User Manual

Allen-Bradley

FLEX I/O Diagnostic Modules

Catalog Numbers 1794-IB16D, 1794-OB16D

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

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Purpose of This Manual

This manual provides information on installation, setting, and reading your diagnostics on the 1794-IB16D and the 1794-OB16D Diagnostic modules.

For information on	See Chapter
1794 Diagnostic Modules	1
Specific Diagnostic Module	2 or 3
Using Diagnostic Modules in a Remote I/O System	4
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Important Warnings and Cautions

Obey the following warnings and cautions when installing or using these modules.

ATTENTION: Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional installation requirements pertaining to this equipment.

WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

ATTENTION: FLEX I/O is grounded through the DIN rail to chassis ground. Use zinc-plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (such as aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

ATTENTION: Prevent Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static-safe workstation.

ATTENTION: During mounting of all devices, be sure that all debris (such as metal chips or wire strands) is kept from falling into the module. Debris that falls into the module could cause damage on power-up.

North American Hazardous Location Approval

The 1794-IB16D and 1794-OB16D diagnostic modules are North American Hazardous Location approved.

The following information applies when operating this equipment in hazardous locations:		**Informations sur l'utilisation de cet équipement en environnements dangereux :**	
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.		Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.	
	**EXPLOSION HAZARD** •Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. •Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. •Substitution of components may impair suitability for Class I, Division 2. •If this product contains batteries, they must only be changed in an area known to be nonhazardous.		**RISQUE D'EXPLOSION** •Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. •Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. •La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. •S'assurer que l'environnement est classé non dangereux avant de changer les piles.

Related Products and Documentation

For additional information on FLEX™ I/O systems and modules, refer to the following documents:

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1794		1794 FLEX I/O Selection Guide	1794–SG002	
1794–ACN	24V DC	ControlNet Adapter	1794–IN101	
1794-AENT		EtherNet/IP Adapter	1794-IN082	ENET-UM001
1794–ACNR	24V DC	Redundant Media ControlNet Adapter	1794–IN101	
1794–ACN15	24V DC	ControlNet Adapter	1794-IN101	CNET-UM001
1794–ACNR15	24V DC	Redundant Media ControlNet Adapter		CNET-UM001
1794–ADN	24V DC	DeviceNet Adapter	1794-IN099	1794–6.5.5
1794–ASB/E	24V DC	Remote I/O Adapter	1794–IN098	1794–UM009
1794–ASB2/D	24V DC	2–Slot Remote I/O Adapter		1794–UM059
1794–APB	24V DC	PROFIBUS Adapter	1794-IN087	1794–UM057
1794–IB8	24V DC	8 Sink Input Module	1794-IN093	
1794–IB16	24V DC	16 Sink Input Module		
1794–IB32	24V DC	32 Sink Input Module		
1794–IV16	24V DC	16 Source Input Module	1794-IN095	
1794–OV16	24V DC	16 Sink Output Module		
1794–OV16P	24V DC	16 Protected Sink Output Module		
1794–OB8	24V DC	8 Source Output Module	1794-IN094	
1794–OB8EP	24V DC	8 Electronically Fused Output Module		
1794–OB16	24V DC	16 Source Output Module		
1794–OB16P	24V DC	16 Protected Source Output Module		
1794–OB32P	24V DC	32 Protected Source Output Module		
1794–IB10XOB6	24V DC	10 Input/6 Output Module	1794-IN083	
1794–IB16XOB16P	24V DC	16 Input/16 Output Module		
1794–OW8	24V DC	8 Relay Output Module	1794-IN019	
1794–IE8	24V DC	Analog 8 Input Module	1794-IN100	1794–6.5.2
1794–OE4	24V DC	Analog 4 Output Module		
1794–IE4XOE2	24V DC	4 Input/2 Output Analog Module		
1794–OF4I	24V DC	4 Output Isolated Analog Module	1794-IN037	1794–6.5.8
1794–IF4I	24V DC	4 Input Isolated Analog Module	1794-IN038	
1794–IF2XOF2I	24V DC	2 Input/2 Output Isolated Analog Module	1794-IN039	

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1794-IE12	24V DC	12 Input Analog Module	1794-IN106	
1794-OE12	24V DC	12 Output Analog Module		
1794-IE8XOE4	24V DC	8 Input/4 Output Analog Module		
1794-IE8H	24V DC	8 HART Input Module	1794-IN108	1794-UM063
1794-OE8H	24V DC	8 HART Output Module	1794-IN109	
1794–IR8	24V DC	8 RTD Input Analog Module	1794-IN021	1794–6.5.4
1794–IT8	24V DC	8 Thermocouple Input Module		1794–6.5.7
1794–IRT8	24V DC	8 Thermocouple/RTD Input Module	1794-IN050	1794–6.5.12
1794–IJ2	24V DC	2 Channel Frequency Input Module	1794-IN049	1794–6.5.11
1794–ID2	24V DC	2 Channel Frequency Input Module	1794-IN063	1794–6.5.15
1794–IP4	24V DC	2 Channel Pulse Counter Module	1794-IN064	1794–6.5.16
1794–VHSC	24V DC	Very High Speed Counter Module	1794IN067	1794–6.5.10
1794–IC16	48V DC	16 Sink Input Module	1794-IN105	
1794–OC16	48V DC	16 Source Output Module		
1794–IA8	120V AC	8 Input Module	1794-IN102	
1794–IA8I	120V AC	Isolated 8 Input Module		
1794–IA16	120V AC	16 Input Module		
1794–OA8	120V AC	8 Output Module	1794-IN103	
1794–OA8I	120V AC	Isolated 8 Output Module		
1794–OA16	120V AC	16 Output Module		
1794–IM8	220V AC	8 Input Module	1794-IN104	
1794–OM8	220V AC	8 Output Module		

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1794–TB2		Cage Clamp Terminal Base	1794-IN092	
1794–TB3		Cage Clamp Terminal Base		
1794–TB3S		Spring Clamp Terminal Base Unit		
1794–TB3T		Temperature Terminal Base Unit		
1794–TB3TS		Spring Clamp Temperature Base Unit		
1794–TB3G		Terminal Base Unit		
1794–TB3GS		Spring Clamp Terminal Base Unit		
1794–TB32		Cage Clamp Terminal Base Unit		
1794–TB32S		Spring Clamp Terminal Base Unit		
1794–TBN		Terminal Base Unit		
1794–TBNF		Fused Terminal Base Unit		
1794-TB3GK		Conformally Coated Terminal Base Unit		
1794-TB3K		Conformally Coated Terminal Base Unit		
1794-TBNFK		Conformally Coated Fused Terminal Base Unit		
1794-TB37DS, -TB62DS, TB37EXD4VM8, -TB37EXD4CM8, -TB62EXD4X15		D-Shell Terminal Base Units and Distribution Boards	1794-IN107	
1794–CE1, –CE3		Extender Cables	1794–5.12	
1794–NM1		Mounting Kit	1794–5.13	
1794–PS13	24V DC	Power Supply	1794-IN069	
1794–PS3	24V DC	Power Supply		
FLEX Ex				
1797–IBN16	See note	16 NAMUR Digital Input Module	1797-5.7	
1797–OB4D	See note	4 NI, Ex Source Digital Output Module	1797-5.6	
1797–IE8, -IE8H	See note	8 Input Module	1797-5.5	
1797–IE8NF	See note	8 Selectable Filter Analog Input Module	1797-5.31	
1797–OE8, -OE8H	See note	Analog 8 Output Module	1797-5.3	
1797–IRT8	See note	8 Thermocouple/RTD Input Module	1797-5.4	
1797–IJ2	See note	2 Channel Frequency Input Module	1797-5.9	
1797–TB3 1797–TB3S		Cage Clamp Terminal Base Spring Clamp Terminal Base	1797-5.1 1797-5.2	

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1797–BIC	See note	I.S. Bus Isolator	1797-5.13	
1797–CEC	See note	FLEX Ex Bus Connector	1797-5.13	
Note: Intrinsically Safe Voltage				

For more information on DeviceNet® modules in Logix 5000™ systems, see DeviceNet Network Configuration User Manual, publication DNET-UM004.

For more information on ControlNet® modules in Logix 5000 systems, see ControlNet Network Configuration User Manual, publication CNET-UM001.

For more information on EtherNet/IP™ modules in Logix 5000 systems, see EtherNet/IP Network Devices User Manual, publication ENET-UM006.

Notes:

1794 FLEX I/O Diagnostic Digital Modules Overview

Introduction

In this chapter, you will learn about the diagnostic input module, cat. no. 1794-IB16D, and the diagnostic output module, cat. no. 1794-OB16D.

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Install Your Digital Input or Output Module	18

General Description

This chapter contains an overview of the FLEX™ I/O diagnostic digital modules, the 1794-IB16D input module and 1794-OB16D output module. You can use the FLEX I/O diagnostic modules to help diagnose problems with input and output field devices, I/O wiring and the user power supply. Additionally, these modules can reduce installation startup time and help minimize time to find and fix failures.

This chapter explains how to use the FLEX I/O diagnostic modules to help detect the following types of faults:

- Open input or output field devices
- Open input or output wiring
- Shorted output field devices
- Shorted input or output wiring
- Reversed polarity of user supply wiring
- Open user supply wiring or failed user supply (using one diagnostic input channel)

Network Compatibility

You can use the diagnostic modules with ControlNet, DeviceNet, EtherNet/IP, or remote I/O networks.

Network	Usage Limitations	
	1794-IB16D	**1794-OB16D**
Remote I/O	Compatible with 1794-ASB series E (or higher) and 1794-ASB2 series D (or higher) remote I/O adapters.	Compatible with 1794-ASB series D (or higher) and 1794-ASB2 series C (or higher) remote I/O adapters.
DeviceNet	No limitations or constraints.	
ControlNet	Direct connection only.	Direct or rack connections.
EtherNet/IP	Direct connection only.	Direct or rack connections.

1794-IB16D Diagnostic Input Module Compatibility

The 1794-IB16D diagnostic input module interfaces to sensing devices and detects whether they are on or off. The diagnostic input module converts DC signals from user devices to the appropriate logic level for use in the FLEX I/O system. Typical input devices include these types of switches.

- Proximity switches
- Limit switches
- Photoelectric switches
- Selector switches
- Float switches
- Push button switches

When designing a system using a FLEX I/O diagnostic input module, you must consider:

- the voltage necessary for your application.
- current leakage through the input devices.
- the amount of current consumed by the input devices.
- whether the application requires sinking or sourcing devices.

Capabilities of the 1794-IB16D include:

- 61131-2 Type 3 compatible sinking inputs.
- interface with PNP sourcing sensors.
- 10...31.2V DC operating range.
- provides up to 50 mA to power an attached sensor.
- detects for an open wire condition down to 50 µA.

You need a dummy resistor to mask the channel diagnostic function for each unused sensor port. Used sensor ports must have a 50 µA minimum current draw with the input field device in both the on- and off-state.

1794-OB16D Diagnostic Output Module Compatibility

You can use FLEX I/O diagnostic output modules to drive various output devices. Typical output devices include the following.

- Relays
- Solenoids
- Contactors
- Indicators
- Small motor starters

When you design a system using FLEX I/O diagnostic output modules, you must consider:

- The output must supply the necessary surge and continuous current for the output device being used.
- When sizing output loads, check the documentation that is supplied with the output device for the surge and continuous current needed to operate the device.

