient for operation with reduced performance with up to 200 V common–mode. The module provides electrical isolation of externally generated noise between field wiring and the backplane through the use of optical isolation.

This module can be installed in any I/O slot of an RX3i system.

Isolated +24 VDC Power

If this module is located in an RX3i Universal Backplane, an external source of Isolated +24 VDC is required to provide power for the module. The external source must be connected via the TB1 connector on the left side of the backplane.

If the module is located in an Expansion Backplane, the backplane's power supply provides the Isolated +24 VDC output for the module.

LEDs

The **Module OK** LED is ON when the module's power supply is operating.

Specifications: ALG221

Input Current Ranges	4 to 20 mA and 0 to 20 mA
Calibration	Factory calibrated to 4 µA per count
Update Rate	2 milliseconds (all four channels)
Resolution at 4–20 mA	4 µA (1 LSB = 4 µA)
Resolution at 0–20 mA	5 µA (1 LSB = 5 µA)
Absolute Accuracy *	0.1% full scale + 0.1% reading
Common Mode Voltage	200 volts
Linearity	< 1 Least Significant Bit
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Common Mode Rejection	> 70dB at DC; >70dB at 60Hz
Cross–Channel Rejection	> 80dB from DC to 1kHz
Input Impedance	250 Ohms
Input Filter Response	325 Hz
Internal Power Consumption	100 mA from the isolated +24 VDC supply 25 mA from+5 VDC bus on the backplane

Refer to Appendix A for product standards and general specifications.

In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to ±0.5% FS.

Data Format: ALG221

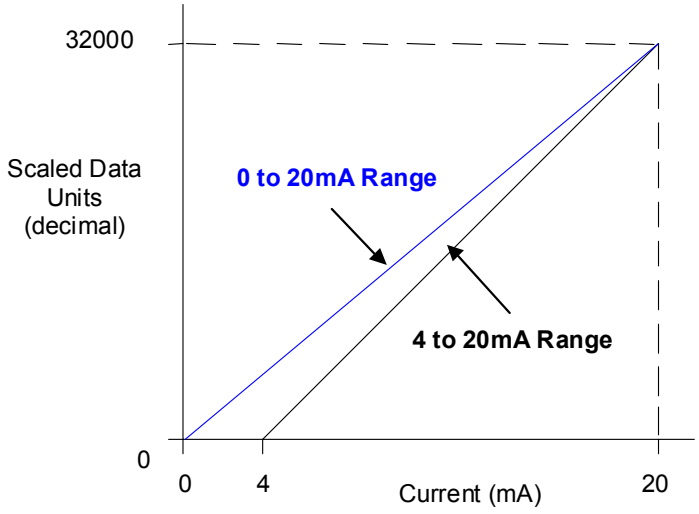
Module data is stored in the PLC CPU in16–bit 2's complement format as shown below.

MSB															LSB
X	11	10	9	8	7	6	5	4	3	2	1	0	X	X	X

Current Inputs, A/D Data and Scaled Units

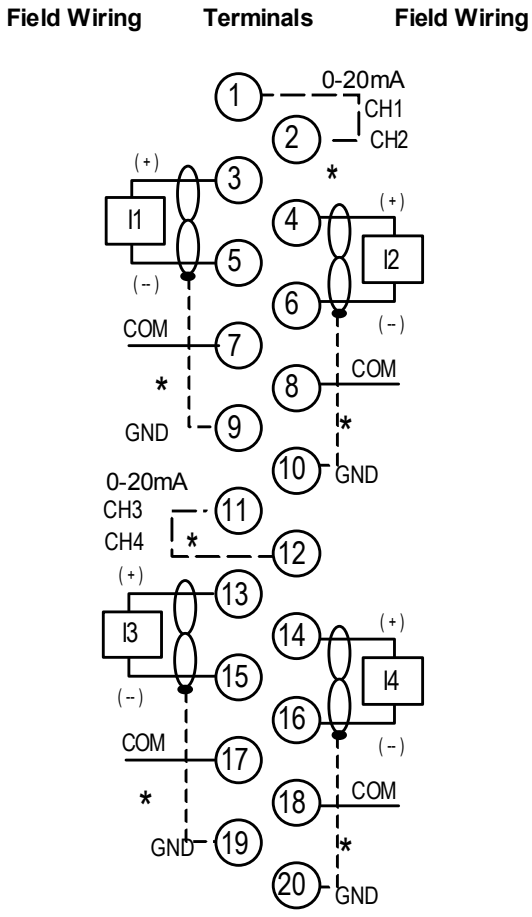
The default range for each input is 4 to 20 mA, scaled so that 4 mA corresponds to a count of 0 and 20 mA corresponds to a count of 32000 with each 1000 counts representing 0.5 mA.

When a jumper is added to the I/O terminal board, the input range for a PAIR of inputs is changed to 0 to 20 mA. In 0 to 20 mA range, 0 mA corresponds to a count of 0 and 20 mA corresponds to a count of 32000 with each 800 counts representing 0.5 mA.



If the current source is reversed into the input or is less than the low end of the current range, the module provides an input data word corresponding to the low end of the current range (0000H in PLC memory). If an input is greater than 20 mA, the module provides an input data value at full scale (7FF8H in PLC memory).

Field Wiring: ALG221



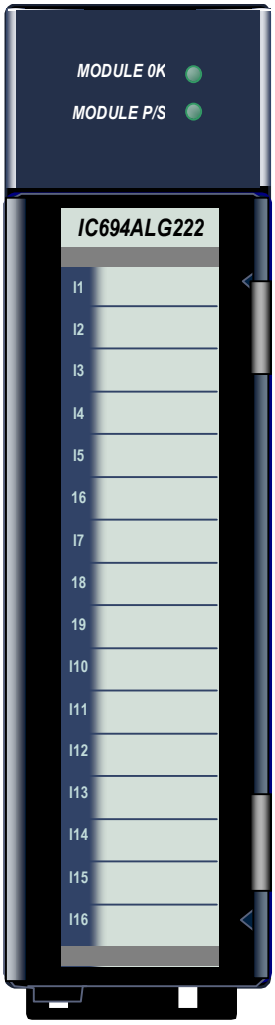
*Optional Connections

Terminal	*Connection*
1	0-20mA Jumper for channels 1 and 2
2	0-20mA Jumper for channels 1 and 2
3	Channel 1 +
4	Channel 2+
5	Channel 1-
6	Channel 2 -
7	Common
8	Common
9	Shield Termination Point for Channel 1
10	Shield Termination Point for Channel 2
11	0-20mA Jumper for channels 3 and 4
12	0-20mA Jumper for channels 3 and 4
13	Channel 3 +
14	Channel 4+
15	Channel 3-
16	Channel 4 -
17	Common
18	Common
19	Shield Termination Point for Channel 3
20	Shield Termination Point for Channel 4

To minimize the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to either COM or GND. The COM connection provides access to the common of the analog circuitry in the module. The GND connection provides access to the Backplane (frame ground).

To limit common–mode voltages, each current source common line may also be tied to its associated COM terminal if the source is floating. These optional connections are shown above.

Analog Input Module, 16 / 8 Channel Voltage: IC694ALG222



The ***16–Channel Analog Voltage Input*** module, IC694ALG222, provides 16 single-ended or eight differential input channels.

Each channel can be configured using the configuration software for either of two input ranges:

- 0 to 10 V (unipolar), default
- -10 to +10 V (bipolar)

High and Low alarm limits can be configured for both ranges.

This module can be installed in any I/O slot of an RX3i system.

Isolated +24 VDC Power

If the module is located in an RX3i Universal Backplane, an external source of Isolated +24 VDC is required to provide power for the module. The external source must be connected via the TB1 connector on the left side of the backplane.

If this module is located in an Expansion Backplane, the backplane's power supply provides the Isolated +24 VDC for the module.

LEDs

The **MODULE OK** LED provides module status information on powerup:

- *ON*: status is OK, module configured
- *OFF*: no backplane power or software not running (watchdog timer timed out)
- *Continuous rapid flashing*: configuration data not received from CPU
- *Slow flashes, then OFF*: failed power–up diagnostics or encountered code execution error

The **Module P/S** LED indicates that the module's internally-generated +5 VDC supply is above a minimum designated level.

Specifications: ALG222

Number of Channels	1 to 16 selectable, single-ended 1 to 8 selectable, differential
Input Current Ranges	0 V to +10 V (unipolar) or -10 V to +10 V (bipolar); selectable each channel
Calibration	Factory calibrated to: 2.5 mV per count on 0 V to +10 V (unipolar) range 5 mV per count on -10 to +10 V (bipolar) range
Update Rate	6 milliseconds (all 16 single-ended channels) 3 milliseconds (all 8 differential channels)
Resolution at 0V to +10V	2.5 mV (1 LSB = 2.5 mV)
Resolution at -10V to +10V	5 mV (1 LSB = 5 mV)
Absolute Accuracy *	+/10.25% of full scale @ 25°C (77°F) +/-0.5% of full scale over specified operating temperature range
Linearity	< 1 LSB
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Common Mode Voltage (Differential)	*/-11 V (bipolar range) **
Cross–Channel Rejection	> 80dB from DC to 1 kHz
Input Impedance	>500K Ohms (single-ended mode) >1 MegaOhms (differential mode)
Input Filter Response	41 Hz (single-ended mode) 82 Hz (differential mode)
Internal Power Consumption	112 mA (maximum) from the backplane +5 VDC bus 41 mA (maximum) from the backplane isolated +24 VDC supply

Refer to Appendix A for product standards and general specifications.

* In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to +/-5% FS.

**The summation of the differential input, common–mode voltage, and noise must not exceed +/-11 volts when referenced to COM.

Configuration: ALG222

Configurable parameters for module IC694ALG222 are described below.

Parameter	Choices	Description
Active Channels	1 to 16 for Single-ended mode, or 1 to 8 for Differential mode	The number of channels to be scanned. Channels are scanned in sequential, contiguous order.
Mode	Single-ended (default), or Differential	In Single-ended mode, there are 16 inputs referenced to a single common. In Differential mode, each of the 8 inputs has its own signal and common.
Reference Address for Input Data		The memory location for input data from the module. Each channel provides 16 bits of analog input data to the PLC CPU.
Reference Address for Status Data		The memory location for where status information from the module starts.
Length	8, 16, 24, 32, 40	The number of status bits reported to the PLC. Bits 1 – 8 provide basic module diagnostics. Bits 9 – 24 contain channel 1 – 8 high alarm and low alarm status. Bits 25 – 40 contain channel 9 – 16 high alarm and low alarm status. Data formats are shown in this section.
Range	0 to 10 V (default) or -10 to 10 V	In the 0 to 10 V default range, input voltage values from 0 to 10 V report 0 to 32,000 integer values to the CPU. In the -10 to 10 V range, input voltage values from -10 to 10 V report -32000 to 32,000 integer values to the CPU.
Alarm Low	0 to 10 V Range = 0 to 32760 -10 to 10 V Range = -32767 to 32752	Each channel can be assigned a low alarm limit alarm. Values entered without a sign are assumed to be positive. Be sure the alarm low values are appropriate for the selected range.
Alarm High	0 to 10 V Range = 0 to 32760 -10 to 10 V Range = -32767 to 32752	Each channel can also be assigned a high alarm limit. Values entered without a sign are assumed to be positive. Be sure the alarm high values are appropriate for the selected range.
I/O Scan Set	Default = 1	Assign the module to one of the I/O Scan Sets defined in the CPU configuration.

Data Format: ALG222

The 12-bit resolution module analog input data is stored in the PLC CPU in16–bit 2's complement format in the unipolar range as shown below.

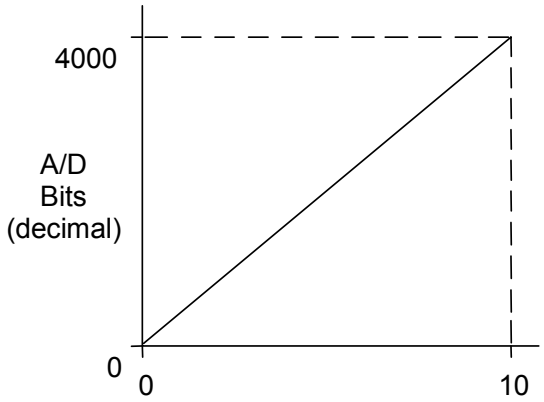
MSB															LSB
X	11	10	9	8	7	6	5	4	3	2	1	0	X	X	X

Input Scaling

The default input mode and range is single–ended, unipolar. In 0 to 10V mode, input data is scaled so that 0 volts corresponds to a count of 0 and 10 volts corresponds to a count of +32000.

The bipolar range and mode can be selected by changing the module's configuration parameters. In bipolar mode, -10 V corresponds to a count of -32000, 0 V corresponds to a count of 0, and +10 V corresponds to a count of +32000.

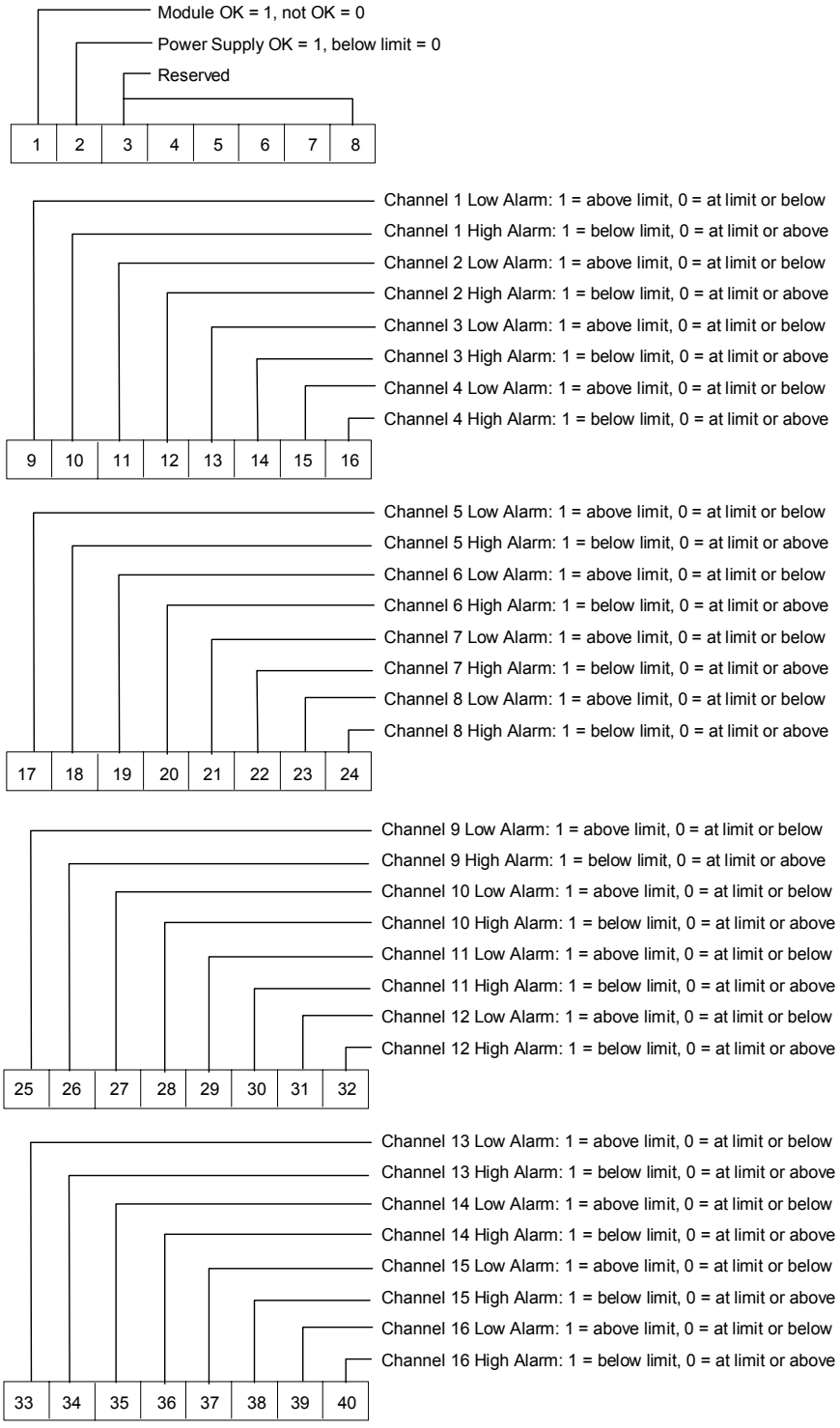
Factory calibration adjusts the analog value per bit (resolution) to a multiple of full scale (2.5 mV per bit for unipolar; 5 mV per bit for bipolar). The data is then scaled with the 4000 counts over the analog range. The data is scaled as shown below.



Voltage: 0 to 10 V Range

Status Data: ALG222

Analog Module IC694ALG222 can be configured to return 8, 16, 24, 32, or 40 status bits to the PLC CPU. This status data provides the following information about module operation:

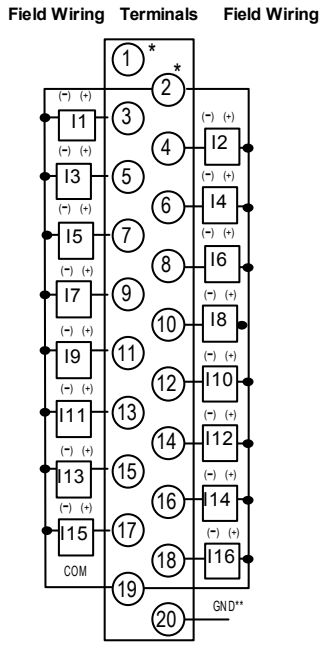


Field Wiring: ALG222

Terminal	Single-ended Mode	Differential Mode
1, 2	not used	
3	Channel 1	Channel 1 +
4	Channel 2	Channel 1 -
5	Channel 3	Channel 2 +
6	Channel 4	Channel 2 -
7	Channel 5	Channel 3 +
8	Channel 6	Channel 3 -
9	Channel 7	Channel 4 +
10	Channel 8	Channel 4 -
11	Channel 9	Channel 5 +
12	Channel 10	Channel 5 -
13	Channel 11	Channel 6 +
14	Channel 12	Channel 6 -
15	Channel 13	Channel 7 +
16	Channel 14	Channel 7 -
17	Channel 15	Channel 8 +
18	Channel 16	Channel 8 -
19	Common	Common
20	Ground	Ground

Connections are shown below for 16-channel single-ended mode and 8-channel differential mode. Single-ended mode is the module's default operating mode. Differential mode must be set up by configuration.

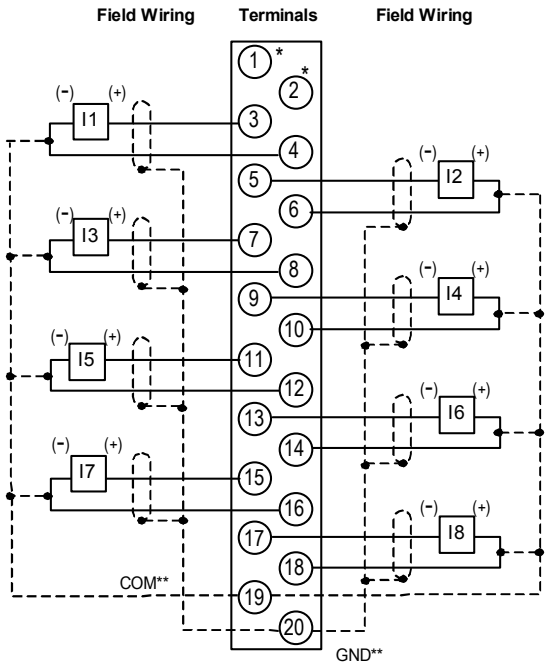
16 Single-ended Channels



* Not Connected

** Optional Shield Connection

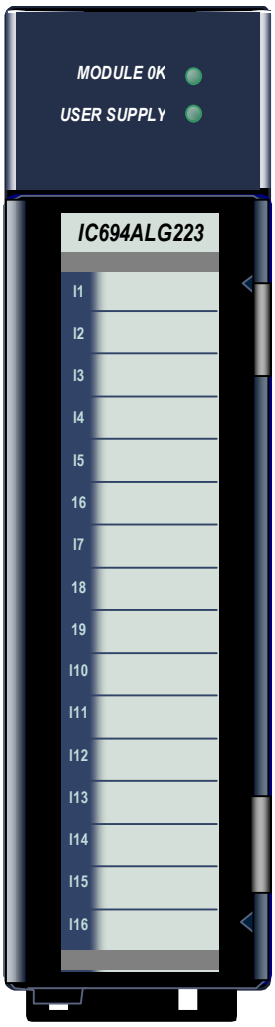
8 Differential Channels



* Not Connected

** Optional Connections

Analog Input Module, 16 Channel, Current: IC694ALG223



The ***16–Channel Analog Current Input*** module, IC694ALG223, provides 16 single–ended inputs. Each input can be configured using the configuration software for any of three input ranges:

- 4 to 20 mA
- 0 to 20 mA
- 4 to 20 mA Enhanced

High and Low alarm limits are available on all ranges. In the 4 to 20 mA Enhanced range, a low alarm limit can be set up to detect input current from 4 mA to 0 mA, providing open-wire fault detection in 4 to 20 mA applications.

The module also reports module status and external power supply status to the CPU using its assigned program reference addresses.

This module can be installed in any I/O slot in an RX3i system.

Module Power

This module consumes 120 mA from the 5 VDC bus on the PLC backplane. It also requires 65 mA plus current loop current(s) from a user-supplied +24 VDC supply.

LEDs

The **MODULE OK** LED provides module status information on power–up as follows:

- *ON*: status is OK, module configured;
- *OFF*: no backplane power or software not running (watchdog timer timed out);
- *Continuous rapid flashing*: configuration data not received from CPU;
- *Slow flashes, then OFF*: failed power–up diagnostics or encountered code execution error.