Capabilities of the 1794-OB16D diagnostic output module include:

- sourcing style outputs for loads that are connected to common.
- 10...31.2V DC operating range.
- provides continuous current of 0.5 A maximum (8 A per module), 2.0 mA minimum per output.
- capable of 2 A surge for 50 ms, repeatable every 2 s.
- protection from short circuit and overload.

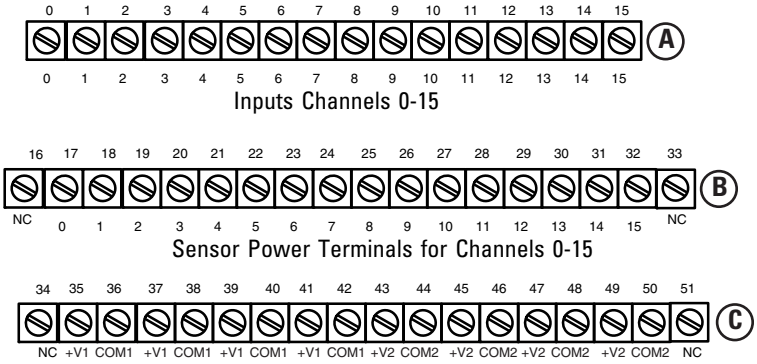
You need a dummy resistor to mask the channel diagnostic function for each unused output channel.

Install Your Digital Input or Output Module

To install a digital diagnostic module, follow these steps:

✓	Installation Step
❑ **1**.	Mount the terminal base unit See installation instructions 1794-IN096.
❑ **2.**	Install the module in the terminal base unit See installation instructions 1794-IN096.
❑ **3.**	Connect the wiring to the terminal base unit See installation instructions 1794-IN096.

1794-TB32 and 1794-TB32S Terminal Base Wiring for the 1794-IB16D

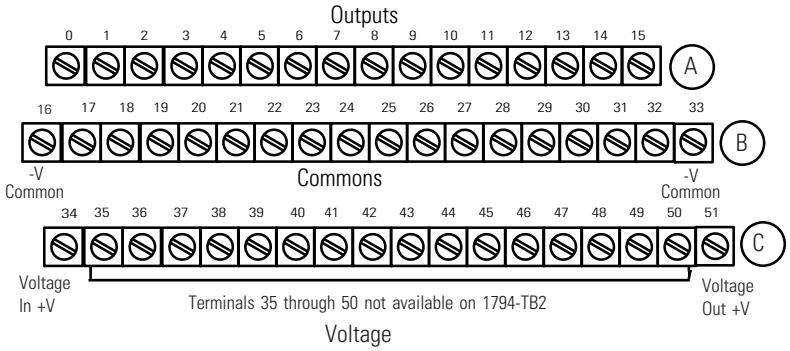


Wiring for 1794-IB16D (use with 1794-TB32 or 1794-TB32S Terminal Base Units)

Input	Input Terminal	Sensor Power Terminal	Common[1]	Supply
IN 00	A-0	B-17	-V common connected to terminals 36, 38, 40, 42, 44, 46, 48, and 50	+V2 connected to terminals 43, 45, 47, and 49 (+V1 terminals 35, 37, 39, and 41 are not used).
IN 01	A-1	B-18		
IN 02	A-2	B-19		
IN 03	A-3	B-20		
IN 04	A-4	B-21		
IN 05	A-5	B-22		
IN 06	A-6	B-23		
IN 07	A-7	B-24		
IN 08	A-8	B-25		
IN 09	A-9	B-26		
IN 10	A-10	B-27		
IN 11	A-11	B-28		
IN 12	A-12	B-29		
IN 13	A-13	B-30		
IN 14	A-14	B-31		
IN 15	A-15	B-32		
+V2 DC power	Power terminals 43, 45, 47, and 49 (power terminals are internally connected together in the module)			
COM DC Return	Common terminals 36, 38, 40, 42, 44, 46, 48, and 50 (common terminals COM 1 and COM 2 are internally connected together in the module)			

(1)3-wire devices only. 2-wire devices use input and sensor power terminals; 3-wire devices use input, sensor power and common terminals.

1794-TB2, -TB3, and -TB3S Terminal Base Wiring for the 1794-OB16D



-V (Supply Common) = Terminals B-16 through B-33.
+V (Supply +Voltage In) = Terminals C-34 through C-51.
(Use B-33 and C-51 for daisy-chaining to next terminal base unit.)

(1794-TB3 shown)

Wiring Connections for the 1794-OB16D (use with 1794-TB2, 1794-TB3, or 1794-TB3S Terminal Base Units).

Outputs	Output Terminal	Common Terminal
Output 00	A-0	B-17
Output 01	A-1	B-18
Output 02	A-2	B-19
Output 03	A-3	B-20
Output 04	A-4	B-21
Output 05	A-5	B-22
Output 06	A-6	B-23
Output 07	A-7	B-24
Output 08	A-8	B-25
Output 09	A-9	B-26
Output 10	A-10	B-27
Output 11	A-11	B-28
Output 12	A-12	B-29
Output 13	A-13	B-30
Output 14	A-14	B-31
Output 15	A-15	B-32
+V DC	C-34 and C-51 (1794-TB2) (Power Terminals are internally connected in the terminal base unit. C-34…C-51 (1794-TB3, 1794-TB3S) (Power terminals are internally connected in the terminal base unit.	
Common	B-16…B-33 (Common terminals are internally connected in the terminal base unit.	

About the FLEX I/O Diagnostic Input Module

Introduction

In this chapter, you will learn about the diagnostic input module, cat. no. 1794-IB16D.

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About the 1794-IB16D Diagnostic Input Module

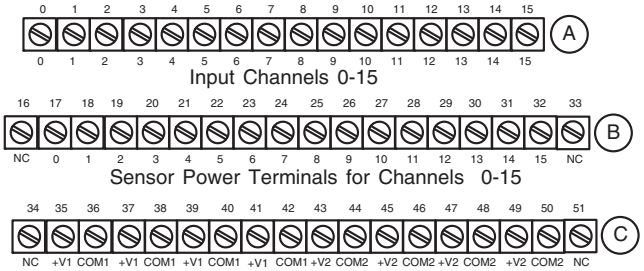
The 1794-IB16D diagnostic input module provides 16 points of 24V DC sinking inputs with open-wire, short-circuit, and user supply reverse polarity diagnostic features. Each input signal has an associated sensor power connection. The module monitors current and voltage at each input channel sensor power terminal.

The module detects:

- an open fault if the sensor-power current drops.
- a short fault if the sensor-power voltage goes low.
- a reverse-polarity fault if reverse voltage is applied to the user terminals.

Wiring Input Sensors

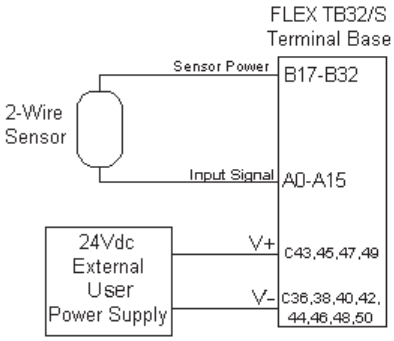
You must use a 1794-TB32 or 1794-TB32S terminal base unit with the 1794-IB16D diagnostic input module. See FLEX I/O Digital Input and Output Modules with Diagnostics Installation Instructions, publication 1794-IN096 for complete information.

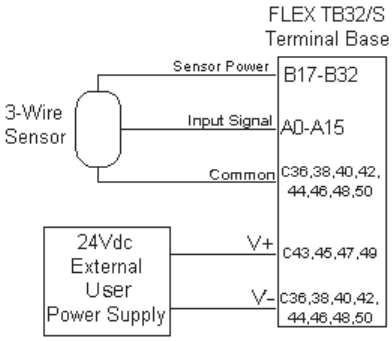


Sensor Common and User Power Common:
Terminals C-36, C-38, C-40, C-42, C-44, C-46, C-48 and C-50.
+V1 Terminals C-35, C-37, C-39 and C-41 are not used

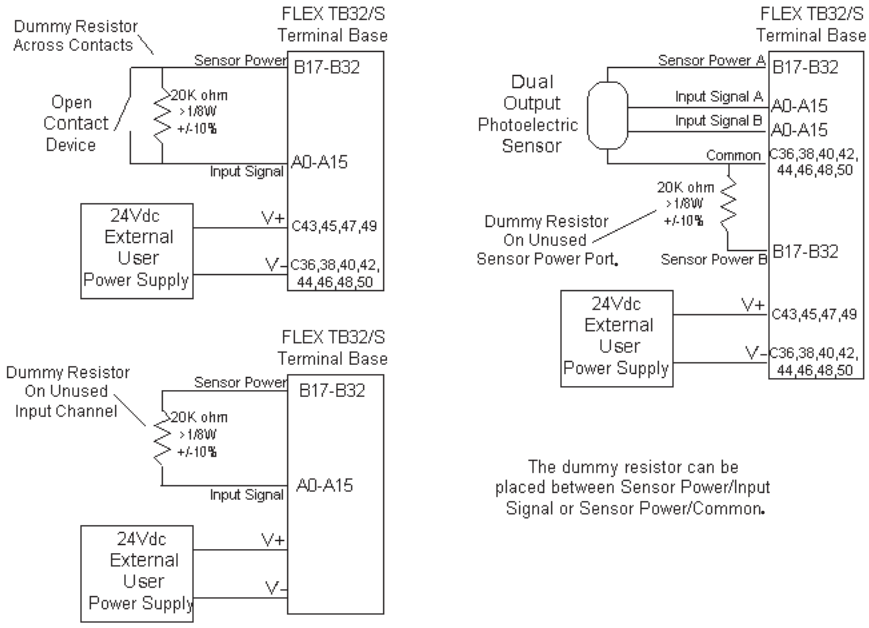
User power (+) Voltage: Terminals C-43, C-45, C-47 and C-49
COM1 and COM2 are connected together in the module.

Two-wire input devices connect to the input and sensor power terminals; 3-wire devices use input, sensor power, and common terminals. You can wire 2-wire and 3-wire sensors to the FLEX I/O 1794-TB32 or 1794-TB32S terminal base units.



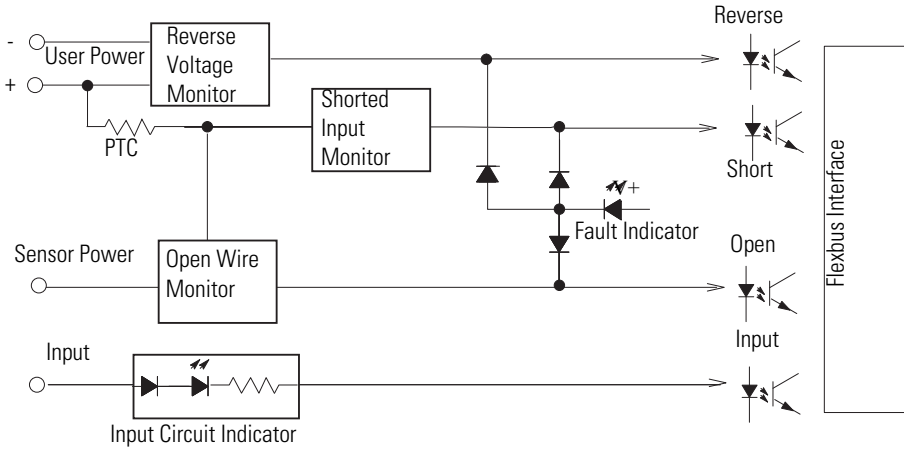


Unused sensor-power ports or open-contact input devices must use a dummy resistor to mask the diagnostic function. If these external resistors are not used, the module's fault indicator will light, along with the module's error bits, thus rendering fault detection of the remaining channels useless. The recommended value of this dummy resistor is 20 kΩ (±10%), 1/8 watt (or larger). Connect the resistor between sensor power and input signal or between sensor power and common.



Diagnostic Fault Detection

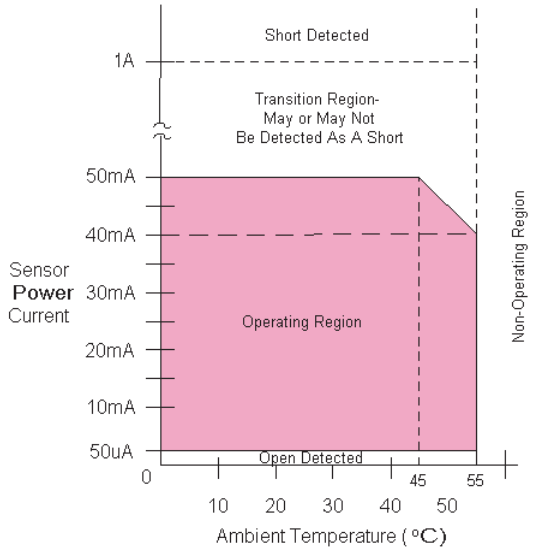
The module monitors current and voltage at each input channel sensor power terminal, and monitors the user supply for reverse user supply voltage. The figure below shows the location of these fault monitors in the 1794-IB16D diagnostic input module.



Sensor Power Open and Short Circuit Detection

The sensor-power open-wire current monitor detects a fault condition if the sensor-power current drops below 50 µA. Sensor-power shorts are protected by the positive temperature coefficient (PTC) resistor in series with each sensor power output (16 total). For overcurrents or shorts, the PTC resistor heats up, the resistance increases and the sensor power output opens, similar to a fuse opening. This shorted condition is monitored by the sensor power voltage monitor. It detects a short if the sensor power voltage disappears. When the short is removed, the PTC resistor cools down and the previously shorted sensor-power port, sensor power is automatically restored and normal operation continues.

The module's embedded monitors detect open and short conditions.



When a fault is detected:

- the corresponding channel's red indicator lights.
- the module's red fault indicator lights.
- the module's open, short, or reverse error bit is set.
- the module error bit is set.

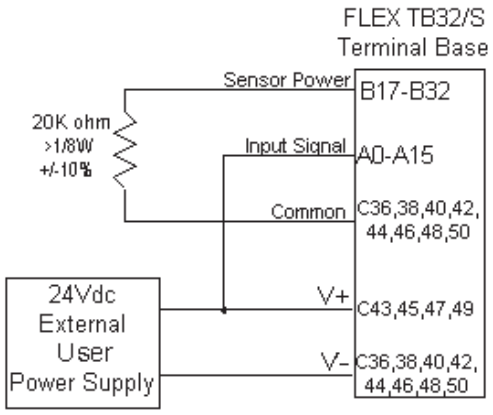
The input circuit is a conventional sinking style with an input voltage dropping resistor. The yellow input indicator is in series with the input signal (field-side indication). FLEX I/O system-side logic voltages are isolated from the user power supply and input channels by optocouplers. This provides protection against field side voltages and transients.

User Power Supply Reverse Voltage Detection

If the external user power supply is miswired (incorrect polarity), the module is protected and reports a reverse user voltage fault. The reverse voltage condition must be at least -10V to detect a fault. The module's Fault indicator turns red and the reverse fault bit is set. The module error bit is also set. When the correct user power supply polarity is applied, the module Fault indicator is off and the reverse fault bit is not set.

User Power Supply Loss Detection

The module does not check for presence of the external user power supply. Detection can be accomplished by wiring an input channel to the user supply. Any 24V DC input can be used. You can wire a 1794-IB16D diagnostic input module or 1794-IB16 input module to monitor the user supply as shown below:



(1794-IB16D shown)

Indicator Status Information

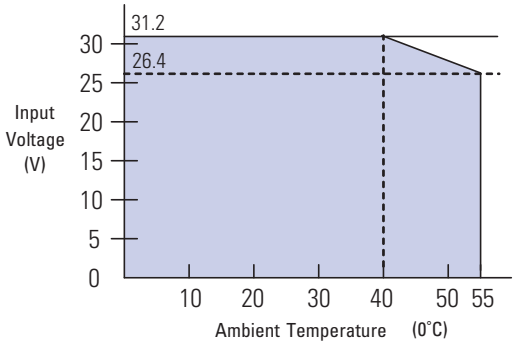
The 1794-IB16D diagnostic input module has indicators that let you check the module health and operational status. The following status can be checked with the indicators.

- Channel I/O Status - This indicator displays the ON/OFF state of the input channel, and channel wiring fault conditions:
  - Off indicates that the input channel is off with no faults.
  - Yellow indicates that the input channel is on with no faults.
  - Red indicates either a channel sensor power open or short condition.
- Module Fault Status- This indictor turns red for any individual input channel open, short, or module reverse power conditions.
  With no fault, the module fault status indicator turns off.

Module Limitations

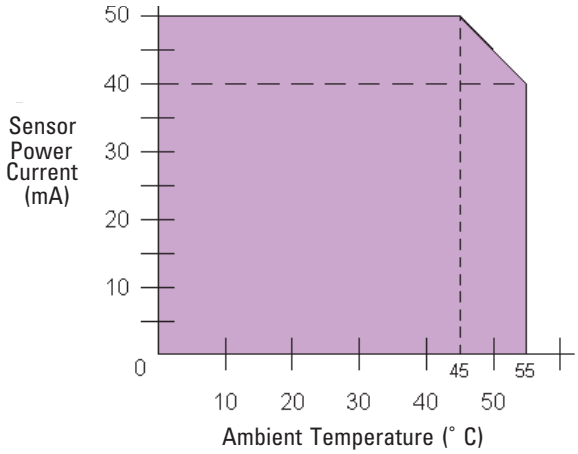
Input Voltage Derating

You must derate the input voltage that is applied to each input channel, based on operating ambient temperature, to keep module power dissipation within an acceptable level.



Sensor-Power Derating

You must derate the allowable current from each channel sensor-power port based on operating ambient temperature to keep module power dissipation to an acceptable level.



Unused Sensor Power Ports

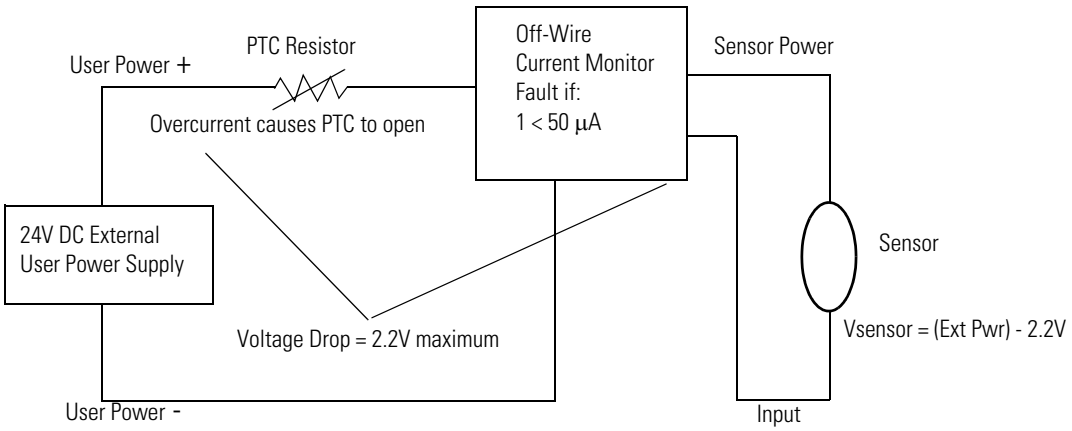
You must connect dummy resistors to unused Sensor Power ports to mask the diagnostic function. If external resistors are not used, the module's sensing circuitry will not detect the intended voltage or current and not report that a fault exists. The module's fault and open-channel indicators light, and the module's open and module error bits are set, thus rendering fault detection of the remaining channels useless. The recommended value of this dummy resistor is 20 kΩ (±10%), 1/8 W (or larger).

Open Contact Mechanical Switches and Relays

The module's sensing circuitry must detect a minimum current level to conclude that an open circuit **does not** exist. Electronic input field devices typically have sufficient leakage current to satisfy the minimum requirement. However, hard contacts have no leakage current, so you must add dummy resistors in parallel to the hard contacts to supply the minimum current that is needed for the module to sense that an open circuit **does not** exist. The recommended resistor value is 20 kΩ (±10%), 1/8 W (or larger). Placement of the dummy resistor at the field device also allows for monitoring of field wiring conditions. Connect the resistor between sensor power and input signal, or between sensor power and common.

Sensor Power Internal Voltage Drop

The modules sensor power circuit exhibits an internal voltage drop. This voltage drop can be as large as 2.2V for all operating conditions. You must subtract 2.2V from the value of your external user power supply to determine the voltage that is applied to power attached sensors. Make sure that this voltage meets sensor requirements. Consult the data sheet for your sensor to determine what voltage is necessary.



Configure Your Diagnostic Input Module

The configuration and input filter selection table are shown below.

Data Table & Input Filter Time Selection

Dec.	**15**	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Oct.	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read 1	I 15	I 14	I 13	I 12	I 11	I 10	I 9	I 8	I 7	I 6	I 5	I 4	I 3	I 2	I 1	I 0
Read 2	Not used												Read Diagnostics Status			
Write 1	Not used					Input Filter FT 0…15			Not used							
Where:	I = Input FT = Input filter time Diagnostic status; Bit 00 = module error; Bit 01 = external power reverse polarity error; Bit 02 = sensor power short error; Bit 03 = sensor power open wire error															

The inputs are read in Word 1. Bit 00 is the first input and decimal bit 15 is the last input.

Diagnostic status is read from Word 2:

Bit 00: Module Error Bit
Bit 01: External Power Reverse Polarity Error Bit
Bit 02: Sensor Power Short Error Bit
Bit 03: Sensor Power Open Wire Error Bit

Input Filter Times

Input filter times are configurable on a module basis. Both off-to-on and on-to-off times are set by write Word 3. The default filter time is 0.25 ms.

Bits			**Description**	**Filter Time**
10	**09**	**08**	**Filter time for inputs 0 thru 15**	**Off-to-On/ On-to-Off**
0	0	0	Filter time 0 (default)	0.25 ms
0	0	1	Filter time 1	0.5 ms
0	1	0	Filter time 2	1 ms
0	1	1	Filter time 3	2 ms
1	0	0	Filter time 4	4 ms
1	0	1	Filter time 5	8 ms
1	1	0	Filter time 6	16 ms
1	1	1	Filter time 7	32 ms

About the FLEX I/O Diagnostic Output Module

Introduction

In this chapter, you will learn about the diagnostic output module, cat. no. 1794-OB16D.