The **User Supply** LED indicates that the external 24 VDC supply is within specifications.

Specifications: ALG223

Number of Channels	1 to 16 selectable; single-ended
Input Current Ranges	0 to 20 mA, 4 to 20 mA and 4 to 20 mA Enhanced (selectable per channel)
Calibration	Factory calibrated to: 4 µA per count on 4 to 20 mA range 5 µA per count on 0 to 20 mA and 4 to 20 mA Enhanced range
Update Rate	13 milliseconds (all 16 channels)
Resolution at 4–20 mA	4 µA (4 µA/bit)
Resolution at 0–20 mA	5 µA (5 µA/bit)
Resolution at 4–20 mA Enhanced	5 µA (5 µA/bit)
Absolute Accuracy *	+/-0.25% of full scale @ 25°C (77°F): +/- 0.5% of full scale over specified operating temperature range
Linearity	< 1 LSB from 4 to 20 mA (4 to 20 mA range) < 1 LSB from 100 µA to 20 mA (0 to 20 mA and 4 to 20 mA Enhanced ranges)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Common Mode Voltage	0 volts (single-ended channels)
Cross–Channel Rejection	> 80dB from DC to 1kHz
Input Impedance	250 Ohms
Input Low Pass Filter Response	19 Hz
External Supply Voltage Range	20 to 30 VDC
External Supply Voltage Ripple	10%
Internal Power Consumption	120 mA from the +5 VDC bus on the backplane 65 mA from 24 VDC external user power supply (in addition to current loop currents)

Refer to Appendix A for product standards and general specifications.

* In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to +/-5% FS.

Configuration: ALG223

Module IC694ALG223 is configured with the configuration software. Its configurable parameters are described below.

Parameter	Choices	Description
Active Channels	1 to 16	The number of channels to be scanned. Channels are scanned in sequential, contiguous order.
Reference Address for Input Data		The memory location for input data from the module. Each channel provides 16 bits of analog input data to the PLC CPU.
Reference Address for Status Data		The memory location for where status information from the module starts.
Length	8, 16, 24, 32, 40	The number of status bits reported to the PLC. Bits 1 – 8 provide basic module diagnostics. Bits 9 – 24 contain channel 1 – 8 high alarm and low alarm status. Bits 25 – 40 contain channel 9 – 16 high alarm and low alarm status. Data formats are shown in this section.
Range	4-20 mA (default), 0-20 mA, or 4-20 mA enhanced	In the 4-20 mA range, input currents from 4 to 20 mA are reported to the CPU as values from 0 to 32000 units. In the 0 to 20 mA range, input currents from 0 to 20 mA are reported to the CPU as values from 0 to 3200 units. In the 4 to 20 mA enhanced range, currents from 4 to 20 mA are reported to the CPU as values form 0 to 32000 units. Currents below 4 mA are reported as negative values with 0 represented as –8000 units.
Alarm Low	4-20 mA = 0 to 32759	Each channel can be assigned a low alarm limit alarm. Values entered without a sign are assumed to be positive. Be sure the alarm low values are appropriate for the selected range.
	0-20 mA = 0 to 32759	
	4-20 mA enhanced = -8000 to +32759	
Alarm High	4-20 mA = 1 to 32760	Each channel can also be assigned a high alarm limit. Values entered without a sign are assumed to be positive. Be sure the alarm high values are appropriate for the selected range.
	0-20 mA = 1 to 32760	
	4-20 mA enhanced = -7999 to +32760	
I/O Scan Set	Default = 1	Assign the module to one of the I/O Scan Sets defined in the CPU configuration.

Data Format: ALG223

The 12-bit resolution module analog input data is stored in the PLC CPU in16–bit 2's complement format as shown below.

MSB															LSB
X	11	10	9	8	7	6	5	4	3	2	1	0	X	X	X

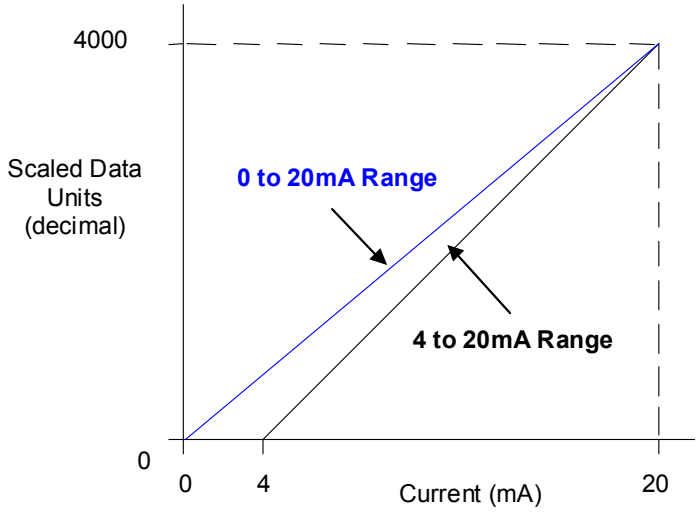
Input Scaling

In the 4 to 20 mA range, input data is scaled so that 4 mA corresponds to a count of 0 and 20 mA corresponds to a count of 32000.

In the 0 to 20 mA range, 0 mA corresponds to a count of 0 and 20 mA corresponds to a count of 32000. Full 12–bit resolution is available over the 4 to 20 mA and 0 to 20 mA ranges.

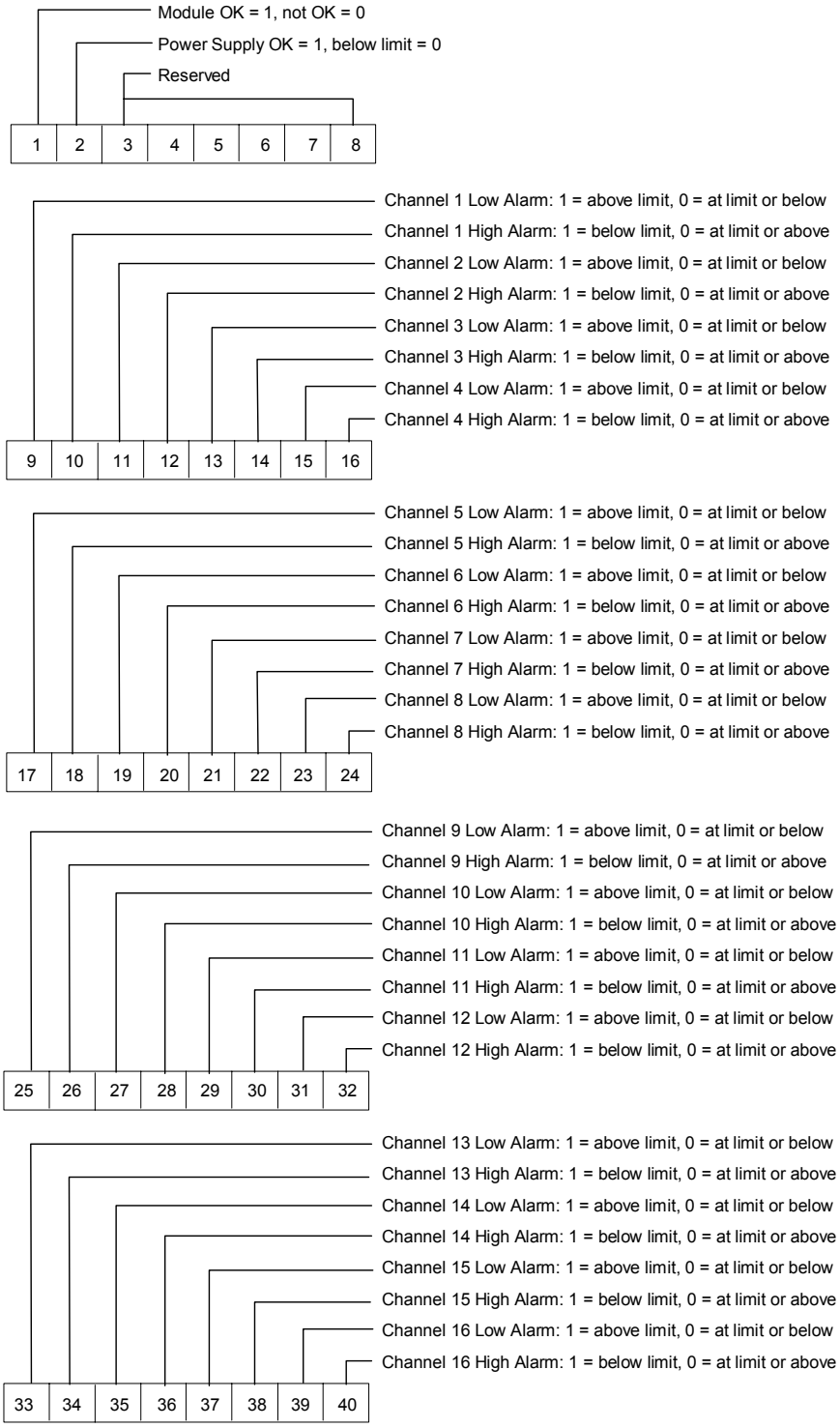
4 to 20 mA Enhanced range can also be configured. In that range, 0 mA corresponds to a count of -8000, 4 mA corresponds to a count of 0 (zero) and 20 mA corresponds to a count of +32000. A low alarm limit can be set up to detect input current from 4 mA to 0 mA, providing open-wire fault detection in 4 to 20 mA applications.

Analog values are scaled over the range of the converter. Factory calibration adjusts the analog value per bit (resolution) to a multiple of full scale (4 μA/bit). This calibration leaves a normal 12–bit converter with 4000 counts (normally 2^{12} = 4096 counts). The data is then scaled with the 4000 counts over the analog range. The data is scaled as shown below.



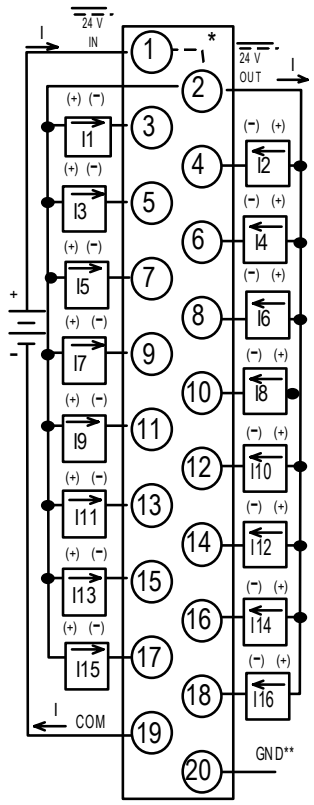
Status Data: ALG223

Analog Module IC694ALG223 can be configured to return 8, 16, 24, 32, or 40 status bits to the PLC CPU. This status data provides the following information about module operation:



Field Wiring: ALG223

Field Wiring Terminals Field Wiring

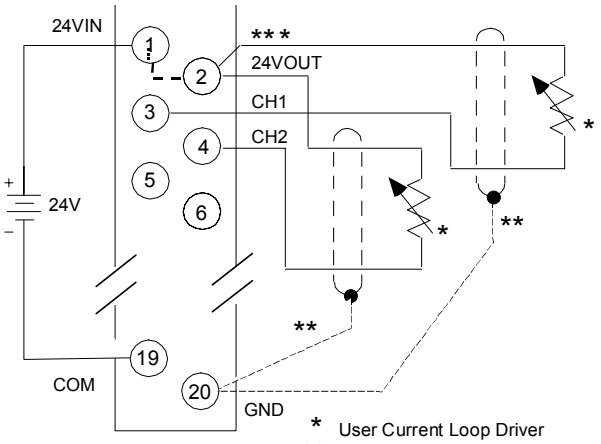


* Internally Connected

** Optional Shield Connection

Terminal	*Connection*
1	User supplied 24V Input; provides loop power via 24VOUT terminal (pin 2)
2	+24V loop power tie point
3	Current Input, Channel 1
4	Current Input, Channel 2
5	Current Input, Channel 3
6	Current Input, Channel 4
7	Current Input, Channel 5
8	Current Input, Channel 6
9	Current Input, Channel 7
10	Current Input, Channel 8
11	Current Input, Channel 9
12	Current Input, Channel 10
13	Current Input, Channel 11
14	Current Input, Channel 12
15	Current Input, Channel 13
16	Current Input, Channel 14
17	Current Input, Channel 15
18	Current Input, Channel 16
19	Common connection to input current sense resistors; user supplied 24V input return or 24VIN return
20	Frame ground connections for cable shields

Connection Example 1

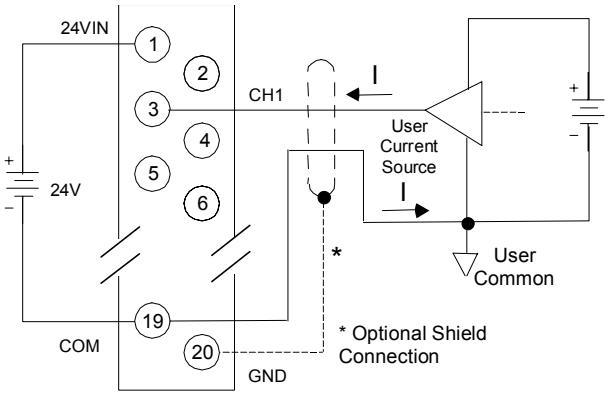


* User Current Loop Driver

** Optional Shield Connection

*** Pin 2 Connected to Pin 1 internally

Connection Example 2



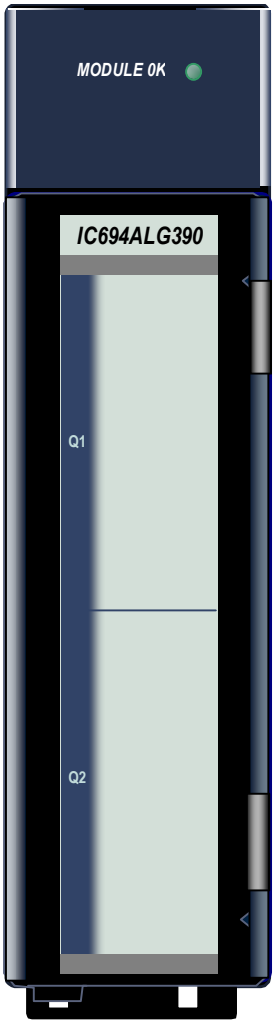
To limit common-mode voltages, the current source can be tied to the COM terminal if the source is floating.

Chapter 10 Analog Output Modules

This chapter describes Analog Output modules for PACSystems RX3i controllers.

Analog Output Module	***Catalog Number***
Output Analog 2 Channels, Voltage	IC694ALG390
Output Analog 2 Channels, Current	IC694ALG391
Output Analog Current/Voltage 8 Channels	IC694ALG392

Analog Output Module, 2 ChannelVoltage: IC694ALG390



The ***2–Channel Analog Voltage Output*** module, IC694ALG390, has two output channels, each capable of converting 13 bits of binary (digital) data to an analog output signal for field devices. The Analog Voltage Output module provides outputs in the range of -10 volts to +10 volts. Both channels are updated on every scan.

The module's outputs can be set up to either *Default to 0 volts* or *Hold–Last–State* if the CPU goes to the Stop mode or Reset. Selection of the output default state is made by a jumper on the module. If the jumper is not installed, the outputs Hold Last State.

This module can be installed in any I/O slot in an RX3i system.

Isolated +24 VDC Power

If the module is located in an RX3i Universal Backplane, an external source of Isolated +24 VDC is required to provide power for the module. The external source can be connected via the TB1 connector on the left side of the backplane or directly on the module's terminal block.

If this module is located in an Expansion Backplane, its primary power source can be either the Isolated +24 VDC from the backplane power supply or an external Isolated +24 VDC power supply connected to the module's terminal block. If the external source is set between 27.5-30 VDC, it takes over the module's load from the Isolated 24 VDC system supply. Note that an external source should be used if it is desired to maintain hold last state operation during a loss of backplane power.

LED

The **Module OK** LED is ON when the module's power supply is operating.

Specifications: ALG390

Voltage Range	-10 to +10 volts
Calibration	Factory calibrated to 2.5 mV per count
Supply Voltage (nominal)	+24 VDC, from isolated +24 VDC on backplane or user-supplied voltage source, and +5 VDC from backplane
External Supply Voltage Range	18 VDC to 30 VDC
External Supply Voltage Ripple	10%
Update Rate	Approximately 5 milliseconds (both channels) Update rate is application dependent.
Resolution	2.5 mV (1 LSB = 2.5 mV)
Absolute Accuracy *	+/-5 mV at 25°C (77°F)
Offset	1 mV maximum, 0 to 60°C (32° to 140°F)
Output Loading (maximum)	5 mA (2 K ohms minimum resistance)
Output Load Capacitance	2000 pico farads, maximum
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Internal Power Consumption	32 mA from +5 VDC supply 120 mA from +24 VDC supply (isolated backplane or user supply)

Refer to Appendix A for product standards and general specifications.

* In the presence of severe RF interference (IEC 801–3, 10 V/m), accuracy may be degraded to ±50 mV.

Data Format: ALG390

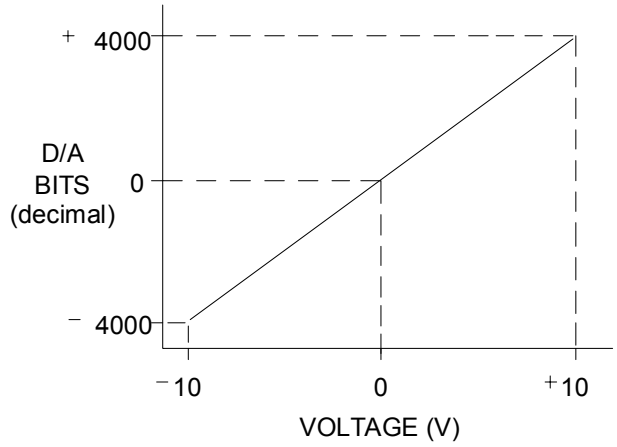
Module data is stored by the PLC CPU in 16–bit 2's complement format:

MSB LSB

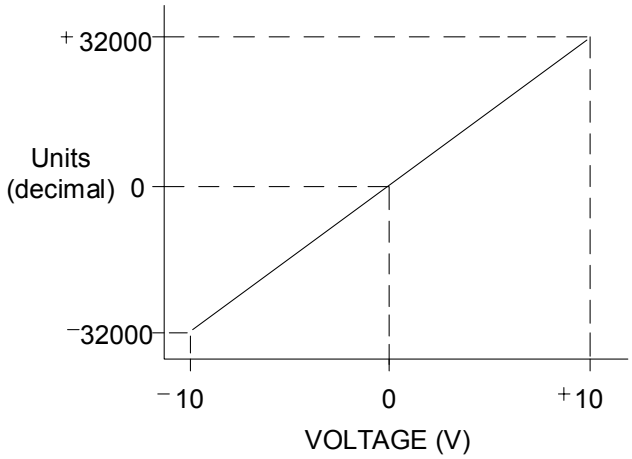
+/-	10	9	8	7	6	5	4	3	2	1	0	X	X	X	X

Resolution of the converted signal is 12 bits binary plus sign, which is effectively 13 bits (1 part in 8192). The module scales the digital data to create an output voltage for the output:

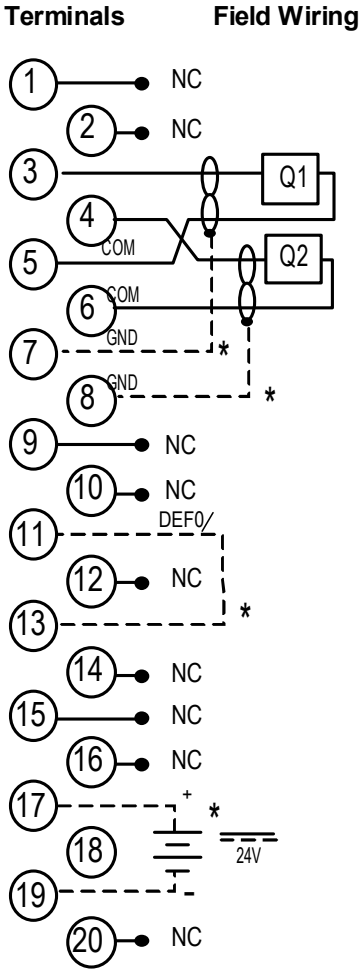
D/A Bits versus Voltage Outputs



Scaling of the output is shown below.



Field Wiring: ALG390



*Optional Connections

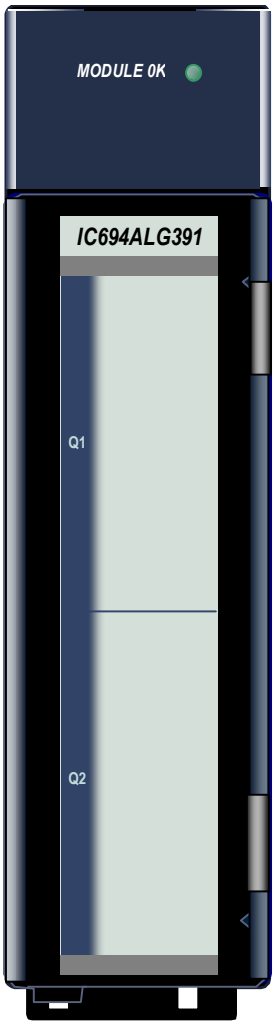
Terminal	*Connection*
1	No connection
2	No connection
3	Output 1
4	Output 2
5	Output 1 Common
6	Output 2 Common
7	Shield termination point for output 1
8	Shield termination point for output 2
9	No connection
10	No connection
11 - 13	Output default selection jumper
12	No connection
13	Output default selection jumper
14	No connection
15	No connection
16	No connection
17	External +24 VDC Power Supply +
18	No connection
19	External +24 VDC Power Supply -
20	No connection

To minimize capacitive loading and noise, all field connections should be wired using a good grade of twisted, shielded instrumentation cable. The shields should be connected to GND on the user terminal connector block. The GND connection provides access to the backplane (frame ground) resulting in superior rejection of noise caused by any shield drain currents.

DEF0 is the optional Output Default Jumper. It determines the operation of both outputs when the CPU is in Stop or Reset mode. The jumper should be installed if outputs should default to 0. The jumper should not be installed if outputs should hold their last state (the last valid commanded value received from the CPU).

An optional external +24 VDC supply can be installed as shown.

Analog Output Module, Current, 2 Channel: IC694ALG391



The ***2–Channel Analog Current Output*** module, IC694ALG391, has two output channels, each capable of converting 12 bits of binary (digital) data to an analog output signal for field devices. Each output can be set using a jumper on the module to produce output signals in one of two ranges:

- 0 to 20 mA
- 4 to 20 mA.

Each output may also be set up as a less accurate voltage source. The selection of current or voltage output is made with a jumper or resistor on the module terminals. Both channels are updated on every scan.

The module's outputs can be set up to either *Default to 0/4 mA* or *Hold–Last–State* if the CPU goes to the Stop mode or Reset. Selection of the output default state is made by a jumper on the module's terminal board. See Output Defaults in this section for more information.

LED

The **Module OK** LED is ON when the module's power supply is operating.

Isolated +24 VDC Power

If the module is located in an RX3i Universal Backplane, an external source of Isolated +24 VDC is required to provide power for the module. The external source can be connected via the TB1 connector on the left side of the backplane or directly on the module's terminal block.

If this module is located in an Expansion Backplane, its primary power source can be either the Isolated +24 VDC from the backplane power supply or an external Isolated +24 VDC power supply connected to the module's terminal block. If the external source is set between 27.5-30 VDC, it takes over the module's load from the Isolated 24 VDC system supply. Note that an external source should be used if it is desired to maintain hold last state operation during a loss of backplane power.

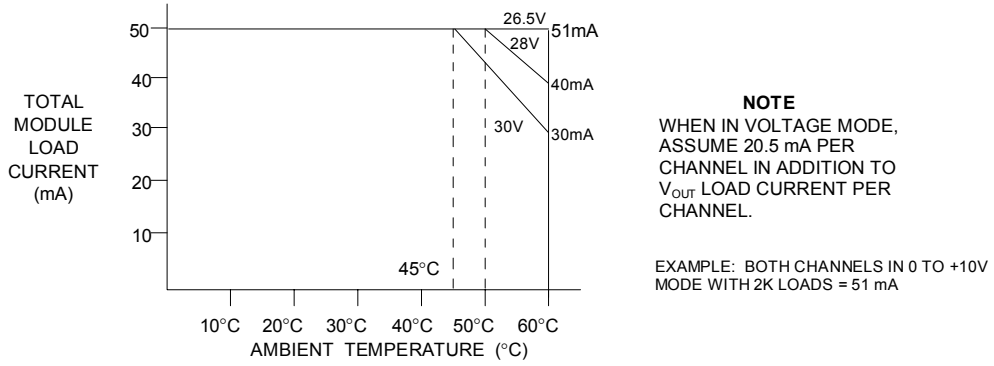
Specifications: ALG391

Output Current Range	4 to 20 mA and 0 to 20 mA
Output Voltage Range	1 to 5 volts and 0 to 5 volts
Calibration	Factory calibrated to 4 µA per count
External Supply Voltage Range	20 VDC to 30 VDC. Depends on the current load and the ambient temperature as shown below.
External Supply Voltage Ripple	10%
Update Rate	5 milliseconds (approximate, both channels) Application dependent.
Resolution:	
4 to 20mA	4 µA (1 LSB = 4 µA)
0 to 20mA	5 µA (1 LSB = 5 µA)
1 to 5V	1 mV (1 LSB = 1 mV)
0 to 5V	1.25 mV (1 LSB = 1.25 mV)
Absolute Accuracy: *	
4 to 20mA	+/-8 µA at 25°C (77°F)
0 to 20mA	+/-10 µA at 25°C (77°F)
1 to 5V	+/-50 mV at 25°C (77°F)
0 to 5V	+/-50 mV at 25°C (77°F)
Maximum Compliance Voltage	25 VDC
User Load (current mode)	0 to 850 Ohms
Output Load Capacitance (current mode)	2000 pF
Output Load Inductance (current mode)	1 H
Maximum Output Loading (voltage mode)	5 mA (2 K Ohms minimum resistance) (2000 pF maximum capacitance)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Internal Power Consumption	30 mA from +5 VDC supply 215 mA from Isolated +24 VDC supply

Refer to Appendix A for product standards and general specifications.

* In the presence of severe RF interference (IEC 801–3, 10 V/m), accuracy may be degraded to ±80 µA (4 to 20 mA range), ±100µA (0 to 20 mA range).

Load Current Derating



Data Format: ALG391

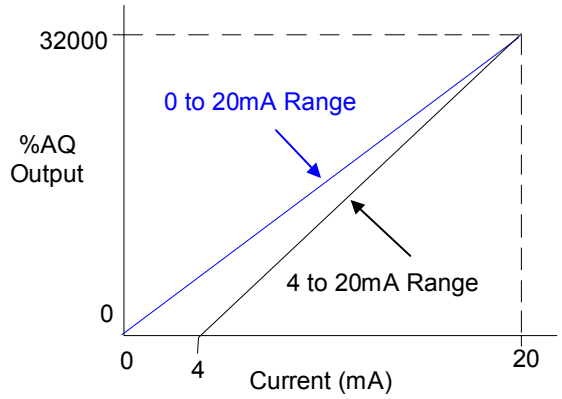
Module data is stored by the PLC CPU in 16–bit 2's complement format as shown below.

MSB															LSB
X	11	10	9	8	7	6	5	4	3	2	1	0	X	X	X

The 13 most significant bits from the %AQ register are converted to sign magnitude by the PLC and sent to the module.

D/A Bits versus Current Outputs

The module scales the output data received from the CPU according to the range selected for the channel.



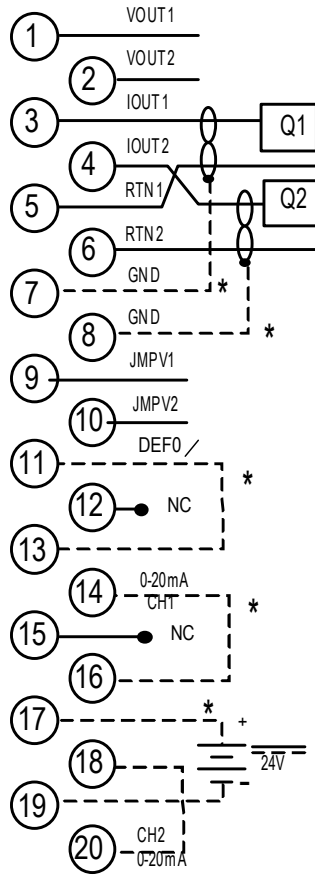
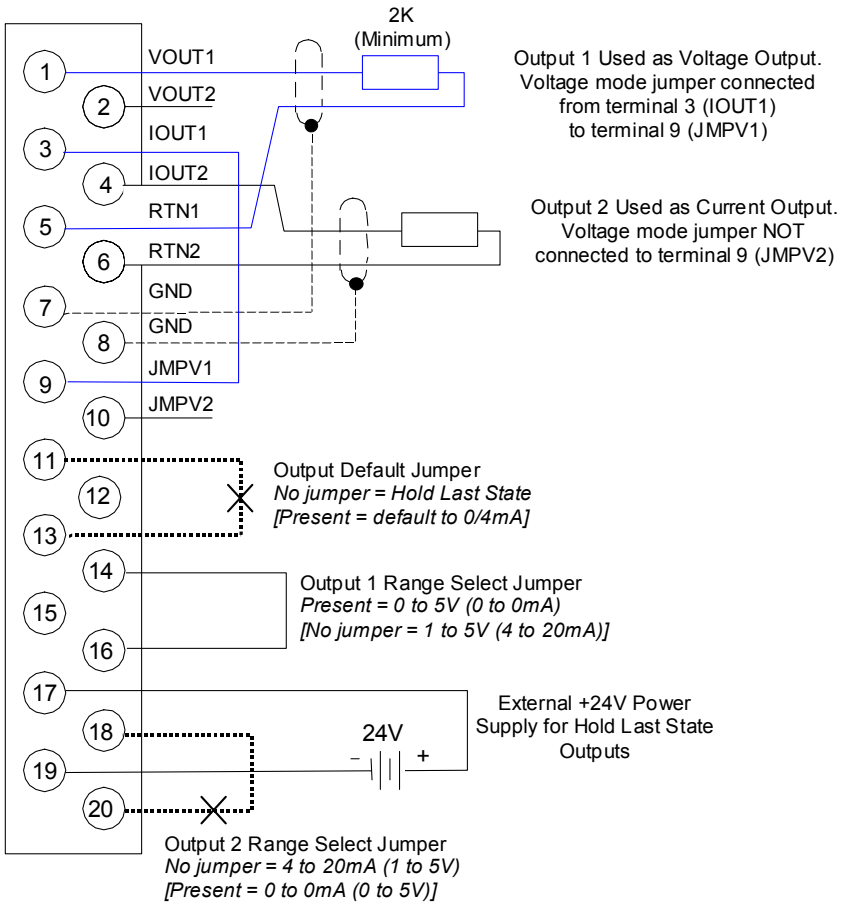
In the 4 to 20 mA range, the module scales output data with each 1000 counts representing 0.5 mA. In this range a count of 0 corresponds to 4 mA and a count of 32000 corresponds to 20 mA.

In 0 to 20 mA range, the module scales output data so that each 800 counts represents 0.5 mA. In this range, a count of 0 corresponds to 0 mA and a count of 32000 corresponds to 20 mA with each 800 counts representing 0.5 mA.

If the module receives negative data from the CPU, it outputs the low end of the range (either 0 mA or 4 mA). If a value greater than 32767 is received, it is not accepted.

Field Wiring: ALG391

To minimize the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields should be connected to GND on the user terminal connector block. The GND connection provides access to the backplane (frame ground) resulting in superior rejection of noise caused by any shield drain currents. If no jumper is installed, the module performs as a current source. If the jumper is present, the module performs as a voltage source.

Module Wiring	*Example Connections*
Terminals **Field Wiring**  *Optional Connections	In this example, Output 1 is used as a voltage output (JMPV1 connected to IOUT1) in the 0 to 5 V range (RANGE 1 jumper installed) Output 2 is used as a current output (JMPV2 not connected) in the 4 to 20 mA mode (RANGE2 jumper not installed). Both outputs will Hold Last State (no Output Default jumper installed, external +24 VDC power supply connected). 

Current or Voltage Outputs

Each channel's range and its operation in current or voltage mode are set with jumpers on the module terminals. For voltage operation, a 250 Ohm resistor can be used instead of a voltage jumper to increase the voltage range. The table below lists the output ranges that can be set up for each output, and the jumper or resistor settings for each range.

Range of the Output	Range Jumper Installed	Voltage Jumper or Resistor Installed
4 mA to 20 mA	No	No
0 mA to 20 mA	Yes	No
0 V to 5 V	Yes	jumper
0 V to 10 V	Yes	250 Ohm resistor
1 V to 5 V	No	jumper
2 V to 10 V	No	250 Ohm resistor

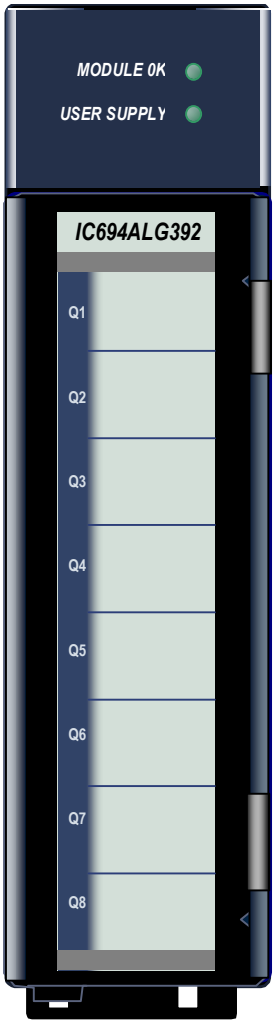
Output Defaults

Both module outputs can be set to either Default to 0 or 4 mA or Hold Last State if the CPU goes to Stop mode or is Reset. The module's Output Default operation is set using another jumper on the terminal block.

If the Output Default (DEF0/4) jumper is installed on module terminals 11 and 13, both outputs default to the low end of their ranges.

If the Output Default jumper is not installed, both outputs hold the last valid output value received from the PLC CPU. This option requires an external +24 VDC power supply to maintain output power when the system power goes down.

Analog Output Module, Current/Voltage, 8 Channel: IC694ALG392



The ***8–Channel Analog Current/Voltage Output*** module; IC694ALG392, provides up to eight single-ended output channels with current loop outputs and/or voltage outputs. Each output channel can be set up using the configuration software for any of these ranges:

- 0 to +10 volts (unipolar)
- 10 to +10 volts (bipolar)
- 0 to 20 milliamps
- 4 to 20 milliamps

Each channel is capable of converting 15 to 16 bits (depending on the range selected) of binary data to an analog output. All eight channels are updated every 12 milliseconds.

In current modes, the module reports an Open Wire fault to the CPU for each channel. The module can go to a known last state when system power is interrupted. As long as external power is applied to the module, each output will maintain its last value or reset to zero, as configured.

This module can be installed in any I/O slot of an RX3i system.

Isolated +24 VDC Power

The module must receive its 24 VDC power from an external source.

If the module is located in an RX3i Universal Backplane, the external source can be connected via the TB1 connector on the left side of the backplane or directly on the module's terminal block.

If this module is located in an Expansion Backplane, the external source must be connected to the module's terminal block.

LEDs

The **Module OK** LED indicates module status. The **User Supply** LED indicates whether the external +24 VDC power supply is present and is above the minimum level. Both LEDs are powered from the +5 VDC backplane power bus.

LED	Indicates
OK	ON: Module OK and configured Flashing: Module OK but not configured OFF: Module is defective or no +5V backplane power present
USOK	ON: External power supply present OFF: No user power

Specifications: ALG392

Number of Output Channels	1 to 8 selectable, single–ended
Output Current Range	4 to 20 mA and 0 to 20 mA
Output Voltage Range	0 to 10 V and –10 V to +10 V
Calibration	Factory calibrated to .625 µA for 0 to 20 mA; 0.5 µA for 4 to 20 mA; and .3125 mV for voltage (per count)
User Supply Voltage (nominal)	+24 VDC, from user supplied voltage source
External Supply Voltage Range	20 VDC to 30 VDC
Power Supply Rejection Ratio (PSRR)	
Current	5 µA/V (typical), 10 µA/V (maximum)
Voltage	25 mV/V (typical), 50 mV/V (maximum)
External Power Supply Voltage Ripple	10% (maximum)
Internal Supply Voltage	+5 VDC from PLC backplane
Update Rate	8 milliseconds (approximate, all eight channels) Determined by I/O scan time, application dependent.
Resolution:	**4 to 20mA:** 0.5 µA (1 LSB = 0.5 µA)
	0 to 20mA: 0.625 µA (1 LSB = 0.625 µA)
	0 to 10V: 0.3125 mV (1 LSB = 0.3125 mV)
	-10 to +10V: 0.3125 mV (1 LSB = 0.3125 mV)
Absolute Accuracy: *	
Current Mode	+/-0.1% of full scale @ 25°C (77°F), typical +/-0.25% of full scale @ 25°C (77°F), maximum +/-0.5% of full scale over operating temperature range (maximum)
Voltage Mode	+/-0.25% of full scale @ 25°C (77°F), typical +/-0.5% of full scale @ 25°C (77°F), maximum +/-1.0% of full scale over operating temperature range (maximum)
Maximum Compliance Voltage	V_{USER} –3 V (minimum) to V_{USER} (maximum)
User Load (current mode)	0 to 850 Ω (minimum at V_{USER} = 20 V, maximum 1350 Ω at V_{USER} = 30 V) (Load less than 800 Ω is temperature dependent.)
Output Load Capacitance (current mode)	2000 pF (maximum)
Output Load Inductance (current mode)	1 H
Output Loading (voltage mode)	5 mA (2 K Ohms minimum resistance)
Output load Capacitance	(1 µF maximum capacitance)
Isolation, Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Internal Power Consumption	110 mA from +5 VDC PLC backplane supply
	315 mA from +24 VDC user supply

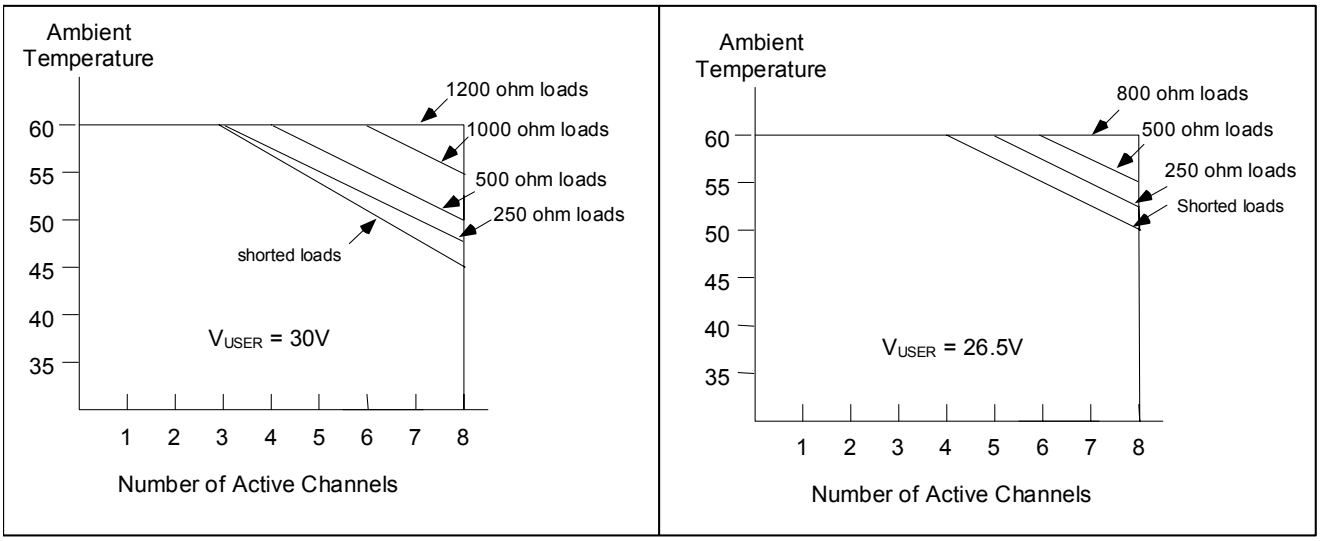
Refer to Appendix A for product standards and general specifications. In order to meet the IEC 1000-4-3 levels for RF Susceptibility specified in Appendix A, when this module is present, the system must be mounted in a metal enclosure.

- In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to ±1% FS for current outputs and ±3% FS for voltage outputs.

Derating Curves: ALG392

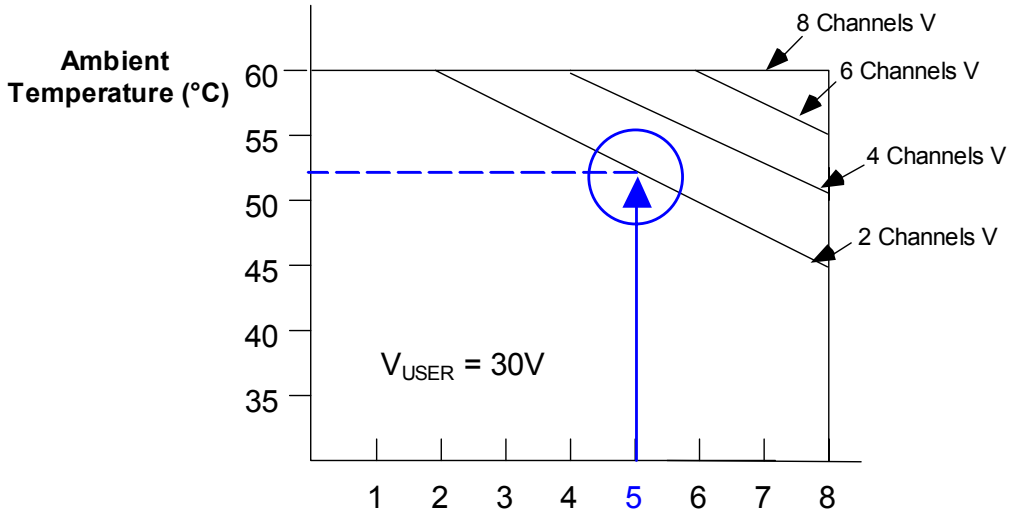
For maximum performance and module life, the module should be operated at maximum load resistance to offload heat. Module thermal deratings depend on the voltage level and the use of current and voltage outputs. The first two charts below show the maximum ambient temperature for current-only modules at 30 VDC and at 26.5 VDC.