For Information About	See Page
About the 1794-OB16D Diagnostic Output Module	29
Diagnostic Fault Detection	31
Module Protection Functions	32
Module Limitations	34
Configure Your Output Diagnostic Module	34

About the 1794-OB16D Diagnostic Output Module

The 1794-OB16D diagnostic output module provides 16 24V DC sourcing outputs with open-wire, short-circuit, and user supply reverse polarity diagnostic features. The module monitors current and voltage at each output channel.

The module detects:

- an open fault if no current is present at the output terminal.
- a short fault if no voltage is present at the output terminal.
- a reverse-polarity fault if reverse voltage is applied.

When an open or short fault is detected:

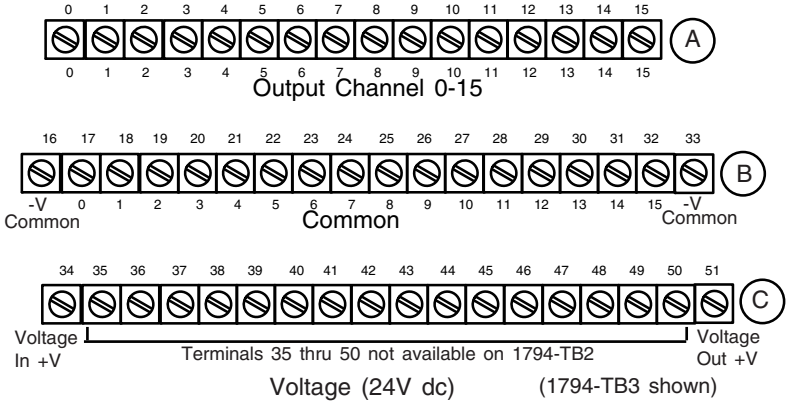
- the corresponding channels red indicator is illuminated.
- the module's red fault indicator is illuminated.
- the module's open or short error bit is set.
- the module error bit is set.

When a user supply reverse-polarity fault is detected:

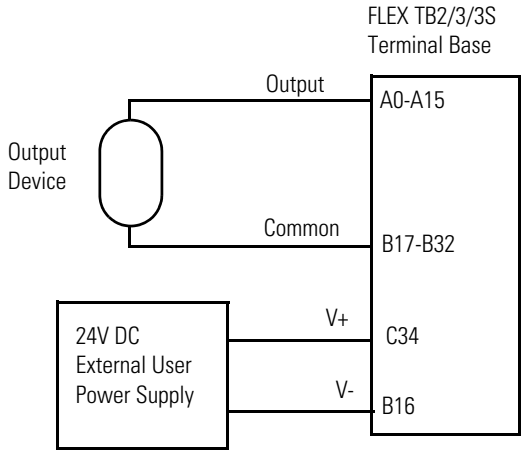
- the modules red fault indicator is turned on,
- and the reverse error bit is set.
- the module error bit is set.

Wiring Output Loads

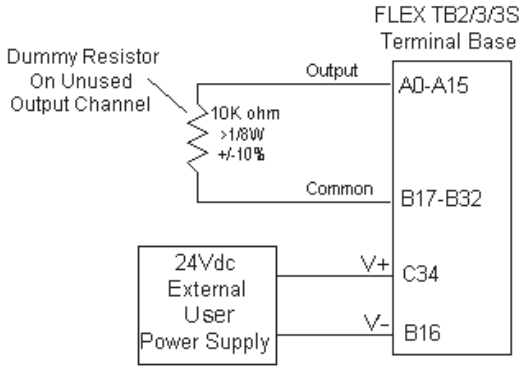
You can use the 1794-OB16D diagnostic module with the 1794-TB2, 1794-TB3, or 1794-TB3S terminal base units.



User power can be wired to the (+) voltage and common terminals directly, or power can be daisy chained from the FLEX I/O terminal base units on the DIN rail. Output channels are not isolated from one another. All 16 channels share a common return (group isolation from FLEX I/O system-side logic voltages).

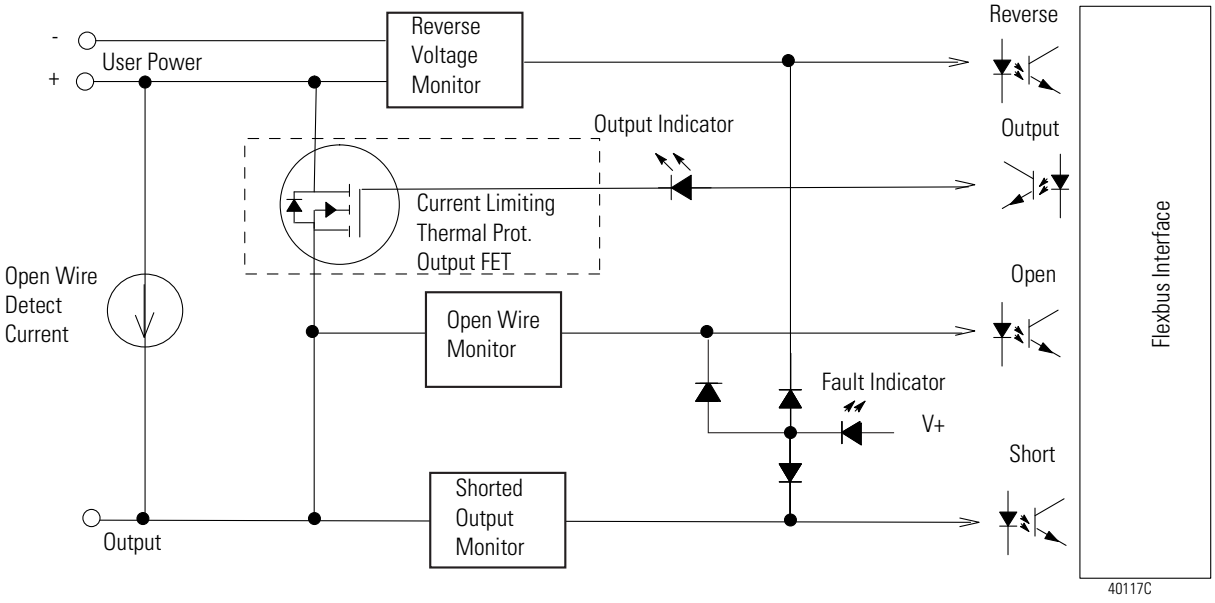


You must connect dummy resistors to unused sensor power ports to mask the diagnostic function. If these external resistors are not used, the module's sensing circuitry will not detect the intended voltage or current and signal a module fault. The channel fault indicator and the module's fault indicator will light, and the module's open and error bits are set, thus rendering fault detection of the remaining channels useless. The recommended value of this dummy resistor is 10 kΩ (±10%), 1/8 W (or larger). The resistor is wired between unused output channels and common. The figure depicts wiring of a dummy resistor.



Diagnostic Fault Detection

The module monitors current and voltage at each output channel terminal, and monitors the user supply for reverse supply voltage. The figure below shows the location of these fault monitors within the 1794-OB16D diagnostic output module.



The output open-wire current monitor detects a fault condition if the output OFF-state current drops below 0.1 mA. Output channel shorts are protected by a current limit and over-temperature thermal sensor that is built into the output device. For overcurrents, the output device's internal current limit is tripped and the output voltage begins to collapse.

For a sustained overcurrent or direct output short the output device's thermal limit is tripped and the output is automatically turned off. This shorted condition is monitored by the on-state output channel short monitor. It detects a short if the output voltage drops below 2V. If the on-state output channel short is removed, the output will automatically recover and voltage will appear at the output, thus driving the attached load on.

ATTENTION: A shorted output channel turns off and de-energizes a connected load. Following removal of the short the output channel becomes active and will reenergize a connected load. Be careful for unexpected machine operation following removal of an active output channel short.

Optocouplers isolate FLEX I/O system-side logic voltages from the user power supply and output channels. This provides protection against field-side voltages and transients.

Module Protection Functions

The module protection functions consist of output device short protection, external power supply reverse voltage protection, and power supply loss detection

Output Device Short Protection

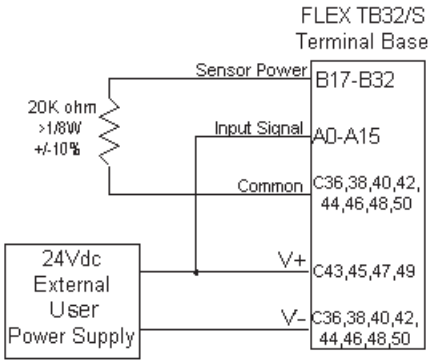
Diagnostic digital outputs have internal electronics to prevent too much current from flowing through the module. This feature protects the module, attached wiring, and load from damage. Current limit and over-temperature thermal sensor that is built into the output device protect against output shorts. For an overcurrent, the output device's internal current limit trips and output voltage collapses. The output device's thermal limit is tripped and the output is automatically turned off if an output short circuit is detected. This shorted condition is monitored by the on-state output channel short monitor. It will detect a short if the output voltage drops below 2V. Under shorted conditions, the shorted channels indicator turns red, the module fault indicator turns red and the short fault bit and module error bit are set. If the on-state output channel short is removed, the output automatically recovers and voltage appears at the output, thus driving the attached load on.

External Power Supply Reverse Voltage

If the external user power supply polarity is incorrect, the module is protected and reports a reverse user voltage fault. The reverse voltage condition must be at least -10V to detect a fault. The modules fault indicator turns red and the reverse fault bit is set. The module error bit is also set. When the correct user power supply polarity is applied, the module Fault indicator is off and the reverse fault bit is not set.

User Power Supply Loss Detection

The module does not check for presence of the external user power supply. You can detect user power loss by wiring any spare 24V DC input on a 1794-IB16D input module or 1794-IB16 input module to the power leads of the power supply for the 1794-OB16D.



(1794-IB16D shown)

Output Fault and Idle States With Network Communication Failure

Configure module outputs for fault states, (either all on, all off or Hold Last State), in the event of a network communication failure (fault state) or switchover to Program mode (idle state). For example, if your module is configured so that the state of the outputs turns off during Program (idle) mode, any on-state outputs will turn off when in idle mode (processor keyswitch placed in Program mode). See documentation for your FLEX I/O adapter and associated processor or controller for further information.

Indicator Status Information

The 1794-OB16D diagnostic output module has status indicators that allow you to check the module health and operational status.

- Channel I/O Status- This indicator displays the on/off state of each output channel, and channel wiring fault conditions:
  - Off indicates that the output channel is off with no faults.
  - Yellow indicates that the output channel is on with no faults.
  - Red indicates either an output channel open or short condition.
- Module Fault Status- This indictor turns red for individual output channel opens, shorts, or module reverse power conditions.

  With no fault, the module fault indicator turns off.

Module Limitations

Unused Output Channels

You must connect dummy resistors to unused output channels to mask the diagnostic function. If these external resistors are not used, the module's sensing circuitry will not detect the intended voltage or current and signal a module fault. The channel fault indicator and the module's fault indicator will light. The module's open and error bits are set, thus rendering fault detection of the remaining channels useless. The recommended value of this dummy resistor is 10 kΩ (±10%), 1/8 W (or larger). The resistor is wired between unused output channels and common.