Current Outputs Only



Mixed Current and Voltage Outputs

In the deratings shown below, voltage channels have 2 K Ohm loads and current channels have shorted loads. To determine the maximum operating temperature for mixed current and voltage outputs, select the line in the chart below that corresponds to the number of voltage channels being used. For example, a module uses 2 voltage channels and 3 current channels. The total channels are 5, and the maximum operating temperature is approximately 52.5°C:



Active Channels Current and Voltage Mixed

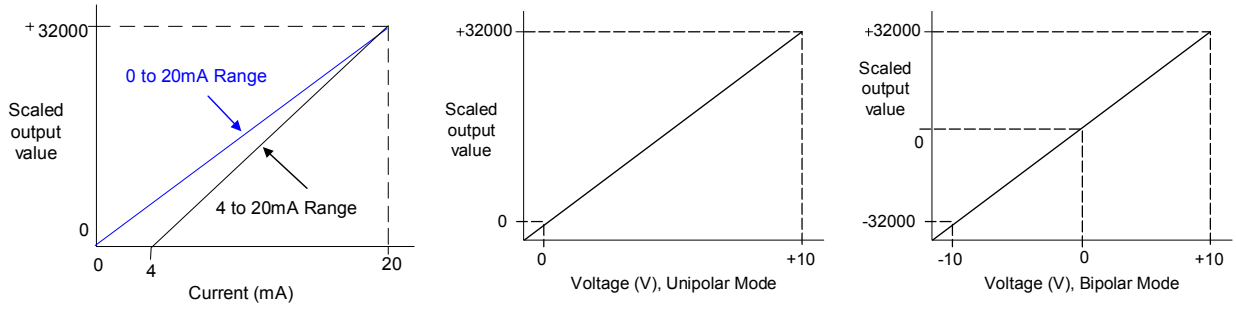
Current and Voltage Ranges and Resolution

In the 4 to 20 mA range the module scans output data from the PLC so that 4 mA corresponds to a count of 0, and 20 mA corresponds to a count of 32000. In the 0 to 20 mA range, user data is scaled so that 0 mA corresponds to a count of 0 and 20 mA corresponds to 32000. In 0 to 20 mA mode, a value up to 32767 provides a maximum output of approximately 20.5 mA. In current mode, the module also reports an open loop fault to the PLC.

For voltage operation in the default unipolar mode (0 to +10 volts), data is scaled so that 0 volts corresponds to a count of 0 and +10 volts corresponds to a count of 32000. In this mode, a value up to 32767 creates an overrange output of approximately 10.24 volts.

In the -10 to +10 volt range, data is scaled so that -10 volts corresponds to a count of -32000 and +10 volts corresponds to a count of +32000. In this range, output values from -32767 to +32767 result in an overrange of approximately -10.24 volts to +10.24 volts.

Scaling for both current and voltage ranges is shown below.



The resolution per bit depends on the channel's configured range:

4 to 20 mA:	0.5 µA
0 to 20 mA:	0.625 µA
0 to 10 V:	0.3125 mV
-10 to +10 V:	0.3125 mV

Module Data

Module ALG392 uses up to 8 output reference words. Each channel provides 16 bits of analog output data as an integer value. Output resolution is 15 bits except for the bipolar voltage mode, which has 16-bit resolution. The 16th bit is the sign bit.

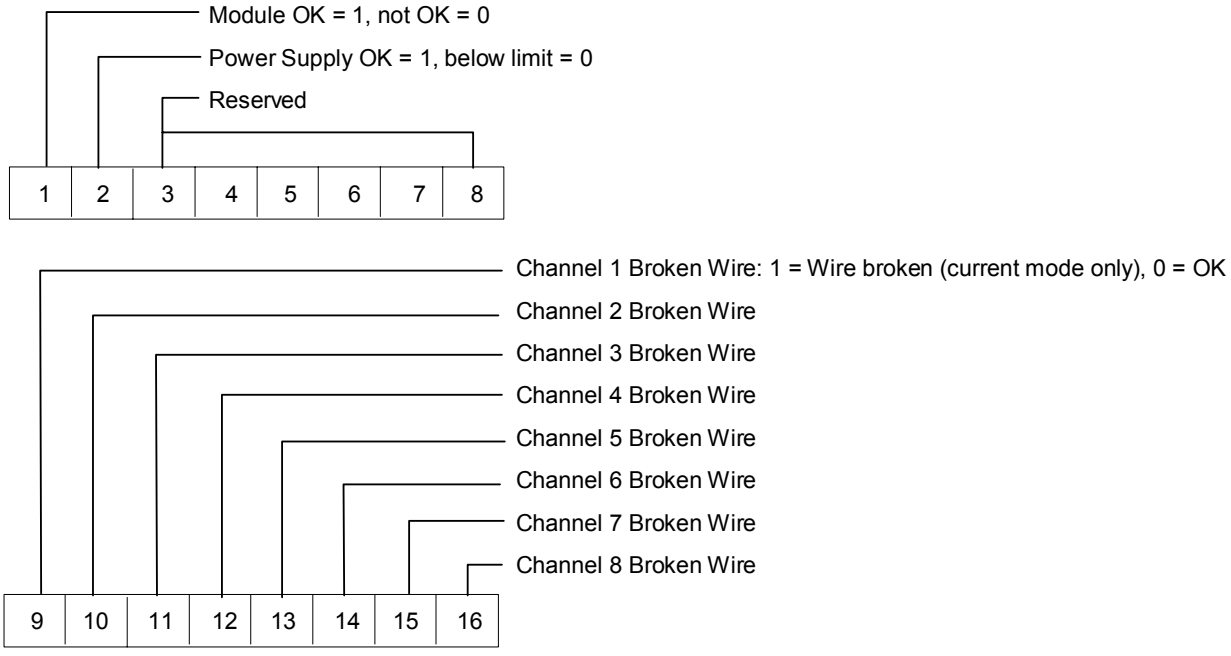
Range	Resolution	Range Limits
0 to 20 mA	15 bits	0 to 32767
4 to 20 mA	15 bits	0 to 32767*
0 to 10 V	15 bits	0 to 32767
-10 to 10 V	16 bits	- 32768 to 32767

* In 4-20 mA mode, if the PLC CPU sends a channel a value that is greater than 32000, the module uses the value 32000 instead.

Status Data: ALG292

This module uses either 8 or 16 discrete input bits, as configured. The first 8 bits are used for module status information as shown below.

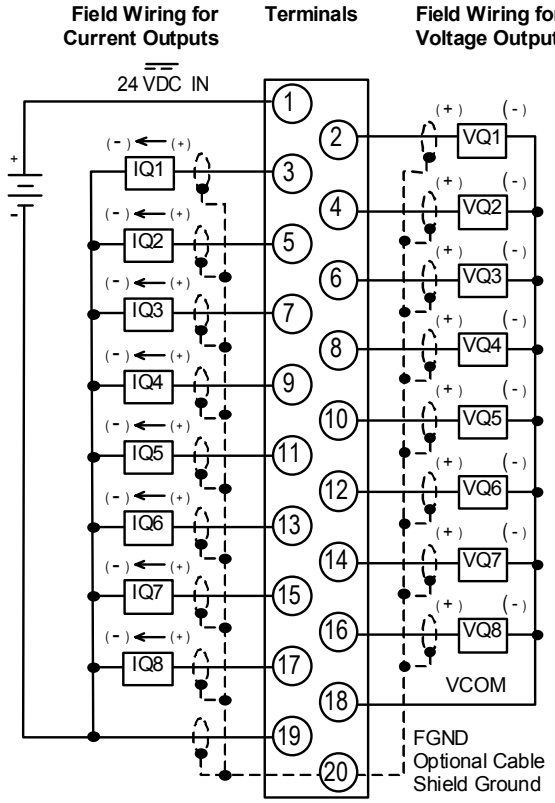
In current mode, individual channels can also report Broken Wire diagnostics. Those diagnostics are reported in bits 9-16:



Field Wiring: ALG392

Terminal	Signal Name	Signal Definition
1	24VIN	User Supplied +24 VDC Input
2	V CH 1	Channel 1 Voltage Output
3	I CH 1	Channel 1 Current Output
4	V CH 2	Channel 2 Voltage Output
5	I CH 2	Channel 2 Current output
6	V CH 3	Channel 3 Voltage Output
7	I CH 3	Channel 3 Current output
8	V CH 4	Channel 4 Voltage Output
9	I CH 4	Channel 4 Current output
10	V CH 5	Channel 5 Voltage Output
11	I CH 5	Channel 5 Current output
12	V CH 6	Channel 6 Voltage Output
13	I CH 6	Channel 6 Current output
14	V CH 7	Channel 7 Voltage Output
15	I CH 7	Channel 7 Current output
16	V CH 8	Channel 8 Voltage Output
17	I CH 8	Channel 8 Current output
18	V COM	Voltage Common
19	I COM	Current Common/User +24 VDC Return
20	GND	Frame ground connection for cable shields

The diagram below shows connections for current and voltage inputs. Each channel can be configured to operate as a voltage output or a current output - not both simultaneously.



Configuration: ALG392

Parameter	Description	Values	Default Values
Active Channels	Number of channels scanned	1 through 8	1
Reference Address for Module Output Data	Starting address for %AQ reference type	standard range	%AQ0001, or next highest available address
Reference Address for Channel Status Data	Starting address for %I reference type	standard range	%I00001, or next highest available address
Length	Number of %I status locations	8 or 16	8
Stop Mode	Output state when module toggled from RUN to STOP mode	Hold Last State or Default to Zero	Hold Last State
Output Channel Range	Type of Output Range	0, +10V -10, +10V 4, 20 mA 0, 20 mA	0, 10V

Active Channels indicates the number of channels that will be scanned by the PLC CPU.

The choice made for Stop Mode determines whether the module's outputs will hold their last states or default to zero when the goes from Run to Stop mode.

The %AQ Reference Address parameter selects the start of the area in the %AQ memory where the output data to the module will begin.

The %I Reference Address selects the start of the area in %I memory for the module's status data. If the length is set to 8, then only module status will be reported. If the length is set to 16, channel status will also be reported for channels that are operating as current outputs.

Each channel can be set up to operate on one of four output ranges:

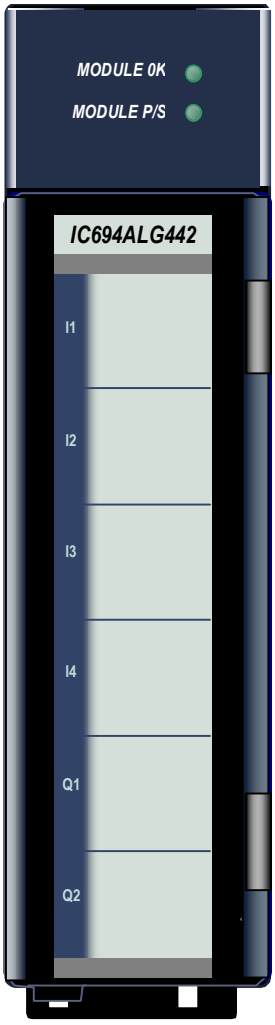
- 0 to 10 V (default
- -10 to +10 V range
- 4 to 20 mA, and 0 to 20 mA
- 0 to 20 mA.

Chapter 11 Analog Mixed Module

This chapter describes the following Analog Mixed module for PACSystems RX3i controllers.

Analog Mixed Module	***Catalog Number***
Output Module, 4 Inputs, 2 Outputs, Current/Voltage	IC694ALG442

Analog Module, 4 Inputs/2 Outputs, Current/Voltage: IC694ALG442



Analog Current/Voltage Input/Output module, IC694ALG422, provides four differential input channels and two single-ended output channels. Each channel can be configured with the Machine Edition software for one of the following ranges:

- 0 to +10 volts (unipolar), default.
- -10 to +10 volts (bipolar)
- 0 to 20 mA
- 4 to 20 mA

Input channels can also be configured for 4 - 20 mA Enhanced mode.

This module may be installed in any I/O slot in the RX3i system.

Module Features

Outputs can be configured to either Hold Last State if system power is interrupted or to reset to the low end of their range. Outputs can also be configured to operate in ramp mode on command from the application program. In ramp mode, the output channel ramps to a new value over a period of time, rather than taking the new value immediately.

High and low alarm limits can be set for all input channels and an open–wire fault (current output modes) can be reported to the CPU for each output channel.

Isolated +24 VDC Power

This module must receive 24 VDC power from an external source. If the module is located in an RX3i Universal Backplane, the external source can be connected via the TB1 connector on the left side of the backplane or directly on the module's terminal block. If the module is located in an Expansion Backplane, the external source must be connected to the module's terminal block.

LEDs

The **Module OK** LED indicates module status. The **Module P/S** LED indicates whether the external +24 VDC power supply is present and is above a minimum designated level. Both LEDs are powered from the +5 VDC backplane power bus.

LED	Description
Module OK	ON: Module OK and configured Flashing: Module OK but not configured OFF: Module is defective or no +5 VDC backplane power present
Module P/S	ON: User power is present OFF: No user power

Specifications: ALG442

Power Requirements	
External Supply Voltage Range	20 to 30 VDC (24 VDC typical)
Power Supply Rejection Ratio	Current: 5 µA/V (typical), 10 µA/V (maximum) Voltage: 25 mV/V (typical), 50 mV/V (maximum) (measured by varying V_{USER} from 24 VDC to 30 VDC)
Voltage Ripple	10%
Power Consumption	95 mA from internal +5 VDC Supply, 129 mA from external supply
Isolation Field to Backplane (optical) and to frame ground	250 VAC continuous; 1500 VAC for 1 minute
Analog Outputs	2, Single–Ended
Analog Current Output	
Output Current Ranges	0 to 20 mA, 4 to 20 mA
Resolution	at 0 to 20 mA: 0.625 µA (1 LSB = 0.625 A) at 4 to 20 mA: 0.5 µA (1 LSB = 0.5 µA)
Absolute Accuracy[1]	+/-0.1% of full scale @ 25°C (77°F), typical +/-0.25% of full scale @ 25°C (77°F), maximum +/-0.5% of full scale over operating temperature range (maximum)
Maximum Compliance Voltage	V_{USER} –3 V (minimum) to V_{USER} (maximum)
User Load	0 to 850Ω (minimum at V_{USER} = 20 V, maximum 1350Ω at V_{USER} = 30 V)
Output Load Capacitance	2000 pF (maximum)
Output Load Inductance	1 H (maximum)
Analog Voltage Output	
Output Ranges	-10 to +10 V (bipolar), 0 to +10 V (unipolar)
Resolution	at –10 V to +10 V: 0.3125 mV (1 LSB = 0.3125 mV) at 0 to +10 V: 0.3125 mV (1 LSB = 0.3125 mV)
Absolute Accuracy[2]	+/-0.25% of full scale @ 25°C (77°F), typical +/-0.5% of full scale @ 25°C (77°F), maximum +/-1.0% of full scale over operating temperature range (maximum)
Output Loading	5 mA (2 K Ohms minimum resistance)
Output Load Capacitance	1 µF (maximum capacitance)

1. In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to +/-1% FS.
2. In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to +/-4% FS.

Continued…

Specifications, *continued*

Analog Inputs	4, differential
Analog Current Input	
Input Ranges	0 to 20 mA, 4 to 20 mA, 4 to 20 mA Enhanced
Resolution	5 µA (1 LSB = 5µA)
Absolute Accuracy[3]	+/- 0.25% of full scale @25°C (77°F) +/-0.5% of full scale over specified operating temperature range
Linearity	<1 LSB
Common Mode Voltage	200 VDC (maximum)
Common Mode Rejection	>70 dB at DC; >70 dB at 60 Hz
Cross Channel Rejection	>80 dB from DC to 1 kHz
Input Impedance	250 Ω
Input Filter Response	29 Hz
Analog Voltage Input	
Input Ranges	0 to +10 V (unipolar), -10 to +10 V (bipolar)
Resolution	at 0 to +10 V: 2.5 mV (1 LSB = 2.5 mV) at –10 to +10 V: 5 mV (1 LSB = 5 mV)
Absolute Accuracy[3]	+/-0.25% of full scale @25°C (77°F); +/-0.5% of full scale over specified operating temperature range
Linearity	<1 LSB
Common Mode Voltage	200 VDC (maximum)
Common Mode Rejection	>70 dB at DC; >70 dB at 60 Hz
Cross Channel Rejection	>80 dB from DC to 1 kHz
Input Impedance	800 K Ohmş typical)
Input Filter Response	29 Hz

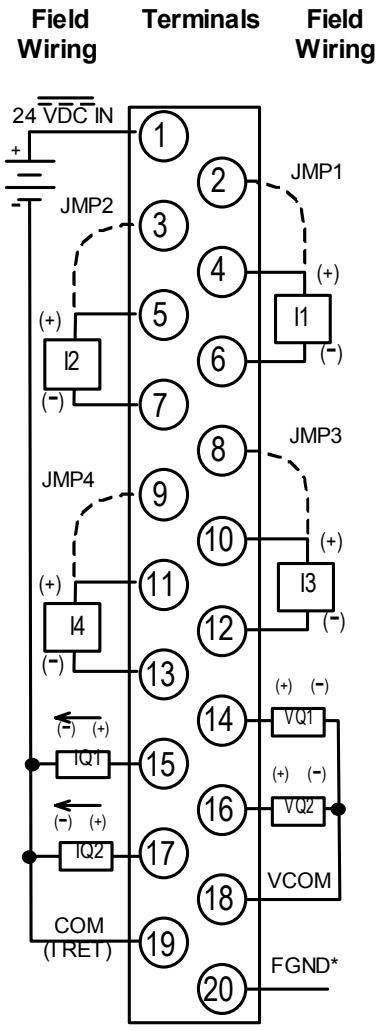
3. In the presence of severe RF interference (IEC 801–3, 10V/m), accuracy may be degraded to +/-2% FS.

Refer to Appendix A for product standards and general specifications. In order to meet the IEC 1000-4-3 levels for RF Susceptibility specified in Appendix A, when this module is present, the system must be mounted in a metal enclosure.

Field Wiring: ALG442

The diagram below shows voltage and current connections for the module. Each channel can be configured independently as a voltage or a current channel, not both simultaneously.

Terminal	Signal	Definition
1	24VIN	User Supplied +24 VDC Input
2	JMP1	Jumper terminal for connecting 250Ω sense resistor for CH1
3	JMP2	Jumper terminal for connecting 250Ω sense resistor for CH2
4	+CH1	Positive connection for differential analog input channel 1
5	+CH2	Positive connection for differential analog input channel 2
6	-CH1	Negative connection for differential analog input channel 1
7	-CH2	Negative connection for differential analog input channel 2
8	JMP3	Jumper terminal for connecting 250Ω sense resistor for CH3
9	JMP4	Jumper terminal for connecting 250Ω sense resistor for CH4
10	+CH3	Positive connection for differential analog input channel 3
11	+CH4	Positive connection for differential analog input channel 4
12	-CH3	Negative connection for differential analog input channel 3
13	-CH4	Negative connection for differential analog input channel 4
14	V_{out} CH1	Voltage output for channel 1
15	I_{out} CH1	Current output for channel 1
16	V_{out} CH2	Voltage output for channel 2
17	I_{out} CH2	Current output for channel 2
18	V COM	Common return for voltage outputs
19	I RET	Common return for User supplied +24 V and current outputs
20	GND	Frame ground connections for cable shields



* Optional Shield Connection

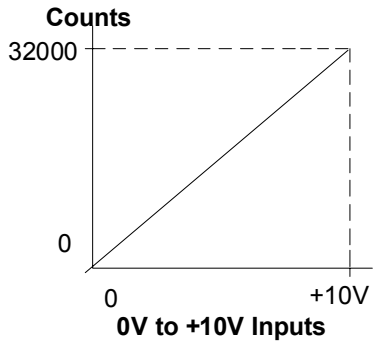
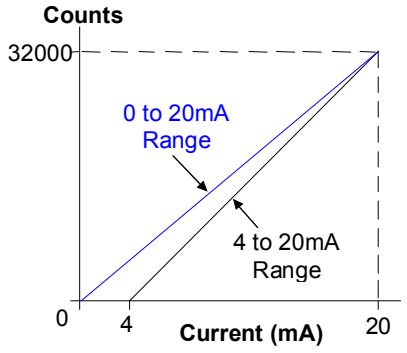
Input Scaling

Resolution per bit depends on the configured input or output range as shown in the table of module specifications. The module scales each current and voltage input to a value in counts for the CPU.

Configured Range	Scaled Counts Values
0 to 10 V (default)	0 to 32767
-10 to 10 V	-32768 to 32767
4 to 20 mA	0 to 32767
0 to 20 mA	0 to 32767
0 to 20 mA Enhanced	-8000 to 32767

In the 0 to +10 V default range, 0 volts corresponds to a count of 0 and +10 volts corresponds to a count of 32000. In the -10 to +10 volt range, -10 volts corresponds to a count of -32000 and +10 volts corresponds to a count of +32000. Full 12–bit resolution is available over either range. In the 4 to 20 mA range, 4 mA corresponds to a count of 0 and 20 mA corresponds to a count of 32000. In the 0 to 20 mA range, 0 mA corresponds to a count of 0 and 20 mA corresponds to a count of 32000. Full 12–bit resolution is available over the 0 to 20 mA range.

In the 4 to 20 mA Enhanced range, 0 mA corresponds to a count of -8000, 4 mA corresponds to a count of 0 (zero) and 20 mA corresponds to a count of +32000. The Enhanced range automatically provides 4 to 20 mA range scaling. Negative digital values are provided for input current levels between 4 mA and 0 mA. This creates a low alarm limit that detects when the input current falls from 4 mA to 0 mA, providing open–wire fault detection in 4 to 20 mA applications.

Input Voltage Scaling	*Input Current Scaling*
	

If the current source is reversed into the input, or is less than the low end of the current range, the module inputs a data word corresponding to the low end of the current range (0000H in %AI). If an input is out of range (greater than 20 mA), the A/D converter adjusts it to full scale (corresponding to 7FFFH in %AI).

Output Scaling

The module scales counts data received from the CPU to a current or voltage value for each output.