Configure Your Output Diagnostic Module

The configuration data table is shown below.

1794-OB16D Configuration Data Table

Dec.	**15**	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Oct.	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read 1	Not used												Read Diagnostics Status			
Write 2	O15	O14	O13	O12	O11	O10	O9	O8	O7	O6	O5	O4	O3	O2	O1	O0
Where	O = Output Diagnostic status; Bit 00 = module error; Bit 01 = external power reverse polarity error; Bit 02 = output short error; Bit 03 = output open wire error															

The outputs are written in Word 2. Decimal bit 00 is the first output and decimal bit 15 is the last output.

Diagnostic status is read from Word 1:

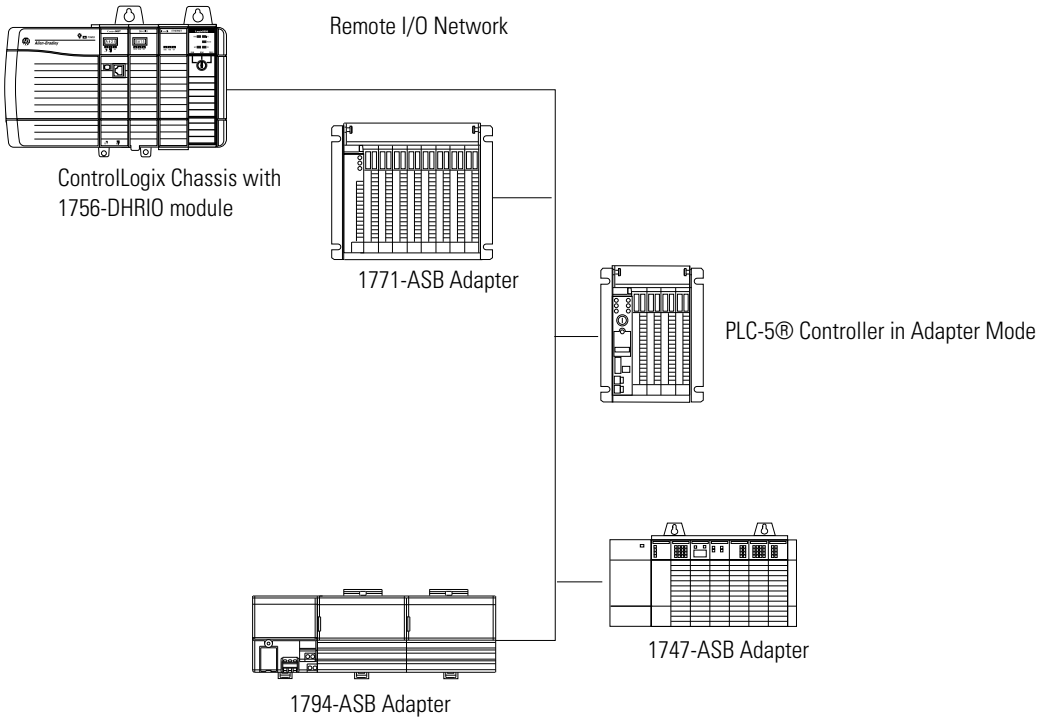
Bit 00: Module Error Bit
Bit 01: External Power Reverse Polarity Error Bit
Bit 02: Output Short Error Bit
Bit 03: Output Open Wire Error Bit

Configuring Modules for Communication on a Remote I/O Network

Chapter Objectives

This chapter provides you with the RSLogix 5000® software steps you need to configure a 1756-DHRIO module, remote adapter, and block transfer and digital modules for use with a ControlLogix® controller on a Remote I/O (RIO) network.

For this Information:	See page:
Add a DHRIO module to the project	36
Add a 1794-ASB adapter to the project	39
Configuring Block Transfer Modules	42
Create a Block Transfer (Read or Write) Message Instruction	44



Add a 1756-DHRIO Module

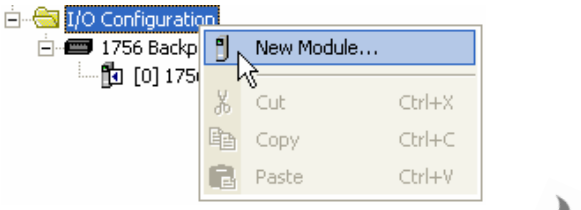
The 1756-DHRIO module provides two configurable channels that can either send and receive messages over DH+ or scan remote I/O devices. When a channel is configured for remote I/O, the 1756-DHRIO module is designed to function as a remote I/O scanner for a ControlLogix controller. I/O data is exchanged between the 1756-DHRIO module and:

- remote adapters on the remote I/O link
- the ControlLogix controller
- remote block transfer modules

Use the following steps to add a 1756-DHRIO module to your RSLogix 5000 project.

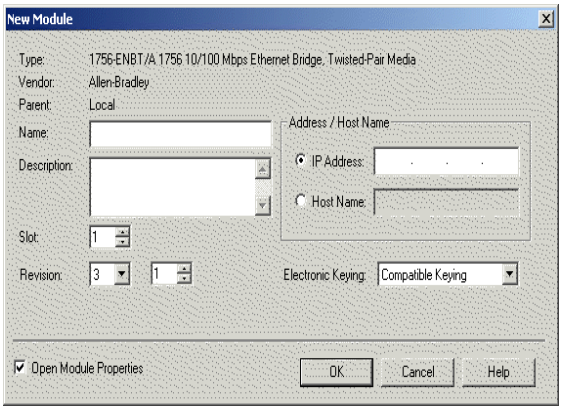
1. Start the RSLogix 5000 software.
2. Begin a new project or open an existing project offline.
3. Add the 1756-DHRIO Module to the project.

A. Right-click on I/O Configuration folder in the controller organizer and select New Module from the pull-down menu.

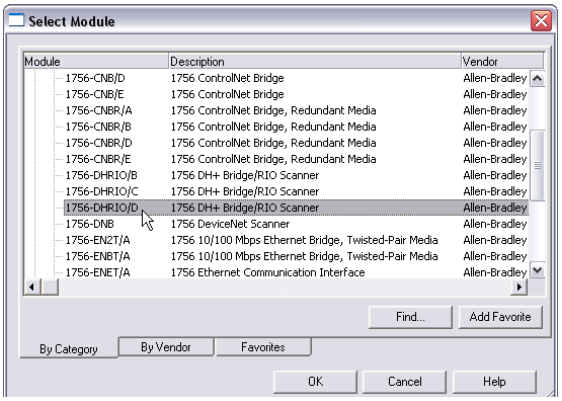


B. Click the + to the nonisolated left of the Communications group to display the communication modules available.

C. Select the series of 1756-DHRIO module you are using in your configuration.



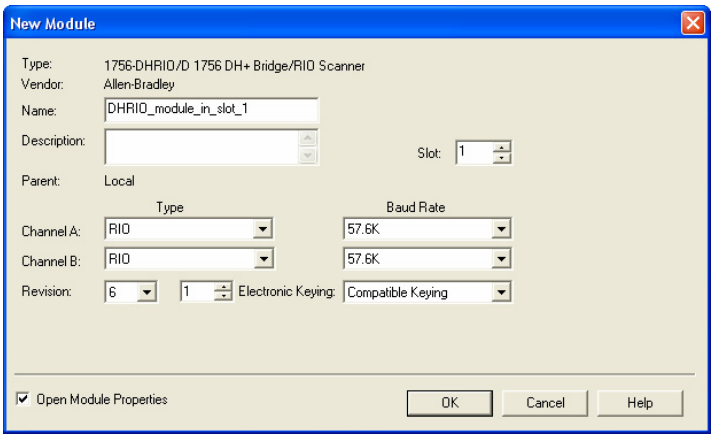
D. Click OK.



4. Configure the 1756-DHRIO module parameters.

A. Define the following parameters:
   - Name
   - Slot
   - Type
   - Baud Rate
   - Revision
   - Electronic Keying
   - Open Module Properties

   See the 1756-DHRIO Module Properties Dialog Box table for information on how to complete the dialog box.
   Click OK.



1756-DHRIO Module Properties Dialog Box

In This Field:	Do the Following:
Name	Type a name for the module (that is, DHRIO_module_in_slot_1).
Slot	Type or select the slot number where the module is installed.
Type Channel A Channel B	Select RIO for the Channel that is connected to the remote I/O network. If only one channel is configured as a remote I/O scanner, we recommend that you use Channel B. If you configure Channel A as a remote I/O scanner, you cannot use the programming terminal din connector on the front of the 1756-DHRIO module.
Baud Rate	Specify a baud rate for the Remote I/O channel. This value defines the communication rate at which the 1756-DHRIO module scans the remote I/O modules.
Revision	Select the major and minor revision level for your module.
Electronic Keying	Specify a keying option. When you configure a module, you specify the slot number for the module. However, it is possible to place a different module in that slot, either on purpose or accidentally. Electronic keying lets you protect your system against accidental placement of the wrong module in a slot. The keying option that you choose determines how closely a module in a slot must match the configuration for that slot.
Open Module Properties	Verify that this box is checked to access all available configuration screens for the module. If this box is not checked, clicking OK assigns the default parameters for the remaining configuration fields.

If:	Then Select:
all of the following must match: • type • catalog number • vendor • major and minor revision number	Exact Match
all information except the minor revision number must match	Compatible Module
no information must match	Disable Keying

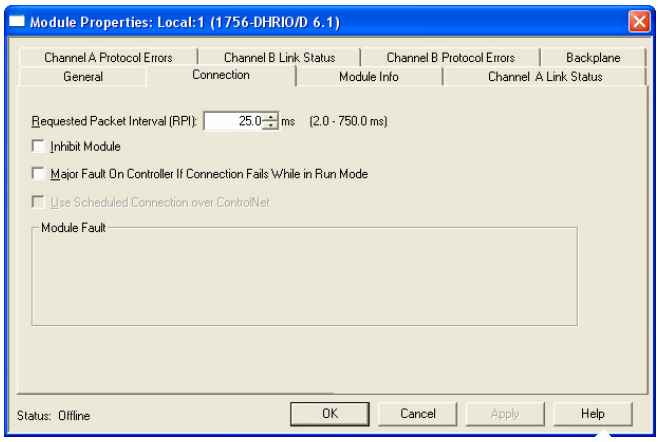
5. Specify parameters on 1756-DHRIO Connection tab screen.

A. Define the following parameters:

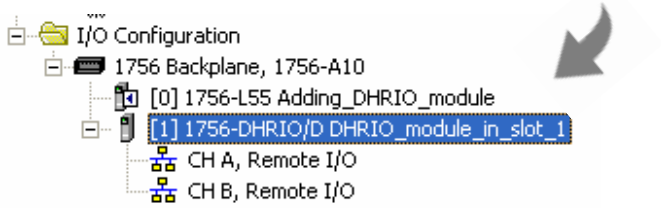
- Requested Packet Interval
- Inhibit Module
- Major Fault on Controller if Connection Fails While in Run Mode

  See the Connection Tab Screen table for information on how to complete the dialog box.