Configured Range	Values Sent By CPU	Values Accepted by Module
0 to 10 V (default)	0 to 32767	0 to 32767
-10 to 10 V	-32768 to 32767	- 32768 to 32767
4 to 20 mA	0 to 32767	0 to 32000
0 to 20 mA	0 to 32767	0 to 32767

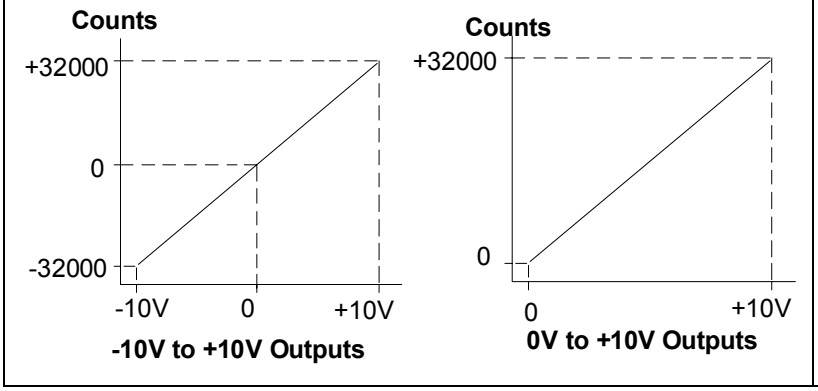
For a 0 to 10 V output, the module scales count outputs from 0 to 32000 to output voltages from 0 to +10 volts. The module scales count values from 32001 to 32767 to overrange voltages up to a maximum of approximately 10.24 volts.

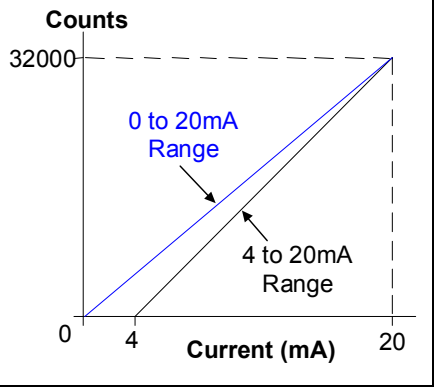
For a -10 to +10 V output, the module scales count outputs in the range +/-32000 to output voltages from –10 V to +10 V. The module scales count values from -32001 to -32768 and from +32001 to +32767 to overrange voltages up to a maximum of approximately +/-10.24 V.

For a 4 to 20 mA output, the module scales count outputs from 0 to 32000 counts to output currents from 4 to 20 mA. If the CPU sends a value above 32000 counts, the module uses the value 32000 in the D/A converter. No error is returned.

For a 0 to 20 mA output, the module scales count outputs from 0 to 32000 to output currents from 0 to 20 mA. The module scales count values from 32001 to 32767 up to a maximum output current of approximately 20.5 mA.

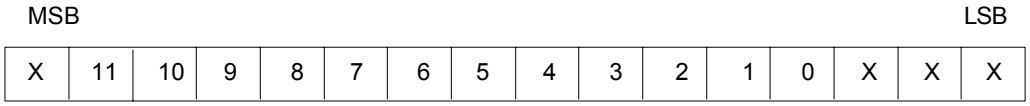
Output Voltage Scaling	*Output Current Scaling*





I/O Data: ALG442

This module uses two %AQ references and four %AI references, depending on configuration. Data in the %AI and %AQ registers is in 16–bit 2's complement format.



The module also uses 8, 16 or 24 %I references for status data, depending on the alarm status configuration. Status data format is shown on the next page.

Input Data

Resolution of the converted signal is 12 bits binary (1 part in 4096). The placement of the 12 bits from the A/D converter in the %AI data word is shown above.

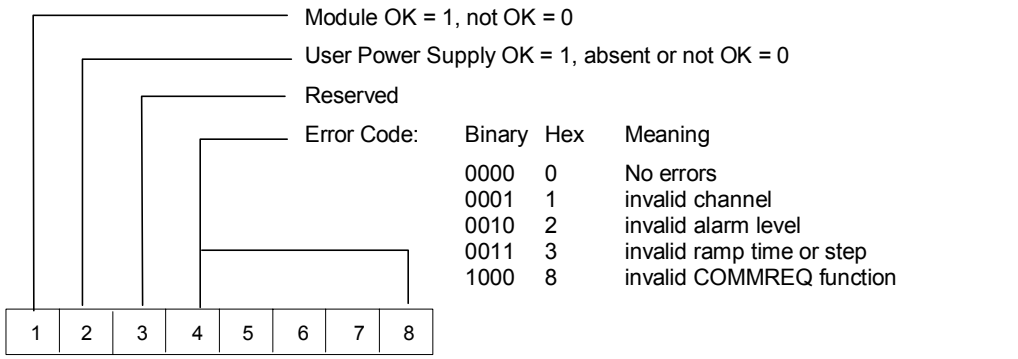
The bits in the %AI data table that were not used are forced to 0 (zero) by the analog input channel.

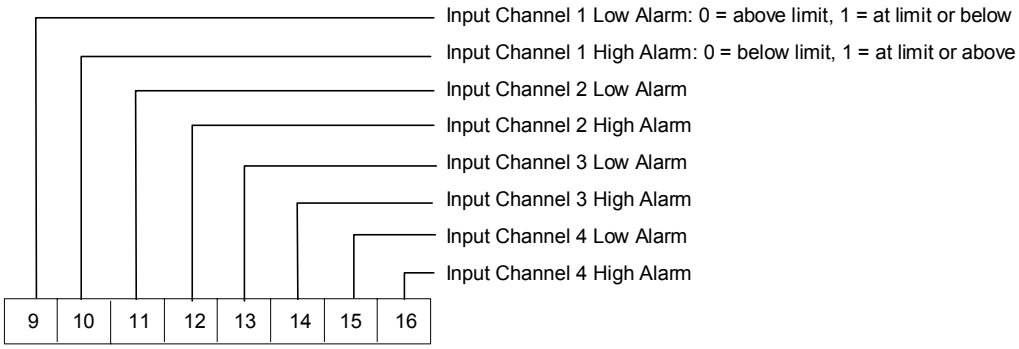
Output Data

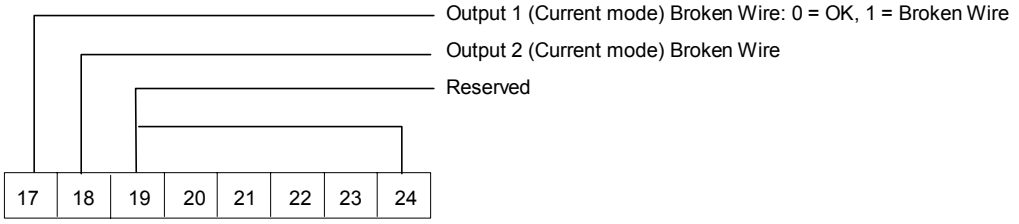
Each output channel is capable of converting 15 to 16 bits (depending on the range selected) of binary data to an analog output.

Status Data: ALG222

Analog Module IC694ALG222 can be configured to return 8, 16, or 32 status bits to the PLC CPU. Content of the status data is shown below.







Error Code

Byte 1 of the status data contains a status/error code for COMMREQs sent to the module. Only the most recent error is reported; an existing error code is overwritten if another error occurs. The priority of errors is:

1. Invalid COMMREQ function (highest priority)
2. Invalid channel.
3. Invalid data (ramp or alarm parameter) (lowest priority).

If multiple errors occur, the one with the highest priority is reported in the error code. The module does not stop standard operation if an error is detected; these error bits are informational only and can be ignored.

Configuration: ALG442

The following module parameters can be configured using the Machine Edition software:

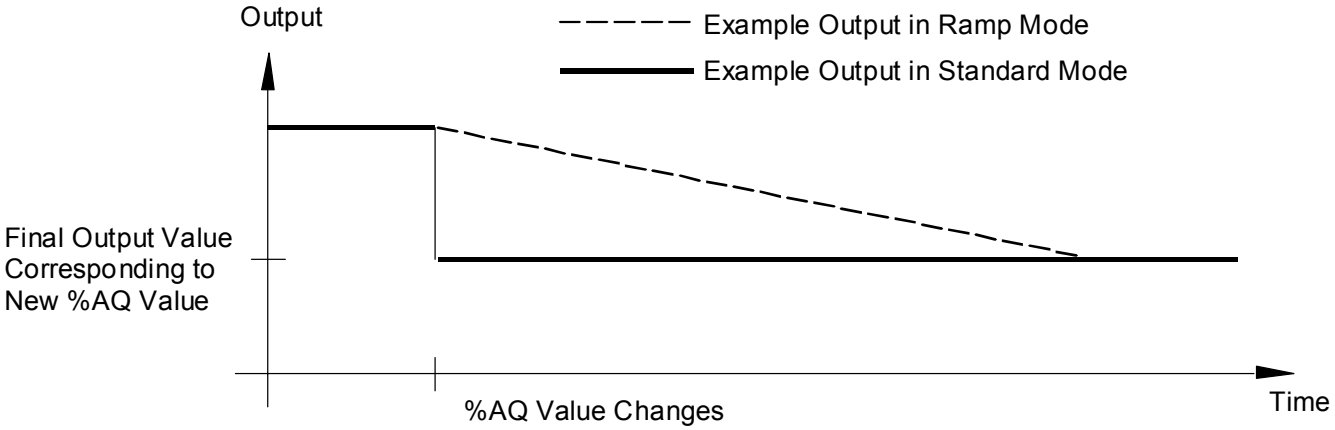
Parameter	Description	Values
Stop Mode	Output state when module goes from Run to Stop mode	Hold or Default Low
Reference Address	Starting %AI address for the module's analog input data	
Reference Address	Starting %AQ address for the module's analog output data	
Reference Address	Starting %I address for the module's status data	
%I Length	Number of %I status bits that will be used for module and channel status data:	8 (module and power status only) 16 (above plus input status) 24 (all above plus output status)
Output Range	Type of output range	0 to +10 V, -10 to +10 V, 4 to 20 mA, 0 to 20 mA
Input Range	Type of input range	0 to +10 V, -10 to +10 V, 4 to 20 mA, 0 to 20 mA, 4 to 20 mA Enhanced
Alarm Low Limit	Low limit alarm value for each input. Must be less than the same channel's high alarm	-32768 to 32759
Alarm High Limit	High limit alarm value for each input	-32767 to 32760

The choice for Stop Mode (Hold or Default Low) determines how outputs operate when the module goes from Run to Stop mode. If the configured Stop Mode is Hold (the default), the module holds outputs at the last state received from the CPU. If the Stop Mode is Default Low, the outputs will go to their low values. In current mode (4-20 mA), outputs go to 4 mA if configured for DEFLOW. In current mode (0-20 mA), outputs go to 0 mA if configured for DEFLOW. In voltage mode (unipolar (0 to +10V) and bipolar (+10V to -10V), outputs go to 0V if configured for DEFLOW.

The Alarm Low and Alarm High parameters can be used to set up limits that cause alarm indications to be passed to the PLC for each channel. Values entered without a sign are assumed to be positive. These configured alarm limits are stored until changed by a new configuration. The configured high and low alarm limits can be changed temporarily by a COMMREQ from the application program as described later in this chapter.

Ramp Mode Operation for ALG442

Outputs on module ALG442 can be set up to operate in Ramp mode. In normal operating mode, a new value entered in an output channel's %AQ reference causes the output to change directly to the new value. In Ramp mode, the output goes to the new value over a period of time. The output channel starts a new ramp (either up or down) each time the value in its %AQ reference changes. The module performs range checking on new output values and automatically adjusts out-of-range values before making the ramp computations.



Use of Ramp mode is set up for either channel or both output channels using a COMMREQ command as explained in this chapter. The ramp slope can be set up in the COMMREQ as:

- a total ramp time from 1 millisecond to 32 seconds, or:
- a sequence of 1 to 32000 1-millisecond steps.

A channel stays in Ramp mode until the module receives a new COMMREQ either changing or canceling the ramp operation, or until power is cycled. The channel will not change modes after a hardware configuration download. Because COMMREQ settings are temporary, they are lost after a power cycle.

If the module receives a new COMMREQ that changes ramp operation while an output is in the process of ramping, the new ramp settings take effect as follows:

- If Ramp mode is turned off during a ramp, the channel goes directly to the value in its %AQ reference.
- If a channel is set up to ramp over a period of time, but a new COMMREQ is received commanding the channel to instead ramp in a sequence of measured steps, ramp operation changes as soon as the COMMREQ is processed (assuming that the step is valid).
- If a channel is set up to ramp as a sequence of measured steps, but a new COMMREQ is received commanding the channel to instead ramp over a period of time, it immediately starts a new ramp using the present output as the starting output and the present time as the start time.

If the module receives a Ramp command for an invalid channel, step height or ramp time, the module ignores the command and returns an error code in the first byte of its %I status references. The error code can be cleared by a Clear Errors COMMREQ as described in this chapter, or by reconfiguring the module.

Changing Module Operation on Command

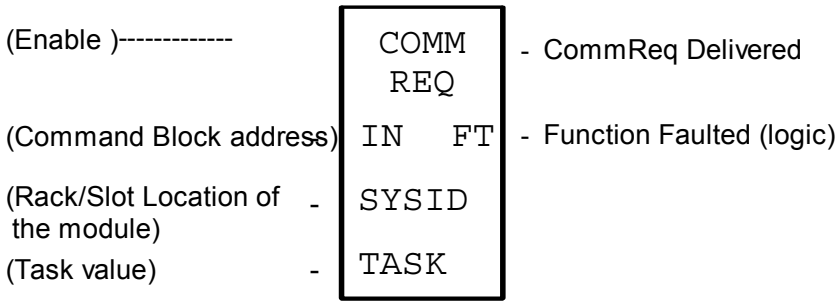
Module ALG442 can respond directly to a specific COMMREQ command from the application program to:

- clear the module's %I error code
- modify the Input alarm limits, and
- put one or both outputs in Ramp mode and set up the ramp characteristics

These changes to module are not retained during loss of power. If the module is power-cycled, new commands must be sent to the module to again modify the configured alarm limits, or to set up Ramp operation for the outputs.

COMMREQ Format

The Communications Request is triggered when the logic program passes power to the COMMREQ Function Block.



When sent to module ALG442, the parameters of the COMMREQ are:

Enable: Control logic for activating the COMMREQ Function Block.

IN: The location of the Command Block. The Command Block contains the parameters of the COMMREQ request. It can be located at any valid address within a word-oriented memory area (%R, %AI, %AQ, %P, %L, or %W) in the PACSystems PLC.

SYSID: A hexadecimal word value that gives the rack (high byte) and slot (low byte) location of the analog module.

TASK: Task must be set to zero.

FT Output: The FT output is set if the PLC CPU is unable to deliver the COMMREQ to the module. When the FT output is set, the module is unable to return a COMMREQ status word to the PLC logic application.

COMMREQ Command Block

The format of the COMMREQ for module ALG442 is shown below. For more information about using COMMREQs, check the online help and the *PACSystems Reference Manual*.

Word Offset	Value	Description
Word 1	Must be 0004	Length of the command block
Word 2	0000	Not used
Word 3	(See below)	Memory type of COMMREQ Status Word
Word 4	0-based.	Offset of COMMREQ Status Word
Word 5	0	Reserved
Word 6	0	Reserved
Word 7	E201H (-7679 decimal)	COMMREQ command number
Word 8	0006	Byte length of Command Data (see below)
Word 9	(See below)	Memory type in the CPU for the Command Data
Word 10	0-based	Memory offset for the Command data

Memory Types and Offsets

The COMMREQ Command Block specifies a memory type and location to receive status information about the execution of the command (word 3), and for the command data (word 9). The memory types are listed in the table below. ***For word 4 and word 10, the address offset is a zero-based number.*** For example, the offset for %R100 is 99 decimal.

Type	Value (Decimal)	Value (Hex.)	Description
%R	8	08H	Register memory (word mode)
%AI	10	0AH	Analog input memory (word mode)
%AQ	12	0CH	Analog output memory (word mode)
%I	16 70	10H 46H	Discrete input memory (byte mode) Discrete input memory (bit mode)
%Q	18 72	12H 48H	Discrete output memory (byte mode) Discrete output memory (bit mode)
%T	20 74	14H 4AH	Discrete temporary memory (byte mode) Discrete temporary memory (bit mode)
%M	22 76	16H 4CH	Discrete momentary internal memory (byte mode) Discrete momentary internal memory (bit mode)
%G	56 86	38H 56H	Discrete global data table (byte mode) Discrete global data table (bit mode)
%W	196	C4H	Word memory (word mode; limited to %W1-%W65536)

COMMREQ Command Data Format

In the COMMREQ Command Block (above) words 9 and 10 assign a CPU memory location for six bytes of command data. The program logic can use these bytes to set the parameters of the COMMREQ. This module does not use the last command data word.

word 1 command word
word 2 alarm or ramp data
word 3 Unused for module ALG442

Command to be Performed	*Word 1 Contains*	*Word 2 Contains*
Change the specified input's low alarm limit to the value in word 2.	0000 (Input 1) 0001 (Input 2) 0002 (Input 3) 0003 (Input 4)	New low alarm limit for the input
Change the specified input's high alarm limit to the value in word 2.	0010 (Input 1) 0011 (Input 2) 0012 (Input 3) 0013 (Input 4)	New high alarm limit for the input
Change the specified input's low alarm limit by the increment in word 2.	0020 (Input 1) 0021 (Input 2) 0022 (Input 3) 0023 (Input 4)	Increment to change the input's configured low alarm limit. Increment can be + or -.
Change the specified input's high alarm limit by the increment in word 2.	0030 (Input 1) 0031 (Input 2) 0032 (Input 3) 0033 (Input 4)	Increment to change the input's high alarm limit. Increment can be + or -.
Turn off Ramp operation for the specified output channel and put it in normal mode.	0040 (Output 1) 0041 (Output 2)	--
Put the specified output channel in Ramp step mode. Step increment in word 2.	0050 (Output 1) 0051 (Output 2)	Step (1 to 32000 counts) to be taken each millisecond.
Put the specified output channel in Ramp time mode. Ramp total time in word 2.	0060 (Output 1) 0061 (Output 2)	Time in milliseconds: 1 to 32000 (1 ms to 32 seconds)
Clear the module's %I error code	00C0	--

If the requested command is not valid (for example, if the changed alarm limit would be out of range) the module ignores the COMMREQ command and returns an error code in the module's %I status data. The module does NOT stop operating; these error bits are informational only and can be ignored. The error code remains in the %I status bits until cleared by another COMMREQ (command 00C0, see directly above), or until the module is reconfigured.

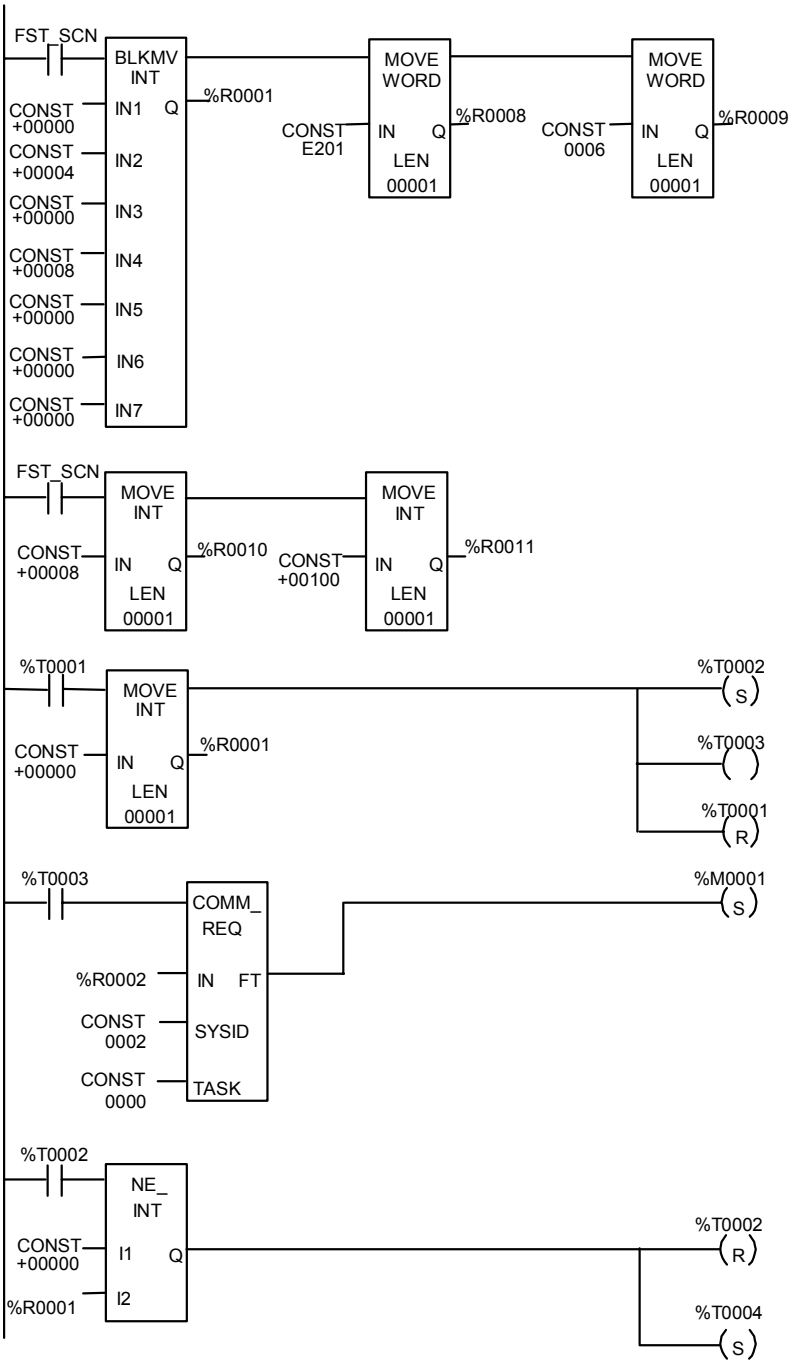
COMMREQ Example

This example shows setting up COMMREQ data and issuing the COMMREQ to an Analog Mixed module.

The application program should verify the completion of the COMMREQ in progress before initiating another, so the module does not receive COMMREQs faster than it can process them. One way to do that is to zero the contents of the COMMREQ status (%R0001 in this example) as the COMMREQ is enabled. Since the status returned for a completed COMMREQ is never zero, a non–zero status word indicates that the COMMREQ has completed.