B. Click OK.



The 1756-DHRIO module is now listed in the controller organizer



Connection Tab Screen

In This Field:	Do the Following:
Requested Packet Interval (RPI)	Define the requested rate of packet arrival. This value defines the rate for status information about the DHRIO module to be sent to the controller. We recommend that this value be equal to the overall scan time of your program. The parenthetical values to the right of this field display the module-dependant minimum and maximum values.
Inhibit Module	Check/clear this box if you want to disable/enable connection to the DHRIO module when the controller goes online. If this box is checked, and you go online, the controller organizer displays an inhibit icon next to the module. Although the 1756-DHRIO module connection is inhibited, the DHRIO scanner (Channel A or B) changes to program mode and continues to scan the remote I/O adapters on the remote I/O network. When inhibited, the 1756-DHRIO module accepts configuration from any ControlLogix controller in the control system.
	ATTENTION: Inhibiting the DHRIO module causes the connection to the module to be disabled and can result in the loss of data.
Major Fault on Controller if Connection Fails While in Run Mode	Determine what action you want the controller to take if communication is lost to the DHRIO module. Place a check mark in this box if you want a major fault to occur on the controller if the connection between the controller and the DHRIO module is lost. Leaving this box unchecked means that failure to connect to the DHRIO module will not cause a major controller fault.

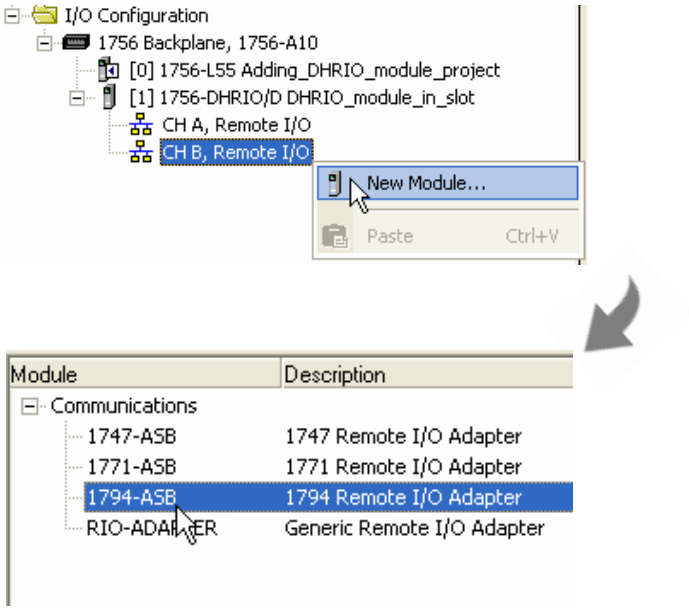
Add a 1794 Remote Adapter

The following steps show you how to add a 1794-ASB module to your project and set the configuration parameters.

1. Add the 1794-ASB adapter to the controller organizer.

A. From controller organizer, select the channel that you are using for your configuration then, right-click to display the pull-down menu.

In this example, only channel B is connected to remote I/O. You can connect both channels to remote I/O simultaneously if necessary. If only one channel is connected to remote I/O, we recommend that you use channel B. If you connect channel A to remote I/O, you cannot use the programming terminal din connector on the front of the 1756-DHRIO module.



B. Choose New Module.

C. Click the Communications group to expand the tree and then, choose the 1794-ASB adapter from the list.

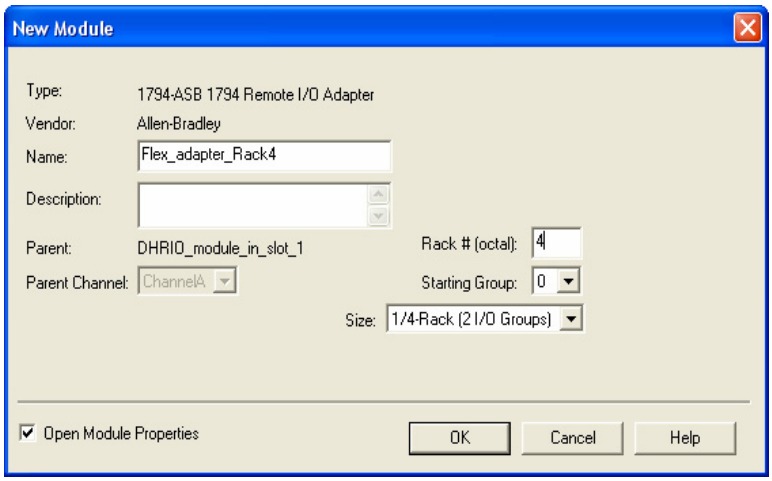
D. Click OK.

2. Define configuration parameters for the 1794-ASB module.

A. Define the following parameters:

- Name
- Rack #
- Starting Group
- Size
- Open Module Properties

See the 1794-ASB Adapter Module Properties Dialog Box table for additional information.



B. Click OK.

1794-ASB Adapter Module Properties Dialog Box

In This Field:	Do the Following:
Name	Type a name for the adapter. We recommend that you use a name that identifies the I/O type for the adapter you are configuring.
Rack # (Octal)	Select the Remote I/O network rack ID for the rack.
Starting Group	Select the starting group of this rack-based on the switch setting of the 1794-ASB adapter.
Size	Select the rack size for the adapter based on the switch setting of the 1794-ASB adapter.
Open Module Properties	Verify that this box is checked to access all available configuration screens for the adapter. If this box is not checked, clicking OK assigns the default parameters for the remaining configuration fields.

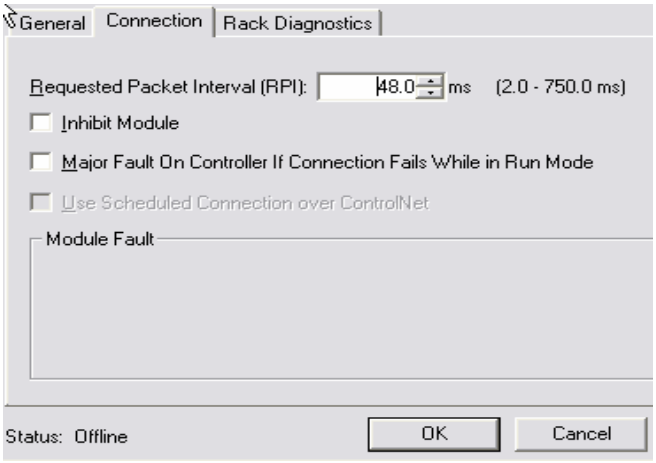
3. Specify parameters on 1794-ASB adapter Connection tab screen.

A. Define the following parameters:

- Requested Packet Interval
- Inhibit Module
- Major Fault on Controller if Connection Fails While in Run Mode

See the 1794-ASB Connection Tab Configuration Parameters table for additional information.

B. Click OK.



1794-ASB Connection Tab Configuration Parameters

In This Field:	Do the Following:
Requested Packet Interval (RPI)	Select the rate at which the DHRIO module sends discrete data from the I/O rack to the controller. The rate of data exchange is directly related to the configured baud rate for the 1756-DHRIO module.

If the baud rate of the scanner is configured for:	The scan rate per adapter equals:
57.6 Kbaud	8 ms
115.2 Kbaud	5 ms
230.4 Kbaud	3 ms

All adapters under the same DHRIO channel should be set to the same RPI time. We recommend that the value be equal to 0.5 ms x the number of adapters under a given channel x 3, 5, or 8 ms depending on the baud rate. For example, if you are using 4 adapters on Channel A of the 1756 DHRIO module that is configured for a baud rate of 57.6 Kbaud, the recommended RPI for all adapters would be:

(0.5 ms x 4 adapters x 8 ms per adapter = 16 ms)

1794-ASB Connection Tab Configuration Parameters

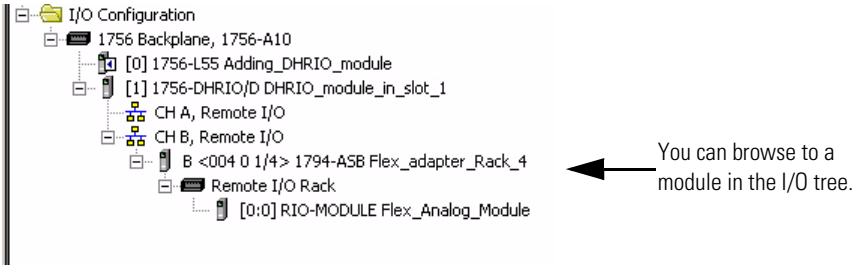
Inhibit Module	Check/clear this box if you want to disable/enable connection to the adapter when the controller goes online. If this box is checked, and you go online, the controller organizer displays an inhibit icon next to this module.	
		**ATTENTION:** Inhibiting the adapter causes the connection to the adapter to be disabled and can result in the loss of data.
Major Fault On Controller If Connection Fails While in Run Mode	Determine what action you want the controller to take if communication is lost to the adapter. Place a check mark in this box if you want a major fault to occur on the controller if communication with the adapter is lost. Leaving this box unchecked means that failure to connect to the adapter will not cause a major controller fault.	
		**ATTENTION:** If communication with a module fails, the controller operates on old data from the module. To avoid potential injury or damage, either monitor communications with modules or configure modules to produce a major fault if communications fail.

Configure Digital Modules

Although not required, when the module is in the I/O configuration, you gain these advantages:

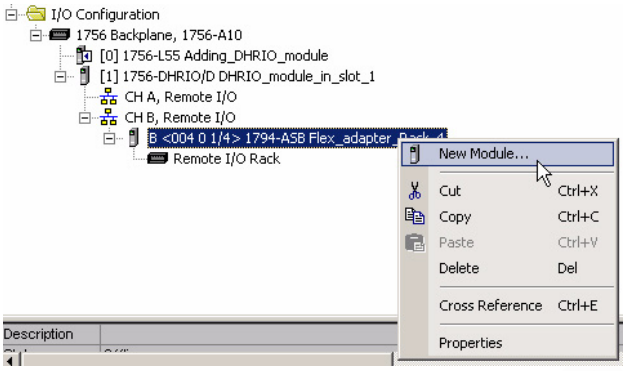
- It is easier to complete the communication path to the module.
- The I/O configuration provides documentation about the module.

For example, once you add an I/O module to the controller organizer window you can use the Browse button on the Communication Tab to select the path for the block transfer message.



1. Add a block transfer module to your project configuration...

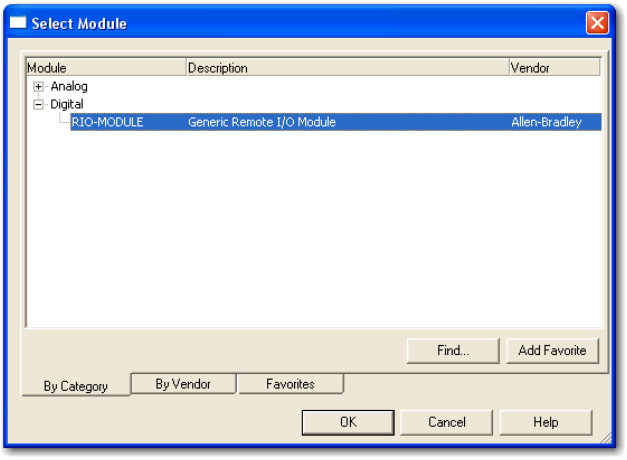
A. In the controller organizer, right-click on the adapter and select New Module from the pull-down menu.



B. Depending on the type of Block I/O module you are using, expand the Analog or Digital list by clicking on the + sign to the left of the group.

C. Right-click on RIO-MODULE to highlight.

D. Click OK.

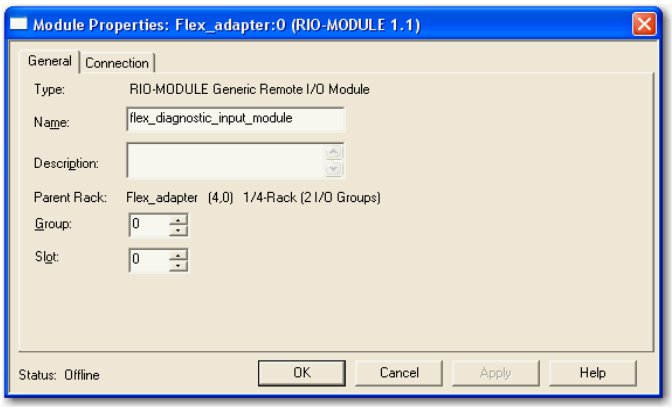


2. Configure parameters for the RIO Block Transfer module.

A. Define the following parameters:

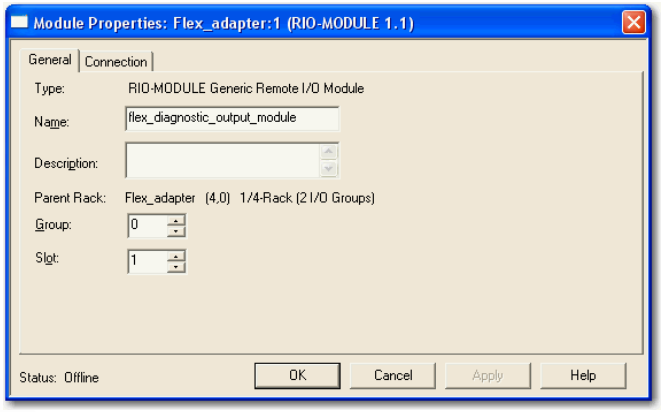
- Name
- Group
- Slot
- Open Module Properties

See the 1756-DHRIO Block Module Transfer Parameters table for additional information.

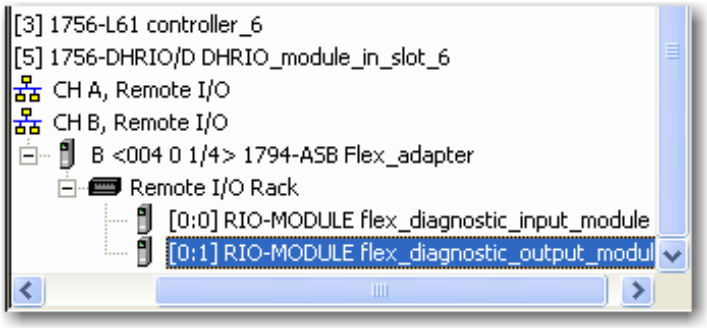


B. Click OK.

C. Repeat steps A and B for the Diagnostic output module.



The I/O modules are added to the controller organizer tree.



1756-DHRIO Block Module Transfer Parameters

In This Field:	Do the following:
Name	Type a name for the I/O module on the RIO network. You must name this module to be able to choose a path from the pull-down menu for the message instruction.
Group	Determine what group on the module provides the first word of I/O data. This selection is affected by the parent module's configuration. For example, if the parent module's size is equal to 1/2 rack (4 I/O groups), this module's configuration offers the option of starting with group 0, 1, 2 or 3.
Slot	Enter the location of the remote I/O module.
Open Module Properties	Uncheck this box. There are no additional module properties to configure for the module.

Create a Block Transfer (Read or Write) Message Instruction

Analog and specialty I/O modules are block transfer I/O modules. The size of the data that is transferred from the modules to the controller is larger than the space that RSLogix 5000 software has allocated in the controller memory. As a result, you must create message instructions in the Ladder Logic program of the ControlLogix controller to initiate the block transfer request and generate tags (for example, space in the controller's memory) for the data transferred. This section explains how to configure a block transfer application.

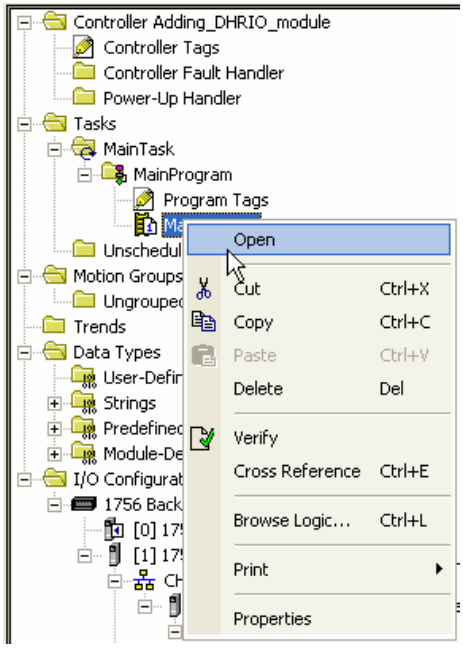
To monitor or control an I/O device, assign the tag name of the device to an instruction in your ladder logic:

- For step-by-step instructions on how to enter logic and tag names, refer to the Logix 5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.
- Data for I/O modules is stored at the controller scope. Controller scope data tags can be used by all programs. In other words, the data in a controller tag is available to every task or program within the controller application. Controller tags can be viewed as global variables. When you assign addresses, be sure that the scope selection is at the Controller to view the I/O tags.

1. Access the project's Main Routine of ladder logic in the controller organizer.

A. Right-click on Main Routine.

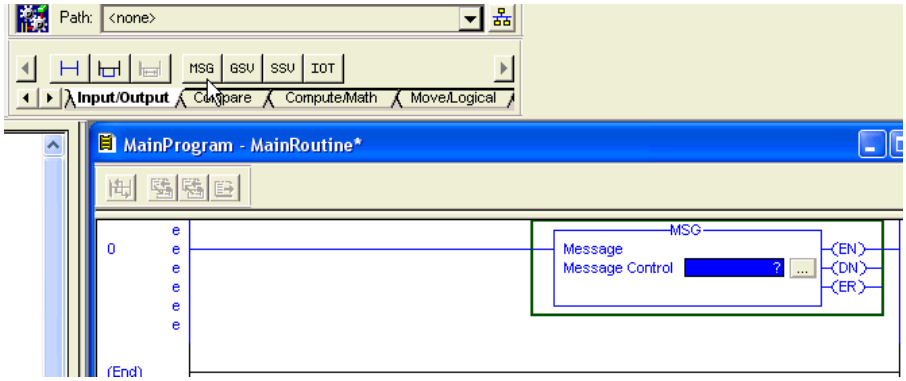
B. Click Open in the pull-down menu.



2. Add a Message instruction (MSG).

A. Click the Input/Output instruction set tab.

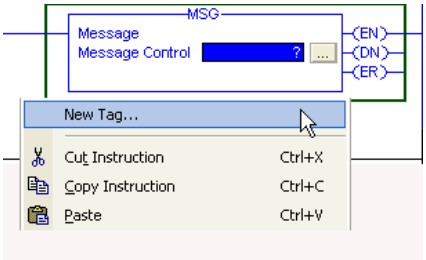
B. Click MSG to insert the message instruction.



3. Add a new tag to the MSG instruction.

A. Right-click on the ? in the MSG instruction.

B. Click New Tag in the pull-down menu.



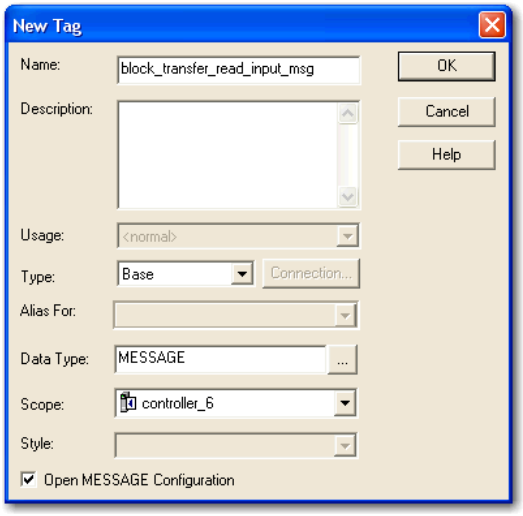
4. Name and define the parameters for the MSG tag.

A. Enter information for the following fields:

- Name
- Type
- Data Type
- Scope
- Open Message Configuration

See the Defining Tag Parameters table for additional information.

B. Click OK.



Defining Tag Parameters

In this Field:	Do the following:
Name	Enter a name for the tag. We recommend that you name the tag to indicate what module service is sent by the message instruction and the module type and location.
Type	Choose Base type.
Data Type	Choose Message type.
Scope	Message Tags can only be created within the Controller Scope.
Open Message Configuration	Verify that this box contains a check mark to access all available configuration screens.

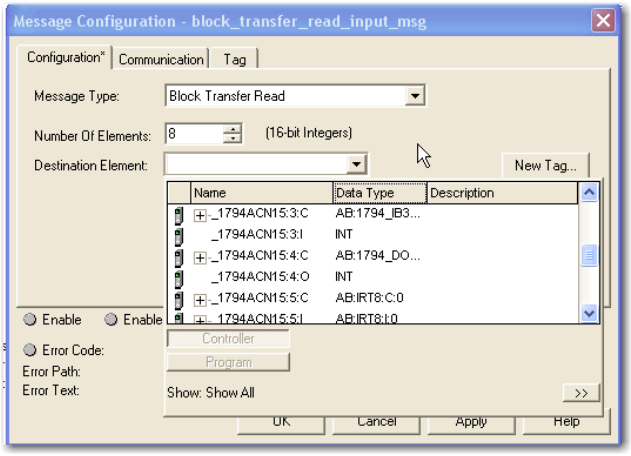
5. Define the Block Transfer Configuration Tab parameters

A. Define the following message configuration fields:

- Message Type
- Number of Elements
- Destination Element or New Tag (Block Transfer Read only)
- Source Element (Block Transfer Write only)

See the Message Configuration Parameters - Block Transfer Read or Write table below for additional information.

B. Click the Communication tab.



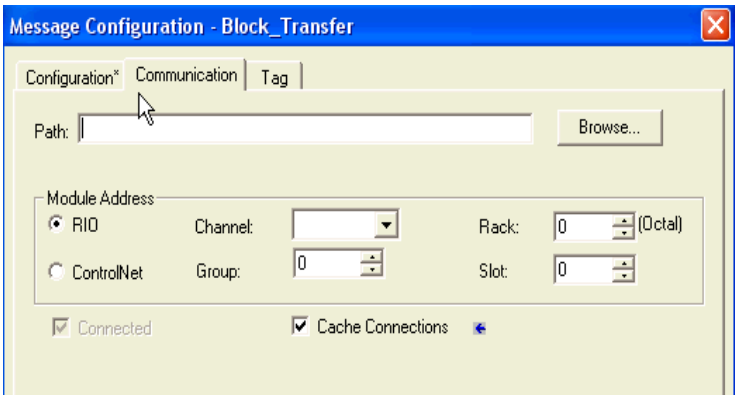
Message Configuration Parameters - Block Transfer Read or Write

In This Field:	Do the following:
Message Type	Select Block Transfer Read or Block Transfer Write from the pull-down menu. The fields for the screens change based on the type of message you choose.
Number of Elements	Define the number of 16-bit integers to transfer. The value that is entered in this field is determined by the type of module you are using. The value range is 0…64.
Block Transfer Read Screen	
Destination Element	Use the pull-down menu to select a tag to place the data from the read transfer into (that is, browse to a tag) or, click New Tag to create a tag for data that is read from module to be placed into. When creating a tag be sure to select Controller scope and assign Integer (INT) as the data type.
Block Transfer Write Screen	
Source Element	Use the pull-down menu to select the tag in the controller that contains data to transfer to the I/O module (that is, browse to a tag) or, click New Tag to create the tag for the controller where data is placed to be transferred to the I/O module. When creating a tag, be sure to select Controller as the scope and assign Integer (INT) as the data type.