In this example, the COMMREQ command block starts at %R0002 and is initialized on the first scan. The 6 bytes of COMMREQ data sent to the module must have been moved into%R0101-%R0103 before the COMMREQ is enabled.

The module is located in rack 0, slot 2 so the SYSID input to the COMMREQ is 0002.



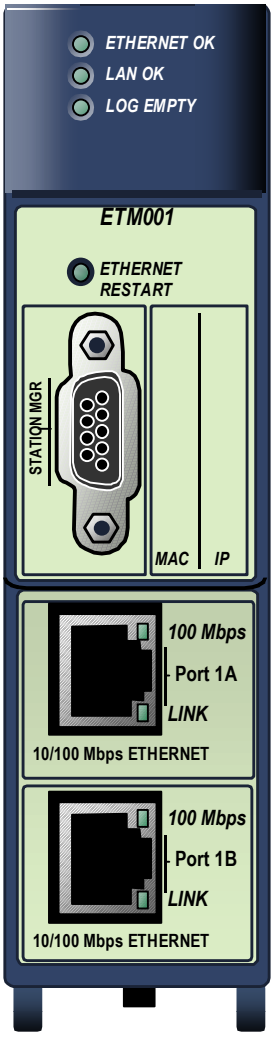
Setting %T0001 moves zero into the COMMREQ status word, enables %T0003 for one sweep to initiate the COMMREQ, and sets %T0002 to begin checking the status word. When a non–zero status word is detected, %T0002 is reset to discontinue checking and %T0004 is set to indicate that the module is ready for the next COMMREQ. Reference %M0001 is set if a COMMREQ fault occurs.

Chapter 12 Special-Purpose Modules

. This chapter describes special-purpose modules for PACSystems RX3i controllers:

Module	*Catalog Number*
Ethernet Interface Module	IC695ETM001
Motion Controller Module	IC694DSM314

Ethernet Interface Module: IC695ETM001



The Ethernet Interface Module, IC695ETM001, is used to connect a PACSystems RX3i controller to an Ethernet network. It enables the RX3i controller to communicate with other PACSystems equipment and with Series 90 and VersaMax controllers. The Ethernet Interface provides TCP/IP communications with other PLCs, host computers running the Host Communications Toolkit or programmer software, and computers running the TCP/IP version of the programming software. These communications use the GE Fanuc SRTP and Ethernet Global Data (EGD) protocols over a four-layer TCP/IP (Internet) stack.

Features of the RX3i Ethernet Interface include:

- Full PLC programming and configuration services
- Periodic data exchange using Ethernet Global Data (EGD)
- EGD Commands to read and write PLC and EGD exchange memory over the network.
- TCP/IP communication services using SRTP
- Comprehensive station management and diagnostic tools
- Extended PLC connectivity via IEEE 802.3 CSMA/CD 10Mbps and 100Mbps Ethernet LAN port connectors.
- Network switch that has Auto negotiate, Sense, Speed, and crossover detection.
- Direct connection to BaseT (twisted pair) network switch, hub, or repeater without an external transceiver.

For more information about this module, please refer to the following publications:

- TCP/IP Ethernet Communications for PACSystems, GFK-2224
- PACSystems TCP'IP Communications, Station Manager Manual, GFK-2225

Specifications: IC695ETM001

Ethernet processor speed	200 MHz
Connectors	- Station Manager (RS-232) Port: 9-pin female D-connector - Two 10BaseT / 100BaseTX Ports: 8-pin female shielded RJ-45
LAN	IEEE 802.2 Logical Link Control Class I IEEE 802.3 CSMA/CD Medium Access Control 10/100 Mbps
Number of IP addresses	One
Number of Ethernet Port Connectors	Two, both are 10BaseT / 100BaseTX with auto-sensing RJ-45 connection.
Embedded Ethernet Switch	Yes – Allows daisy chaining of Ethernet nodes.
Serial Port	Station Manager Port: RS-232 DCE, 1200 - 115200 bps.

Refer to Appendix A for product standards and general specifications.

Ethernet Interface Ports

The Ethernet Interface module has two auto-sensing 10Base T / 100Base TX RJ-45 shielded twisted pair Ethernet ports for connection to either a 10BaseT or 100BaseTX IEEE 802.3 network. The port automatically senses the speed (10Mbps or 100Mbps), duplex mode (half duplex or full duplex) and cable (straight-through or crossover) attached to it with no intervention required.

Ethernet Media

The Ethernet Interface can operate directly on 10BaseT/100BaseTX media via its network ports.

10BaseT: 10BaseT uses a twisted pair cable of up to 100 meters in length between each node and a switch, hub, or repeater. Typical switches, hubs, or repeaters support 6 to 12 nodes connected in a star wiring topology.

100BaseTX: 100BaseTX uses a cable of up to 100 meters in length between each node and a switch, hub, or repeater. The cable should be data grade Category 5 unshielded twisted pair (UTP) or shielded twisted pair (STP) cable. Two pairs of wire are used, one for transmission, and the other for collision detection and receive. Typical switches, hubs, or repeaters support 6 to 12 nodes connected in a star wiring topology.

Station Manager

The built-in Station Manager function of the Ethernet Interface provides on-line supervisory access to the Ethernet Interface, through the Station Manager port or over the Ethernet cable. Station Manager services include:

- An interactive set of commands for interrogating and controlling the station.
- Unrestricted access to observe internal statistics, an exception log, and configuration parameters.
- Password security for commands that change station parameters or operation.

Refer to the *PACSystems TCP/IP Ethernet Communications Station Manager Manual*, GFK-2225 for complete information on the Station Manager.

Firmware Upgrades

The Ethernet Interface receives its firmware upgrades indirectly from the PLC CPU using the WinLoader software utility. WInLoader is supplied with any updates to the Ethernet Interface software.

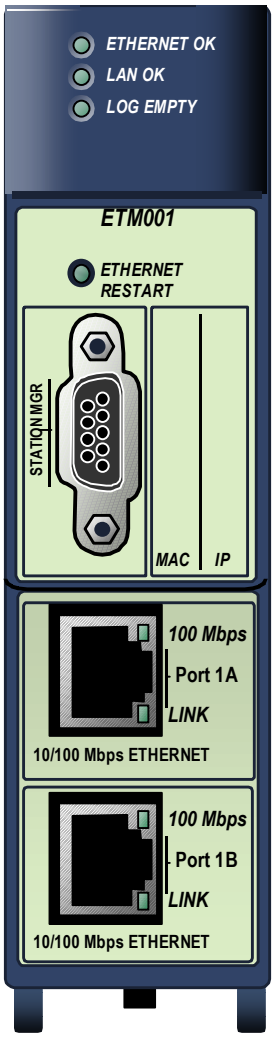
Ethernet Global Data (EGD)

Each PACSystems CPU supports up to 255 simultaneous Ethernet Global Data (EGD) exchanges. EGD exchanges are configured using the programmer and stored into the PLC. Both Produced and Consumed exchanges can be configured. PACSystems Ethernet Interfaces support both selective consumption of EGD exchanges and EGD exchange production and consumption to the broadcast IP address of the local subnet.

The Ethernet Interface can be configured to use SNTP to synchronize the timestamps of produced EGD exchanges.

The Ethernet Interface implements the capabilities of a Class 1 and Class 2 device. COMMREQ-driven EGD Commands can be used in the application program to read and write data into the CPU or other EGD Class 2 devices.

Ethernet Interface Controls and Indicators



LEDs

- The **Ethernet OK** LED indicates whether the module is able to perform normal operation. This LED is On for normal operation and flashing for all other operations. If a hardware or runtime failure occurs, the EOK LED blinks a two-digit error.
- The **LAN OK** LED indicates access to the Ethernet network. The LAN LED blinks when data is being sent or received over the network directed to or from the Ethernet interface. It remains On when the Ethernet interface is not actively accessing the network but the Ethernet physical interface is available and one or both of the Ethernet ports is operational. It is Off otherwise unless software load is occurring.
- The **Log Empty** LED is On during normal operation. It is Off if an event has been logged.
- Two Ethernet network activity LEDS (**LINK**) indicate the network link status and activity.
- Two Ethernet network speed LEDS (**100Mbps**) indicates the network data speed (10 (off) or 100 Mb/sec (on)).

Ethernet Restart Pushbutton

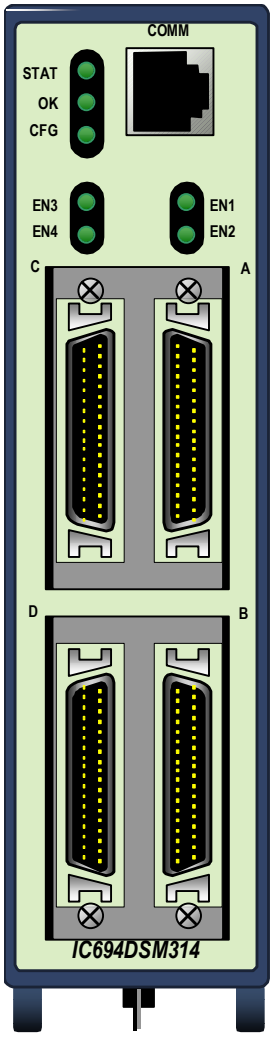
This pushbutton is used to manually restart the Ethernet firmware without power cycling the entire system. It is recessed to prevent accidental operation.

Connectors

The module has two 10BaseT/100BaseTX Ethernet Network Port Connectors. There is only one interface to the network (only one Ethernet MAC address and only one IP address).

It also has a Station Manager (RS-232) Serial Port.

Motion Mate Module: IC694DSM314



The Motion Mate Module, IC694DSM314, is a multi-axis motion control module. It supports two control loop configurations:

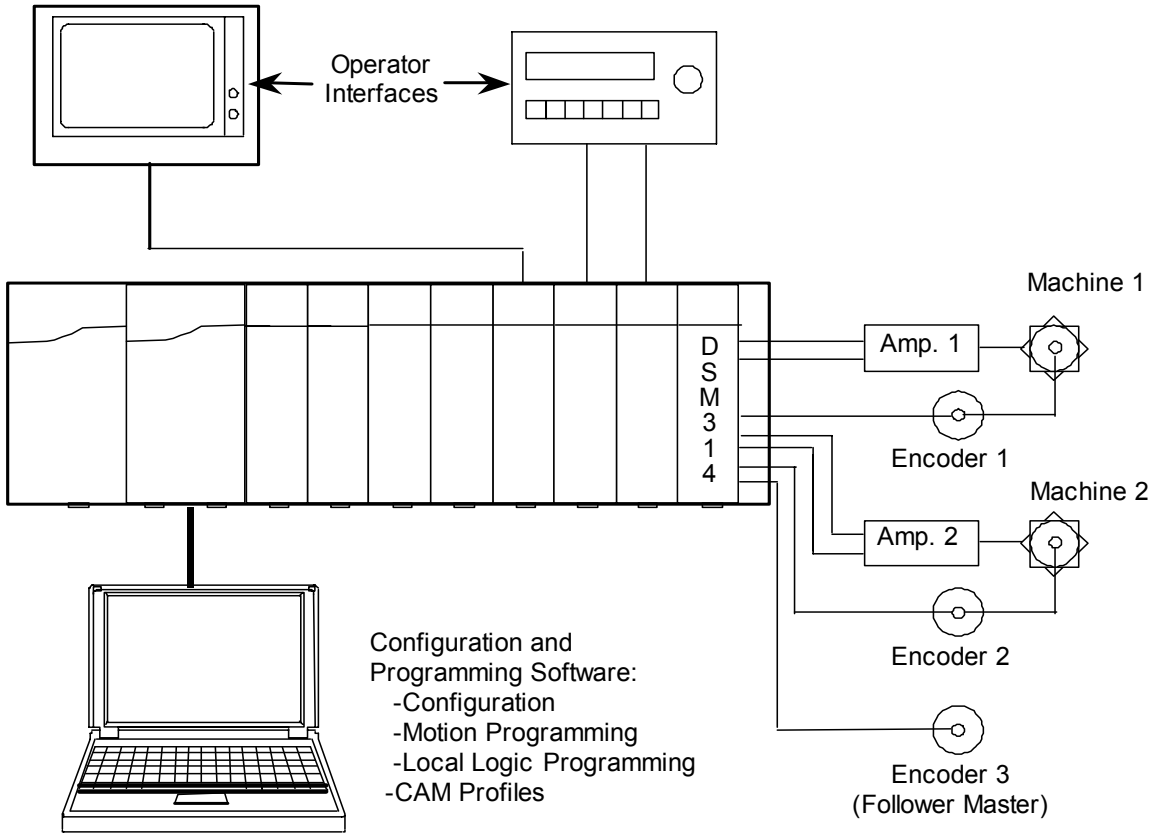
- Standard Mode (Follower Control Loop Disabled)
- Follower Mode (Follower Control Loop Enabled)

The DXM314 Module can be used with digital GE Fanuc α Series and β Series digital servo amplifiers and motors. It can also be used with analog GE Fanuc SL Series analog servos and third-party analog velocity command interface and analog torque command interface servos. Module features include:

- Velocity Feed forward and Position Error Integrator
- High resolution of programming units
- Simple and powerful motion program instruction set
- Simple 1 to 4-axis motion programs
- Non-volatile storage for 10 programs and 40 subroutines
- Single-point-of-connect for programming and configuration.
- Firmware is stored in flash memory and is updated via COMM port.
- Recipe programming using command parameters.
- Electronic CAM capability
- Home and overtravel switch inputs for each Servo Axis
- Two Position Capture Strobe Inputs for each axis
- 5 V, 24 V and analog I/O for use by PLC
- Incremental Quadrature Encoder input on each axis for Encoder/Analog mode
- 13 bit Analog Output can be controlled by PLC or used as Digital Servo Tuning monitor
- High speed digital output (four each 24V and four each 5V) via on-board Local Logic control

Overview

The DSM314 integrates high-performance motion control with the logic-solving functions of the RX3i PACSystem.



For more information about configuring and installing the DSM314 module, see the *Motion Mate User's Manual*, GFK-1742. For details about interfacing the DSM314 to the GE Fanuc SL Servo products, refer to the manual, *SL Series Servo User's Manual*, GFK-1581.

Features: DSM314

LEDs

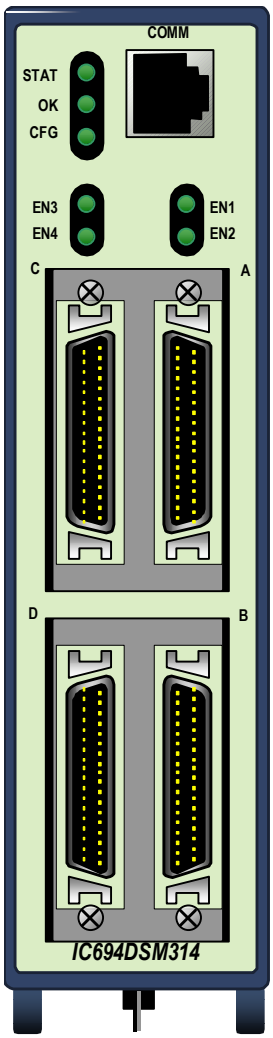
There are seven LED status indicators on the DSM314 module:

The **STAT** LED is normally On. When the LED is OFF, the DSM314 is not functioning. Slow blinking indicates status errors. Rapid blinking indicates errors that cause the servo to stop.

The **OK** LED indicates the current status of the DSM314 module. When the LED is steady On, the module is functioning properly. When the LED is Off, the module is not functioning.

The **CFG** LED is On when a module configuration has been received.

The **EN1** through **EN4** LEDs are On if the Axis 1 through Axis 4 Drive Enable relays are on.



COMM Connector

The COMM port is an RJ-11 connector, used to download firmware updates to the module.

I/O Connectors

The DSM314 is a two-axis digital servo/one axis analog velocity interface or four-axis analog servo (Torque Mode and/or Velocity Mode) controller with four 36-pin I/O connectors labeled A, B, C, and D. All four connectors provide similar analog and digital I/O circuits.

Shield Ground Connection

The DSM314 must be connected to frame ground via the ground terminal on the bottom of the module

Appendix A Product Certifications and Installation Guidelines for Conformance

This appendix describes the compliance markings and standards to which the RX3i products have been certified. It also provides installation requirements for conformance to standards and additional safety guidelines for installing in the European Union.

RX3i Agency Approvals

Description	Agency Standard or Marking	Comments
N.A. Safety for Industrial Control Equipment	c UL us LISTED	Certification by Underwriter's Laboratories to UL508 standard and equivalent CSA C22.2 No 142 - M1987standard
N.A. Safety for Hazardous Locations Class I, Div. 2, Groups A, B, C, D	c UL us LISTED	Certification by Underwriter's Laboratories to UL1604 standard and equivalent CSA C22.2 No 213-M1987 standard
Low Voltage Directive European Safety for Industrial Control Equipment	CE	Self-Declaration in accordance with European Directives; Refer to Declaration of Conformity found at www.gefanuc.com for a complete list of approved products
Electromagnetic Compatibility Directive European EMC for Industrial Control Equipment	CE	Certification by Competent Body in accordance with European Directives; Refer to Declaration of Conformity found at www.gefanuc.com for a complete list of approved products
Explosive Atmospheres Directive European Safety for Hazardous Locations Equipment Group II, Category 3	Ex	Certification in accordance with European Directives and Independent 3rd Party Assessment Certificate; Refer to Declaration of Conformity found at www.gefanuc.com for complete list of approved products

Note: The agency approvals listed above and on the Declaration of Conformities are believed to be accurate, however, a product's agency approvals should be verified by the marking on the unit itself.

UL Class 1 Division 2 Hazardous Location Requirements

The following statements are required to appear for Class I Div 2 Hazardous Locations.

1. EQUIPMENT LABELED WITH REFERENCE TO CLASS I, GROUPS A, B, C, and D, DIV. 2 HAZARDOUS LOCATIONS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON–HAZARDOUS LOCATIONS ONLY.
2. WARNING – EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.
3. WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON–HAZARDOUS.

ATEX Class 1 Zone 2 Hazardous Location Requirements

In order to maintain compliance with the ATEX Directive, a RX3i system located in a Class 1 Zone 2 area (Category 3) must be installed within a protective enclosure meeting the criteria detailed below:

- IP54 or greater, and
- Mechanical strength to withstand an impact energy of 3.5 Joules

Standards Overview

PACSystems RX3i Environmental Specifications

Vibration	**IEC60068-2-6, JISC0911**	10 - 57 Hz, 0.012" displacement peak-peak 57 - 500 Hz, 1.0g acceleration
Shock	**IEC60068-2-27, JISC0912**	15G, 11ms
Operating Temperature		0°C to 60°C: [inlet] (32° to 140°F)
Storage Temperature		-40°C to +85°C (-40° to 185°F)
Humidity		5% to 95%, non-condensing

Additional RX3i Specifications

Standards for EMC Emissions, Immunity, and Isolation for RX3i products are given on the following pages. Refer to the listing of module catalog numbers below to determine which set of standards applies to a specific module: Specifications Group 1 or Group2.

Module	*Group 1*	*Group 2*	*Module*	*Group 1*	*Group 2*
IC694ACC300	■		IC694MDL310	■	
IC694ALG220	■		IC694MDL330	■	
IC694ALG221	■		IC694MDL340	■	
IC694ALG222	■		IC694MDL390	■	
IC694ALG223	■		IC694MDL732	■	
IC694ALG390	■		IC694MDL734	■	
IC694ALG391	■		IC694MDL740	■	
IC694ALG392	■		IC694MDL741	■	
IC694ALG442	■		IC694MDL742	■	
IC694APU300	■		IC694MDL752	■	
IC694DSM314	■		IC694MDL753	■	
IC694MDL230	■		IC694MDL930	■	
IC694MDL231	■		IC694MDL931	■	
IC694MDL240	■		IC694MDL940	■	
IC694MDL241	■		IC695CHS012		■
IC694MDL632	■		IC695CHS015		■
IC694MDL634	■		IC695CPU310		■
IC694MDL645	■		IC695ETM001		■
IC694MDL646	■		IC695LRE001		■
IC694MDL654	■		IC695PSA040		■
IC694MDL655	■		IC695PSD040		■

Specifications Group 1

EMC EMISSIONS		
Radiated, Conducted	**CISPR 11/EN 55011**	"Industrial Scientific & Medical Equipment" (Group 1, Class A)
	CISPR 22/EN 55022	"Information Technology Equipment" (Class A)
	47 CFR 15	referred to as FCC part 15, "Radio Devices" (Class A)
Harmonic	**EN61000-3-2**	Class A
EMC IMMUNITY		
Electrostatic Discharge	**EN 61000-4-2**[1]	±8KV Air, ±4KV Contact
RF Susceptibility	**EN 61000-4-3**[1]	$10V_{rms}$ /m, 80Mhz to 1000Mhz, 80% AM, 1kHz sine wave
	ENV 50140/ ENV 50204	$10V_{rms}$ /m, 900 ± 5Mhz, 100% PM, 200Hz square wave
Fast Transient Burst	**EN 61000-4-4**[1]	AC/DC Input Power: ±2kV direct Signal: ±1kV cap coupled
Voltage Surge	**EN 61000-4-5**[1]	AC Input Power: ±2KV (12Ω) CM, ±1kV (2Ω) DM DC Input Power[2]: ±0.5KV (12Ω) CM, ±0.5kV (2Ω) DM Shielded Signal[3]: ±1kV (2Ω) CM Unshielded Communication Signal[3]: ±1KV (250Ω max.) CM Unshielded I/O Signal[3]: ±1kV (42Ω) CM, ±0.5KV (42Ω) DM
Damped Oscillatory Wave	**ANSI/IEEE C37.90a, EN61000-4-12**[1]	1Mhz, 400Hz rep rate AC/DC Input Power[2]: ±2.5KV CM & DM (200Ω) Signal[3]: ±2.5KV CM (200Ω)
Conducted RF	**EN 61000-4-6**[1]	AC/DC Input Power, Signal: $10V_{rms}$, 0.15 to 80Mhz, 80%AM
Voltage Dips & Interrupts	**EN 61000-4-11**[1]	AC Input Power: 30% Nominal (0.5 period); 60% Nominal (5,50 periods); >95% Nominal (250 periods)
Voltage Variation	**EN 61000-4-11**[1]	AC Input Power: ±10% (50,000 periods)
Voltage Flicker	**EN61000-3-3**	AC Input Power: $d_{max} \leq 4\%$
ISOLATION		
Dielectric Withstand	**UL508, UL840, IEC664**	1.5KV for 1 minute (modules rated from 51v to 250v)

1) EN61000-4-x series of tests are technically equivalent to the IEC61000-4-x series.
2) Not applicable to ports limited to 10m or less.
3) Not applicable to RS232 ports and those ports limited to 30m (98ft.) or less

Specifications Group 2

EMC EMISSIONS		
Radiated, Conducted	**CISPR 11/EN 55011**	"Industrial Scientific & Medical Equipment" (Group 1, Class A)
	CISPR 22/EN 55022	"Information Technology Equipment" (Class A)
	47 CFR 15	referred to as FCC part 15, "Radio Devices" (Class A)
EMC IMMUNITY		
Electrostatic Discharge	**EN 61000-4-2**[1]	±8KV Air, ±4KV Contact
RF Susceptibility	**EN 61000-4-3**[1]	$10V_{rms}$ /m, 80Mhz to 1000Mhz, 80% AM, 1kHz sine wave
Fast Transient Burst	**EN 61000-4-4**[1]	AC/DC Input Power: ±2kV direct Discrete I/O, Communication: ±1kV (clamp) [1] Analog I/O: ±0.25kV (clamp)
Damped Oscillatory Wave	**ANSI/IEEE C37.90a, EN61000-4-12**[1]	AC/DC Input Power: +2.5KV I/O, Communication: +2.5KV [2]
Voltage Surge	**EN61000-4-5**[1]	AC/DC Input Power: ±2kV (12Ω) CM I/O, Communication: ±1kV (42Ω) CM [2]
Conducted RF	**EN 61000-4-6**[1]	Communication: $10V_{rms}$, 0.15 to 80Mhz, 80%AM [3]
Voltage Dips & Interrupts	**EN 61000-4-11**[1]	AC/DC Input Power: 30% & 100% Nominal (10ms)
Voltage Variation	**EN 61000-4-11**[1]	AC Input Power: ± 10% (10s) DC Input Power: ± 20% (10s)
ISOLATION		
Dielectric Withstand	**UL508, UL840, IEC664**	1.5KV for 1 minute (modules rated from 51v to 250v)

*Although a few modules were tested according to the Voltage Surge test, modules were primarily tested to the Damped Oscillatory Wave test.

Note:

1) EN61000-4-x series of tests are technically equivalent to the IEC61000-4-x series.
2) Not applicable to communication or I/O lines whose maximum installed length is less than 30m.
3) Not applicable to communication lines whose maximum installed length is less than 30m.
4) Not applicable to communication or I/O lines whose maximum installed length is less than 3m.

Government Regulations

U.S., Canadian, Australian, and European regulations are intended to prevent equipment from interfering with approved transmissions or with the operation of other equipment through the AC power source.

The PACSystems RX3i family of products has been tested and found to meet or exceed the requirements of U.S. (47 CFR 15), Canadian (ICES-003), Australian (AS/NZS 3548), and European (EN55022) regulations for Class A digital devices when installed in accordance with the guidelines noted in this manual. These various regulations share commonality in content and test levels with that of CISPR 22 and based on this commonality testing to the each individual standard was deemed inappropriate.

The FCC requires the following note to be published according to FCC guidelines:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada requires the following note to be published:

Note: This Class A digital apparatus complies with Canadian ICES-003.

Installation Guidelines for Conformance to Standards

To meet U.S., Canadian, Australian, and European regulations for Class A digital devices and maintain CE Mark compliance, RX3i installations that include the products listed below must be installed in a metal enclosure with external wiring routed in metal conduit as described in this appendix. Modules not listed below must still be installed in a protective enclosure as described in chapter 2, Installation.

Description	***Catalog Number***
RX3i 10-Slot Serial Expansion Backplane	IC694CHS392
RX3i Input 120VAC 8Pt Isolated	IC694MDL230
RX3i Input 240VAC 8Pt Isolated	IC694MDL231
RX3i Input 120VAC 16Pt	IC694MDL240
RX3i Input 24VAC 16Pt	IC694MDL241
RX3i Input 125VDC 8Pt Pos/Neg Logic	IC694MDL632
RX3i Input 5/12VDC (TTL) 32Pt Pos/Neg	IC694MDL654
Series 90-30 10-Slot Expansion Backplane	IC693CHS392
Series 90-30 Remote Baseplate, 10 Slots	IC693CHS393
Series 90-30 Remote Baseplate, 5 Slots	IC693CHS399
Series 90-30 Input 120VAC 8Pt Isolated	IC693MDL230
Series 90-30 Input 240VAC 8Pt Isolated	IC693MDL231
Series 90-30 Input 120VAC 16Pt	IC693MDL240
Series 90-30 Input 24VAC 16Pt	IC693MDL241
Series 90-30 Input 125VDC 8Pt Pos/Neg Logic	IC693MDL632
Series 90-30 Input 5/12VDC (TTL) 32Pt Pos/Neg	IC693MDL654
Series 90-30 Output 120VAC 0.5 12Pt	IC693MDL310
Series 90-30 Output 120/240VAC 2A 8Pt	IC693MDL330
Series 90-30 Output 120VAC 0.5A 16Pt	IC693MDL340
Series 90-30 Output 120/240VAC 2A 5Pt Isolated	IC693MDL390
Series 90-30 Output 12/24VDC 0.5A 8Pt Positive Logic	IC693MDL732
Series 90-30 Output 12/24VDC 0.5A 8Pt Negative Logic	IC693MDL733
Series 90-30 Output 125vdc 1A 6Pt Isolated Pos/Neg	IC693MDL734
Series 90-30 Output 5/24VDC (TTL) 0.5A 32Pt Negative Logic	IC693MDL752
Series 90-30 Solenoid Out 11Pt/24VDC Out 5Pt Positive Logic	IC693MDL760
Series 90-30 Output Relay 4A 8Pt Isolated	IC693MDL930
Series 90-30 Mixed I/O 8Pt 120VAC In / 8Pt Relay Out	IC693MAR590
Series 90-30 Mixed I/O 8Pt 24VDC In / 8Pt Relay Out	IC693MDR390
Series 90-30 Input Analog 4pt Voltage	IC693ALG220
Series 90-30 Input Analog 16sgl/8diff Current	IC693ALG223
Series 90-30 Output Analog 2pt Voltage	IC693ALG390
Series 90-30 Output Analog 2pt Current	IC693ALG391
Series 90-30 Analog Combination Current/Voltage 4in/2out	IC693ALG442
Series 90-30 Fanuc I/O Link Module (Slave)	IC693BEM320
Series 90-30 Fanuc I/O Link Module (Master)	IC693BEM321
Series 90-30 DSM314 Motion Controller	IC693DSM314

Requirements for Installation in a Metal Enclosure

- Backplanes must be mounted in a metal enclosure with a metal-on-metal connection around the door or the equivalent. All surfaces of the enclosure must be adequately grounded to adjacent surfaces to provide electrical conductivity.
- Wiring external to the enclosure must be routed in metal conduit or the equivalent. Using shielded cables and power line filtering, as detailed in “Shielded Cable Alternative to Conduit,” is equivalent to using metal conduit.
- The conduit must be mounted to the enclosure using standard procedures and hardware to ensure electrical conductivity between the enclosure and conduit. The termination for the shielded cable alternative to conduit is detailed in “Shielded Cable Alternative to Conduit.”

Shielded Cable Alternative to Conduit

This section describes the installation requirements for using shielded cable as an alternative to metal conduit for meeting radiated emissions requirements (EN 55022, 47CFR15, etc.). The following practices could be used in place of conduit for systems or cables that require conduit or the equivalent.

Communication Cables

All communication lines should be double-shielded. The outside braided shield (85% coverage) must be terminated at the entrance to the enclosure and not continue within the enclosure. The inside shield should be left intact since it shields the communication line from noise within the enclosure and is terminated to the connector shell. The RX3i communication port connector shells are directly tied to frame ground. To prevent ground loop currents, one cable end of the inside shield should be capacitively coupled to its shell. The outside shield is classified as an RF shield and should be insulated from the inside shield.

An alternative to double-shielded cable for Genius bus communications is Eupen* CMS cable, equivalent Genius cables with an RF-absorptive material outer coating. The shield should be terminated per standard Genius wiring guidelines.

*Telephone: 32 87 55 47 71 (Europe), 908-919-1100 (U.S.A.)

I/O Cables

All I/O lines leaving the enclosure must have at least 85% braided shield coverage terminated at the entrance to the enclosure. This 85% RF shield should not continue into the enclosure. Eighty-five percent braided shield is a standard cable available with various wire sizes and quantities from many cable manufacturers.

Analog/High Speed Cables

Analog or high-speed lines, which require shielded cable for immunity, should be double-shielded. The outside braided shield should be terminated at the entrance to the enclosure and not continue within the enclosure. The inside shield should be terminated per standard installation instructions. The outside shield is classified as an RF shield and should be insulated from the inside shield.

Power Input to Enclosure (for IC694 Power Supplies)

An alternative to shielded input cables is to use RF filters to minimize the noise coupled back onto the power supply inputs. If RF filters are used at the point of enclosure entry, unshielded wires may be used inside and outside the enclosure.

AC Power Input RF Filter Requirements

- Type: Common mode/Differential mode line filter
- Effective range: between 30–300 megahertz
- Leakage current: <0.8 milliampere
- Insertion loss >30 decibels @ 30 megahertz, >20 decibels @ 100 megahertz, >15 decibels @ 300 megahertz

DC Power Input RF Filter Requirements

- Type: Feed-through, π type EMI ceramic filter
- Capacitance: 1500 picofarads (minimum)
- WVDC: 100 volts
- Current rating: As needed for application
- Insertion Loss: >50 decibels at 100 megahertz

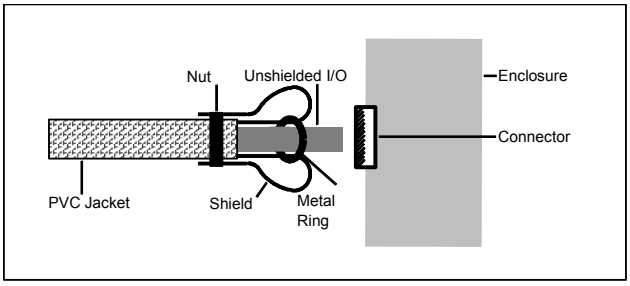
Shield Termination

Termination of RF shields is extremely important in the reduction of RF emissions. The RF shields should be terminated at the entrance to the enclosure with a 360 degree contact between the shield and the enclosure wall.

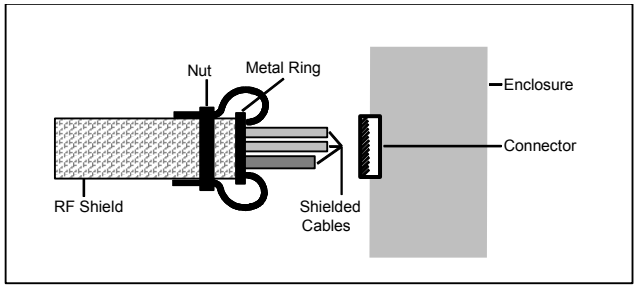
Compression Connectors

Compression connectors are standard hardware available for the termination of conduit. The diameter of the connectors is not of significant importance other than to make sure the wires can actually fit through them. The compression connector provides a metal ring for shield termination and compression.

The following figure shows an unshielded I/O cable with a single shield (side view):



The next figure shows multiple communication/high speed cables that share a single RF shield (side view):



Specialty Shielded Cable Vendors

Eupen specializes in RF-absorptive material outer coating cables (CMS cables). Ask for equivalent Genius cables.

Glenair, Inc. specializes in convoluted tubing (Series 72 & 74) and in flexible metal-core conduit (Series 75). They also carry various kinds of shield termination connectors.

Zippertubing Co. specializes in after installation zip-on shielding where different types of shielding can be selected. Recommended types of shielding are SHN-3, SH1, and SH3 to provide 85% coverage.

Safety-Related Guidelines for Installation in the European Union

This section provides safety-related guidelines specifically for control system products to be installed in the European Union. It is assumed that personnel who install, operate, and maintain automation systems that include GE Fanuc products are trained and qualified to perform those functions

1. ***General***:

   GE Fanuc product manuals provide information required for the intended use of GE Fanuc products. The product manuals are written for technically qualified personnel such as engineers, programmers, or maintenance specialists who have been specifically trained and are experienced in the field of automation control. Such personnel must possess the knowledge to correctly interpret and apply the safety guidelines provided in GE Fanuc product manuals. Should you require further information or face special problems that are not covered in sufficient detail in the product manuals, please contact your local GE Fanuc sales or service office or GE Fanuc authorized distributor.

2. ***Qualified Personnel***:

   Only qualified personnel should be allowed to specify, apply, install, operate, maintain, or perform any other function related to the products described in the product manuals. Examples of such qualified persons are defined as follows:

   - System application and design engineers who are familiar with the safety concepts of automation equipment.
   - Installation, startup, and service personnel who are trained to install and maintain such automation equipment.
   - Operating personnel trained to operate automation equipment and trained on the specific safety issues and requirements of the particular equipment.

3. ***Proper Usage***:

   The equipment/system or the system components may be used only as described in the product manuals. GE Fanuc control system products have been developed, manufactured, tested, and the documentation compiled in keeping with the relevant safety standards. Handling instructions and safety guidelines described for planning, installation, proper operation and maintenance must be followed to ensure safe application and use of the products.

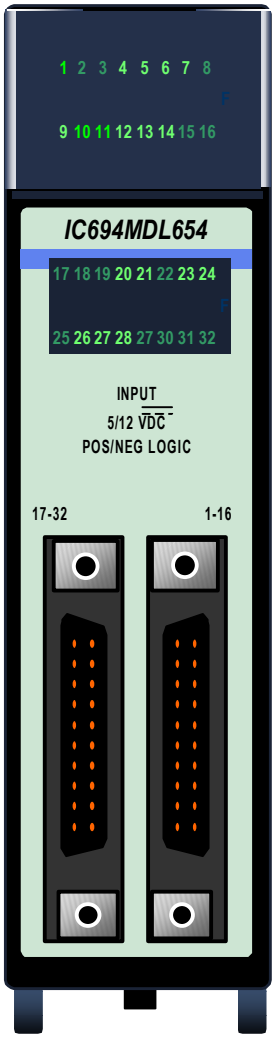
4. ***Guidelines for the Application Planning and Installation of the Product****:*

   RX3i control system products generally form part of larger systems or installations. These guidelines are intended to help integrate GE Fanuc RX3i control system products into systems and installations without constituting a source of danger. The following precautions must be followed:

- Compliance with EN292-1 and EN292-2 (Safety of Machinery) as well as EN60204/IEC204 (Electrical Equipment of Industrial Machines) must be observed during the design phase.
- Opening the housing or the protective cover exposes certain parts of this equipment/system which could have a dangerously high voltage level.
- Only qualified personnel should be allowed access to this equipment/system. These persons must be knowledgeable of potential sources of danger and maintenance measures as described in the product manuals.
- Personnel must strictly adhere to applicable safety and accident prevention rules and regulations.
- A suitable isolating switch or fuses must be provided in the building wiring system. The equipment must be connected to a protective ground (PE) conductor.
- For equipment or systems with a fixed connecting cable but no isolating switch that disconnects all poles, a power socket with the grounding pin must be installed.
- Before switching on the equipment, make sure that the voltage range setting on the equipment corresponds to the local power system voltage.
- In the case of equipment operating on 24 VDC, make sure that proper electrical isolation is provided between the main supply and the 24 VDC supply. Use only power supplies that meet EN60204 (IEC204) requirements.
- The RX3i control system AC power supply must be supplied through an IEC-rated isolation transformer.
- Power supply to the RX3i control system must be controlled not to exceed overvoltage category II per EN60204-1 (IEC204).
- Do not exceed the input specifications of the power supply. Otherwise, functional failures or dangerous conditions can occur in the electronic modules/equipment.
- Emergency shutoff devices in accordance with EN60204/IEC204 must be effective in all operating modes of the automation equipment. Resetting the emergency off device must not result in any uncontrolled or undefined restart of the equipment.
- Automation equipment and its operating elements must be installed in such a manner as to prevent unintentional operation.
- Suitable measurements must be taken to ensure that operating sequences interrupted by a voltage dip or power supply failure resume proper operation when the power supply is restored. Care must be taken to ensure that dangerous operating conditions do not occur even momentarily. If necessary, the equipment must be forced into the “emergency off” state.
- Negative Logic Input and Output Modules cannot be used.

- Cable shielding and grounding are the responsibility of the machine builder. GE Fanuc's installation instructions and guidelines must be followed.
- Install the power supply and signal cables in such a manner as to prevent inductive and capacitive interference voltages from affecting automation functions.
- When interfacing the inputs and outputs of the automation equipment, measures must be taken to prevent an undefined state from being assumed in the case of a wire break in the signal lines.

Appendix B I/O Cables for 32-Point Modules



This section describes the I/O Cables required for 32-point modules: IC694MDL654, MDL655, MDL752, and MDL753:

- Prefabricated I/O Cables: IC693CBL327/328 and IC693CBL329/330/331/332/333/334
- Terminal Block for 32-Point Modules: IC693ACC337
- Making Custom Cables

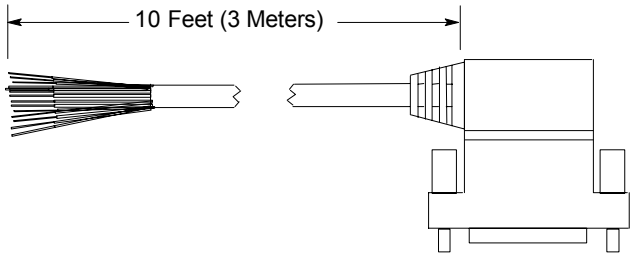
After installation, cables can be secured to the two tie-downs on the bottom of the module.

Prefabricated I/O Cables: IC693CBL327/328 and IC693CBL329/330/331/332/333/334

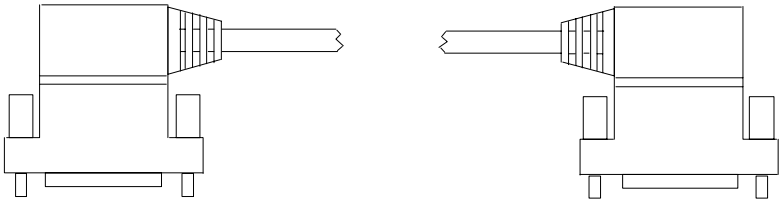
Prefabricated I/O Cables for 32-Point modules are available in several styles:

Catalog Number	Description	Length
IC693CBL327	Cable with one 24–pin, 90 deg. connector, Left Side	3.0 Meters (10 feet)
IC693CBL338	Cable with one24–pin, 90 deg. connector, Right Side	
IC693CBL329	Cable with two 24–pin, 90 deg. connectors, Left Side	1.0 Meter (39.37inches)
IC693CBL330	Cable with two 24–pin, 90 deg. connectors, Right Side	
IC693CBK002	One each: IC693CBL329 and -CBL330	
IC693CBL331	Cable with two 24–pin, 90 deg. connectors, Left Side	2.0 Meters (78.74 inches)
IC693CBL332	Cable with two 24–pin, 90 deg. connectors, Right Side	
IC693CBK003	One each: IC693CBL331 and -CBL332	
IC693CBL333	Cable with two 24–pin, 90 deg. connectors, Left Side	0.5 Meter (19.69 inches)
IC693CBL334	Cable with two 24–pin, 90 deg. connectors, Right Side	
IC693CBK004	One each: IC693CBL333 and -CBL334	

Cables –CBL327 and –CBL328 each have a right–angle 24–pin connector (Fujitsu FCN–365S024–AU) on one end and a set of stripped wire ends on the other.



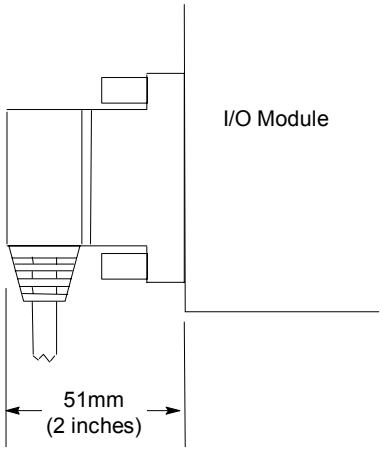
All of the other cables types have connectors (Fujitsu FCN–365S024–AU) on both ends. These cables are wired pin–to–pin (pin A1 to pin A1, pin A2 to pin A2, etc.).



Each pin on these connectors has a current rating of 1.2 Amp.

Connector Depth

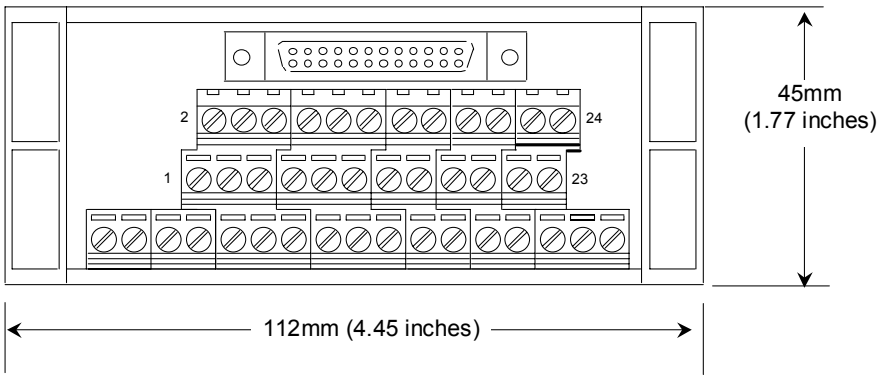
The prefabricated I/O cables extend 2” out from the face of the modules to which they are connected. The depth of the cabinet that the PLC is mounted in should allow for the 2” depth added by the connector.



Terminal Block for 32-Point Modules: IC693ACC337

Terminal Block IC693ACC337 can be used to wire field devices for 32-point discrete modules. Two Terminal Blocks are needed for each module (one per cable). They mount on a standard, user–supplied 35 mm DIN–rail.

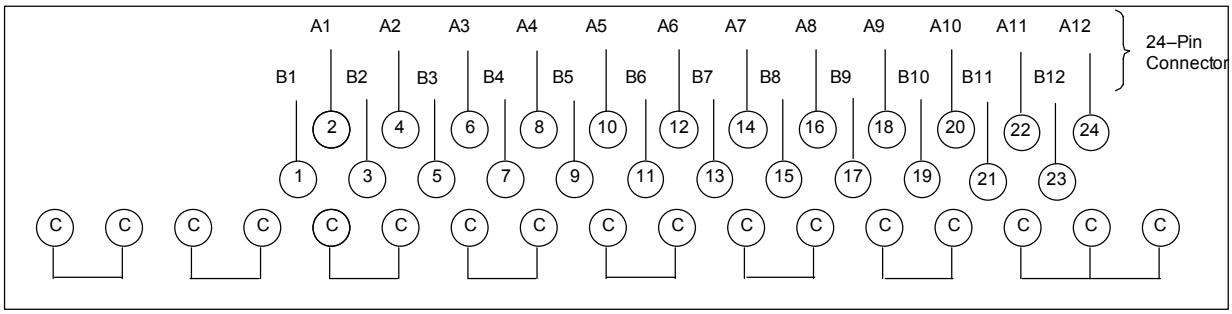
The depth of the Terminal Block, not counting the cable connector and DIN rail, is 57mm (2.12 inches).



The cable from the I/O module attaches to the connector on the Terminal Block.

Individual wires from input or output devices attach to the screw terminals. The diagram below shows how the screw terminals correspond to the connector pins.

The common row terminals (labeled with the letter C below) are provided for wiring convenience, as appropriate. They are electrically isolated from the numbered terminals.



Building Custom Length 24–pin Connector Cables

Cables connecting the 32-point module to field devices can be built to length as described below.

You must purchase the mating female (socket type) 24–pin connectors. The 24–pin connector kit can be ordered as an accessory kit from GE Fanuc. Catalog numbers for these connectors and their associated parts are listed in the following table. The list includes catalog numbers for three types of connectors: solder pin, crimp pin, and ribbon cable. *Each accessory kit contains enough components (D–connectors, backshells, contact pins, etc.*) *to assemble ten single–ended cables of the type specified for each kit.*

GE Fanuc Catalog Number	***Vendor Catalog Number***	***Description***
IC693ACC316 (Solder Eyelet Type)	FCN–361J024–AU	Solder eyelet receptacle
	FCN–360C024–B	Backshell (for above)
IC693ACC317 (Crimp Type)	FCN–363J024	Crimp wire receptacle
	FCN–363J–AU	Crimp pin (for above, 24 needed)
	FCN–360C024–B	Backshell (for above)
IC693ACC318 (Ribbon or IDC Type)	FCN–367J024–AUF	IDC (ribbon) receptacle, closed cover
	FCN–367J024–AUH	IDC (ribbon) receptacle, open cover

Additional tools from Fujitsu are required to properly assemble the crimped contact and ribbon cable type connectors. *The solder eyelet connectors (as provided in IC693ACC316) do not require any special tooling.*

Crimped Contact Connectors (as provided in IC693ACC317) require:

Hand Crimping Tool	FCN–363T–T005/H
Contact Extraction Tool	FCN–360T–T001/H

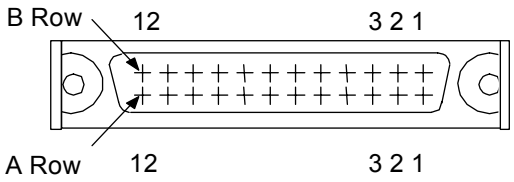
Ribbon Cable Connectors (as provided in IC693ACC318) require:

Cable Cutter	FCN–707T–T001/H
Hand Press	FCN–707T–T101/H
Locator Plate	FCN–367T–T012/H

These tools must be ordered from an authorized Fujitsu distributor.

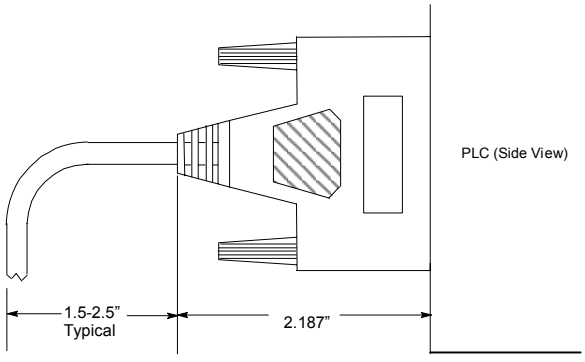
Pin connections with color codes are shown below. Cables are made of 12 twisted pairs; wire size is #24 AWG (0.22mm^2). Each pair has a solid color wire and the same color wire with a black tracer.

Pin Number	Pair #	Wire Color Code		Pin Number	Pair #	Wire Color Code
A1	1	BROWN		B1	7	VIOLET
A2	1	BROWN/BLACK		B2	7	VIOLET/BLACK
A3	2	RED		B3	8	WHITE
A4	2	RED/BLACK		B4	8	WHITE/BLACK
A5	3	ORANGE		B5	9	GRAY
A6	3	ORANGE/BLACK		B6	9	GRAY/BLACK
A7	4	YELLOW		B7	10	PINK
A8	4	YELLOW/BLACK		B8	10	PINK/BLACK
A9	5	DARK GREEN		B9	11	LIGHT BLUE
A10	5	DARK GREEN/BLACK		B10	11	LIGHT BLUE/BLACK
A11	6	DARK BLUE		B11	12	LIGHT GREEN
A12	6	DARK BLUE/BLACK		B12	12	LIGHT GREEN/BLACK



Connector Depth for Custom Built Cables

Because custom built cables use a straight connector, they require more space in front of the PLC than a prefabricated cable, which has a right–angle connector. The depth of the cabinet that the PLC is mounted in should allow for the depth added by this connector.



Appendix C Calculating Heat Dissipation

This section explains how to find the total heat dissipation of PACSystems RX3i equipment.

PACSystems RX3i equipment must be mounted in a protective enclosure. The enclosure must be able to properly dissipate the heat produced by all the devices mounted inside. This includes the modules, discrete output devices, and discrete input devices. Each device manufacturer publishes these values. If an exact value is not available for a device, you can make a close estimate by obtaining the value for a similar device.

Module Heat Dissipation

For each backplane and module except power supplies (discussed separately), look up the power in Watts from the table of Module Load Requirements in the Power Supplies chapter. If the module uses more than one voltage type (for example, 3.3V and 24V relay), find its total power requirement. Then, add together the heat dissipation values for all the modules in the enclosure.

Example:

The Load Requirements table shows that the 12-Slot Universal Backplane IC695CHS012 draws:

1.98 Watts from the 3.3 VDC supply

+1.20 Watts from the 5 VDC supply

=3.18 Watts total heat dissipation of backplane IC695CHS012

Power Supply Heat Dissipation

In general, power supplies are 66% efficient. The power supply dissipates approximately 1 Watt of power in the form of heat for every 2 Watts of power it delivers to the PLC.

After finding the total power requirement for all of the modules in the backplane served by a power supply above, divide the total by 2 to find the power supply dissipation value. Do not use the rating of the power supply (such as 30 Watts) for this calculation because the application may not use the full capacity of the power supply.

If the +24 VDC output on an Expansion Power Supply is being used, calculate the power drawn, divide the value by 2, and add it to the total for the power supply.

Heat Dissipation for Discrete Output Modules

In addition to the module power calculations done above, discrete solid-state output modules require a calculation for their output circuits, which are powered from another supply. (This calculation is not required for Relay Output modules.) To calculate output circuit power dissipation:

- In the module's specifications table, find the value for Output Voltage Drop.
- Using the manufacturer's documentation or other reference information, find the required current value for each device (such as a relay, pilot light, solenoid, etc.) connected to an output point on the module. Estimate the device's percent of "on-time" based on its intended use in the application.
- Multiply the Output Voltage Drop times the current value times the estimated percent of on-time to arrive at average power dissipation for that output.

Repeat these steps for all outputs on the module, and then for all discrete output modules in the backplane.

Example:

The specifications table for the IC694MDL340 16-Point Discrete 120 VAC Output Module lists its Output Voltage Drop as: 1.5 Volts maximum.

Use that value for all of the calculations for the module.

In this example, two output points drive solenoids that control the advance and retract travel of a hydraulic cylinder. The solenoid manufacturer's datasheet shows that each solenoid draws 1.0 Amp. The cylinder advances and retracts once every 60 seconds that the machine is cycling. It takes 6 seconds to advance and 6 seconds to retract.

Because the cylinder takes equal time to advance and retract, both solenoids are on for equal lengths of time: 6 seconds out of every 60 seconds, which is 10% of the time. Therefore, since both solenoids have equal current draws and on-times, one calculation can be applied to both outputs.

Use the formula *Average Power Dissipation = Voltage Drop x Current Draw (in Amps) x Percent (expressed as a decimal) of on-time*:

1.5 x 1.0 x 0.10 = 0.15 Watts per solenoid

Then multiply this result by 2 for two identical solenoids:

0.15 Watts x 2 Solenoids = 0.30 Watts total for the two solenoids

Also in this example, the other 14 output points on the 16-point module operate pilot lights on an operator's panel. Each pilot light requires .05 Amps of current. Seven of the pilot lights are on 100% of the time and seven are on an estimated 40%.

For the 7 lights that are on 100% of the time:

1.5 x .05 x 1.00 = 0.075 Watts per light

Then multiply this value by 7:

0.075 Watts x 7 lights = 0.525Watts total dissipation for the first 7 lights

For the 7 lights that are on 40% of the time:

1.5 x .05 x 0.40 = .03 Watts per light

Then multiply this value by 7:

0.03 Watts x 7 lights = 0.21 Watts total dissipation for the other 7 lights

Adding up the individual calculations, we get:

0.30 + 0.525 + 0.21 = 1.035 Watts for the module's total output calculation

Heat Dissipation for Discrete Input Modules

In addition to the module power calculations described above, a discrete input module requires another calculation for its input circuits, because the power dissipated by the input circuits comes from a separate power source. This calculation assumes that all input circuit power delivered to these modules is eventually dissipated as heat. The procedure is:

- In the module's specifications table find the value for Input Current.
- For DC input modules, multiply the input voltage times the current value times the estimated percent of on-time to arrive at average power dissipation for that DC input.
- For AC input modules only, multiply the input voltage times the current value times the estimated percent of on-time times 0.10 to arrive at average power dissipation for that AC input.

Repeat these steps for all inputs on the module, and then for all discrete input modules in the backplane.

Example:

The Specifications table for the IC693MDL240 16-Point Discrete 120 VAC Input Module gives the following information:

Input Current: 12 mA (*typical) at rated voltage*

Use this value for all of the input calculations for this module.

In this example, eight of the input module's points are used for switches that, for normal operation, stay on (closed) 100% of the time. These include the Emergency Stop, Over Temperature, Lube Pressure OK, and similar switches.

Use the formula *Average Power Dissipation = Input Voltage x Input Current (in Amps) x Percent (expressed as a decimal) of on-time:*

120 x .012 x 1.0 = 1.44 Watts per input

Then multiply this result by 8:

1.44 Watts x 8 inputs = 11.52 Watts total for the 8 inputs

Also in this example, two input points on this 16-point module are for the Control On and Pump Start pushbuttons. Under normal conditions, these pushbuttons are only pressed once per day for about one second – just long enough to start up the control and pump. Therefore, their effect on our power calculation is negligible:

0.0 Watts total for 2 inputs

For the remaining 6 inputs of the 16 point module, it is estimated that they will be on for an average of 20% of the time. So the following calculation is made for these 6 inputs:

Using the formula of *Average Power Dissipation = Input Voltage x Input Current (in Amps) x Percent (expressed as a decimal) of on-time:*

120 x .012 x 0.20 = 0.288 Watts per input

Then multiply this result by 6:

0.288 Watts x 6 inputs = 1.728 Watts total for the 6 inputs

Finally, addi up the individual calculations:

11.52 + 0.0 + 1.728 = 13.248 Watts for the module's total input calculation

Total Heat Dissipation

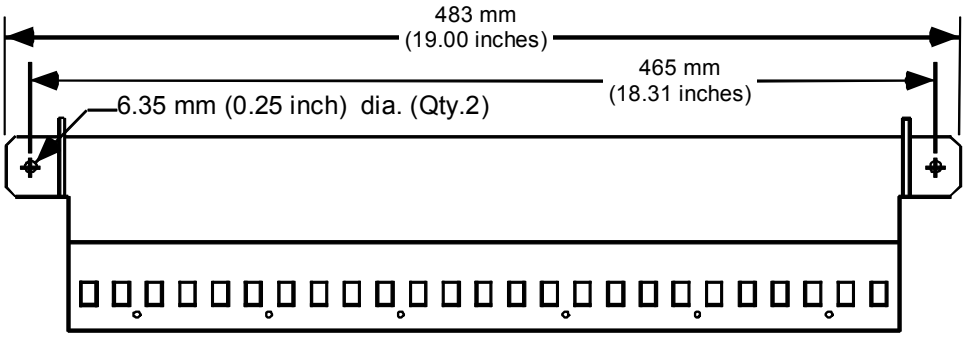
After the individual power dissipations have been calculated, add them together to obtain total PLC heat dissipation. It is usually not necessary to include analog modules because their power dissipation values are negligible when compared with the total.

Appendix D Cable Shield Clamping Assembly

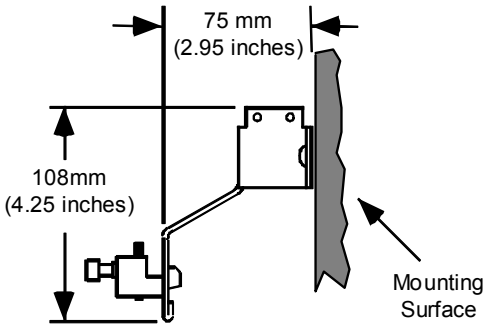
Cable Shield Clamping Assembly, IC697ACC736, contains the parts necessary for providing higher EMC immunity for shielded cables in severe industrial environments. Shield grounding is provided by the ground plate and cable clamps in the kit.

The Cable Shield Clamping Assembly package includes:

- One ground plate
- Six cable clamps
- Four #6 self-tapping screws

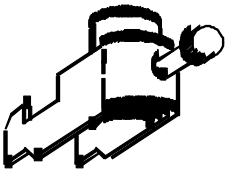


Front View with Mounting Dimensions



Side View with Spacing Requirements

Cable Clamp



(Six cable clamps included with assembly.)

* Additional cable clamps available (12 per package), catalog number IC697ACC737.

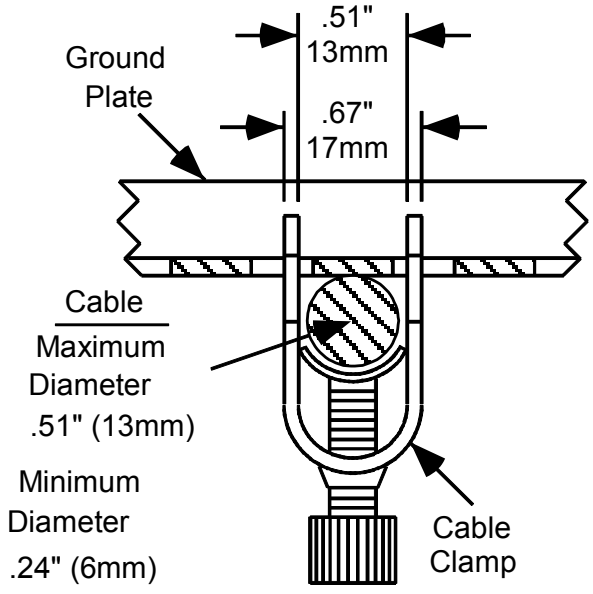
Installing the Cable Clamp Assembly

The ground plate should be mounted near the baseplate. The cable clamp provides mechanical relief as well as electrical grounding. The cable clamp attaches to the ground plate by sliding it into two adjacent slots at the selected cable location. The cable is inserted between the ground plate and the cable clamp after removing the required section of the cable's outer cover. Tighten the cable clamp by turning the thumbscrew clockwise. *Do not over-tighten the thumbscrew; hand-tighten or tighten lightly with a tool.*

If you are installing the ground plate on a painted surface, the paint must be removed where the ground plate is to be mounted to ensure a good ground connection between the plate and mounting surface.

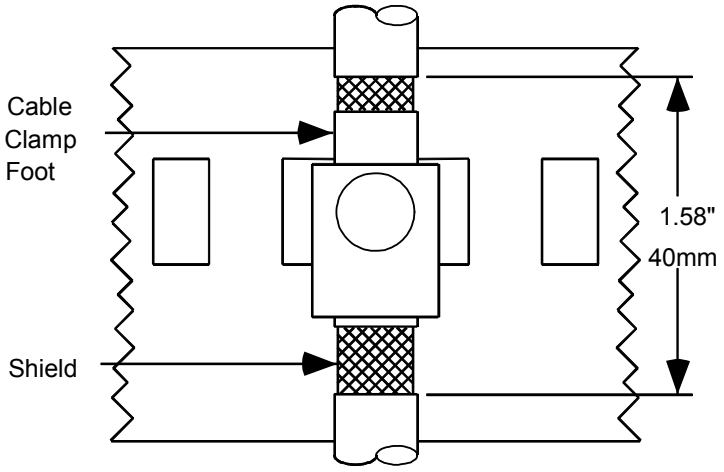
Cable Diameter

The largest diameter cable that can be used with the cable clamp is 0.51 inches (13mm). The smallest cable diameter that can be used with the clamp is 0.24 inches (6mm). Multiple cables can be placed in the clamp if the cable diameter is smaller than the minimum.



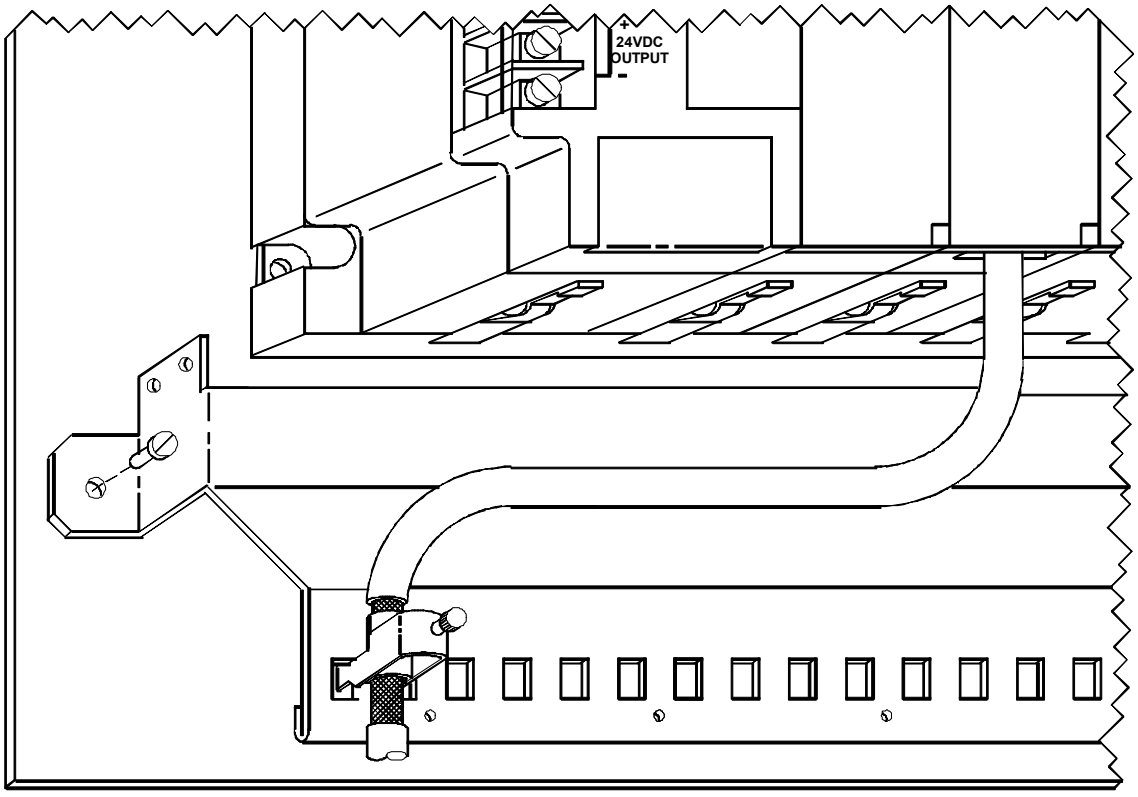
Removing the Insulating Cover

The insulating cover on the shielded cable must be removed to allow maximum contact between the cable shield and the cable clamp as shown below.



Typical Installation

A typical Cable Clamp Assembly installation with an Expansion Backplane is shown below.



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