6. Configure the Communication Tab for the MSG Instruction.

A. Define the following communication fields:
- Path
- Module Address
- Cache Connections

B. Click OK.



Communication Parameters

Path	Click Browse to see a list of the I/O modules in the system. To be able to choose a path for your message instruction using the Browse button, you had to previously configure the I/O module. If the module is not in the I/O configuration tree, you must manually type the path to the 1756-DHRIO module in this field (that is, (1,1) where the first 1 represents the backplane and the second 1 represents the slot of the 1756-DHRIO module).
Module Address	These fields are entered based on the module that you choose in the Path field.
Cache Connections	Checking this box means that the controller keeps the connection open after it completes the block transfer. The next block transfer utilizes the connection and avoids the delay of having to establish connections. Keeping the connection open can result in faster block transfers but be aware that the connection remains open indefinitely. The controller has a limited number of connections and keeping this connection open could result in the controller not being able to establish connections with another device.

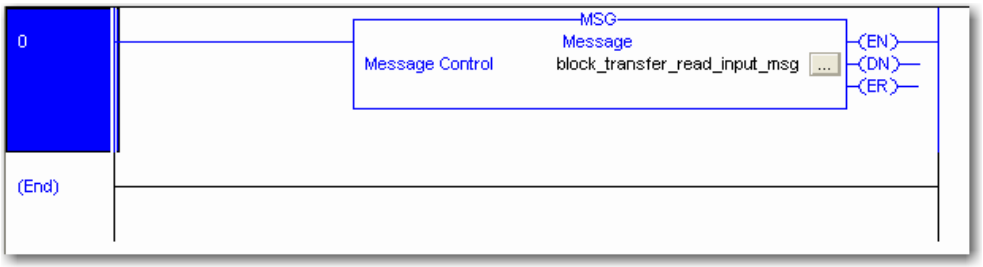
If you have this software and firmware revision:	**Then you can cache:**
11.x or earlier	block transfer messages for up to 16 connections other types of messages for up to 16 connections
12.x or later	up to 32 connections

Clearing this box means that the connection will be uncached. An uncached connection is a connection between two points that opens only when a message is enabled and closes when the controller completes the block transfer. Uncached connections are not as fast as cached connections.

Ladder Logic Examples

The following illustration provides you with a ladder logic example for 1794 diagnostic modules. The example is typical ControlLogix software ladder rungs for block transfer message instructions

Ladder Logic Example for 1794 Diagnostic Modules.



Configure FLEX I/O Digital Modules on a DeviceNet Network

How to Use This Chapter

This chapter provides basic information on how to use a 1794-ADN FLEX I/O adapter to connect 1794 FLEX I/O digital modules to a DeviceNet network.

Topic	See Page
How to Use This Chapter	49
Add the Scanner to the I/O Configuration of the Controller Using RSLogix 5000 Software	50
Determine the Address of DeviceNet Data	54
Tally Memory Requirements	56
If You Configure the Adapter Offline	57
Set the Address of the Adapter	58

Use RSNetWorx™ for DeviceNet software to add the 1794-ADN DeviceNet adapter and FLEX I/O modules on a DeviceNet network.

To use the FLEX I/O adapter, cat. no. 1794-ADN:

Step:		Page:
❑	Tally Memory Requirements	56
❑	As an option, give each module its own memory location (DINTs) within the scanner. This may make your programming easier. Assign one address for the 1794-ADN and all modules that you connect to it.	56
❑	If You Configure the Adapter Offline	57
❑	Set the Address of the Adapter	58

Add the Scanner to the I/O Configuration of the Controller Using RSLogix 5000 Software

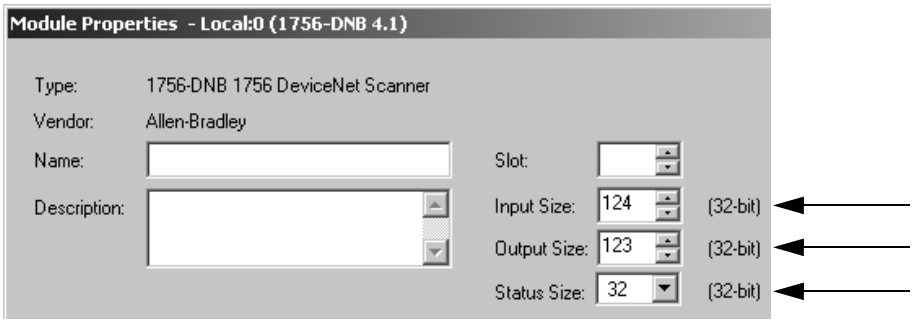
To access the data of your network, add the scanner to the I/O configuration of the controller.

To add a scanner:

Step:	See page:
❑ If You Need to Conserve EtherNet/IP or ControlNet Network Bandwidth	50
❑ Add the Scanner to the I/O Configuration Folder	52
❑ Define the Properties of the Scanner	53

If You Need to Conserve EtherNet/IP or ControlNet Network Bandwidth

The default configuration of the scanner gives you the maximum amount of input, output, and status data.



If the scanner communicates with the controller via an EtherNet/IP or ControlNet network and you must conserve bandwidth over that network, consider reducing the input, output, or status sizes.

- Set the input and output sizes = the number of input and output DINTs in the scanner that actually store device data.
- If you are *not* going to use all the status information, set the status size to the minimum required. See Set the status size for a scanner on page 51.

EXAMPLE Set the status size for a scanner

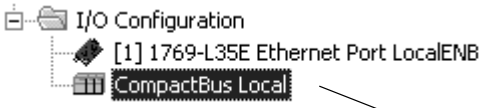
- If you want to *only* use the ASCII representation of scanner status/display, then set the Status Size = 10.
- If you also want to read the status code of the scanner, set the Status Size = 11.

Set the status size for a scanner

If you want this information:	Set the Status Size to (DINTs):	Which gives you:	
		Member:	Data Type
count of I/O scans	10	ScanCounter	DINT
indication that a device has failed: • There is 1 bit for each address on the DeviceNet network (0 -63). • The position of a bit = address of a device. • If a bit = 1, then the device at that address has failed.		DeviceFailureRegister	SINT[8]
indication that the data size of a device does not match the amount of memory that is allocated for the device in the scanner: • There is 1 bit for each address on the DeviceNet network (0 -63). • The position of a bit = address of a device. • If a bit = 1, then their is a mismatch with that address.		AutoverifyFailureRegister	SINT[8]
indication that a device is idle: • There is 1 bit for each address on the DeviceNet network (0 -63). • The position of a bit = address of a device. • If a bit = 1, then the device at that address is idle.		DeviceIdleRegister	SINT[8]
indication that a device is online: • There is 1 bit for each address on the DeviceNet network (0 -63). • The position of a bit = address of a device. • If a bit = 1, then the device at that address is online.		ActiveNodeRegister	SINT[8]
ASCII representation of scanner status/display		StatusDisplay	SINT[4]
address of the scanner	11	ScannerAddress	SINT
status code of scanner		ScannerStatus	SINT
address with an error: • scrolls through the addresses with errors • ScrollingDeviceStatus member shows the status code		ScrollingDeviceAddress	SINT
status code of an address with an error: • scrolls through addresses with errors • ScrollingDeviceAddress member shows the address		ScrollingDeviceStatus	SINT
possible future expansion of the structure – 5 DINTs	16		
status code of lower 32 devices – 1 byte per device	24	DeviceStatus	SINT[32]
status code of all devices – 1 byte per device	32	DeviceStatus	SINT[64]

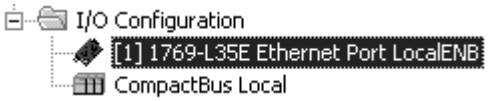
Add the Scanner to the I/O Configuration Folder

CompactLogix scanner



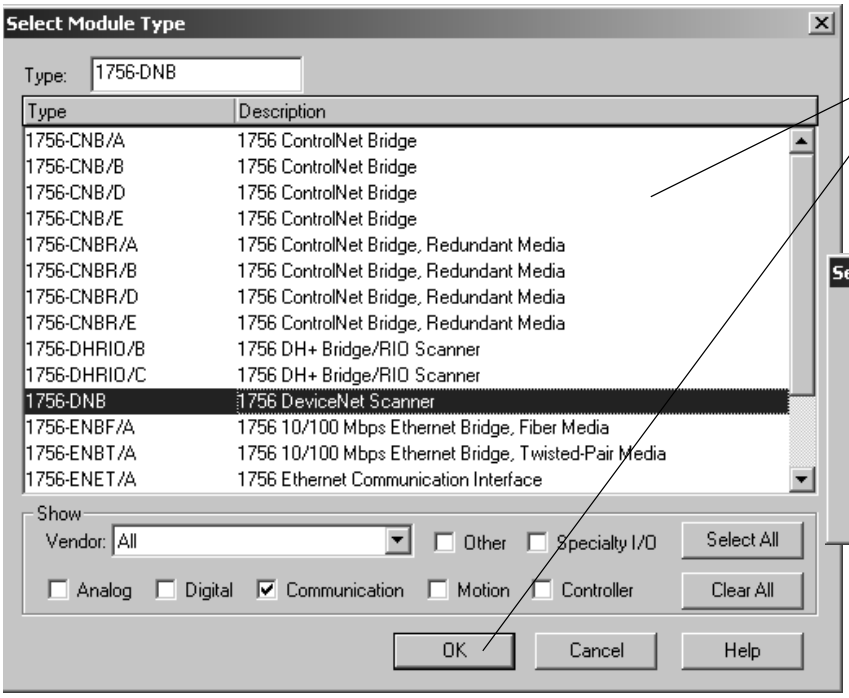
ControlLogix, FlexLogix, and SoftLogix 5800 scanners

EtherNet/IP to DeviceNet linking device

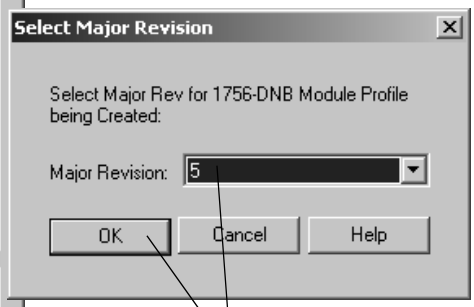


ControlNet to DeviceNet linking device

1. Right-click and choose *New Module*.

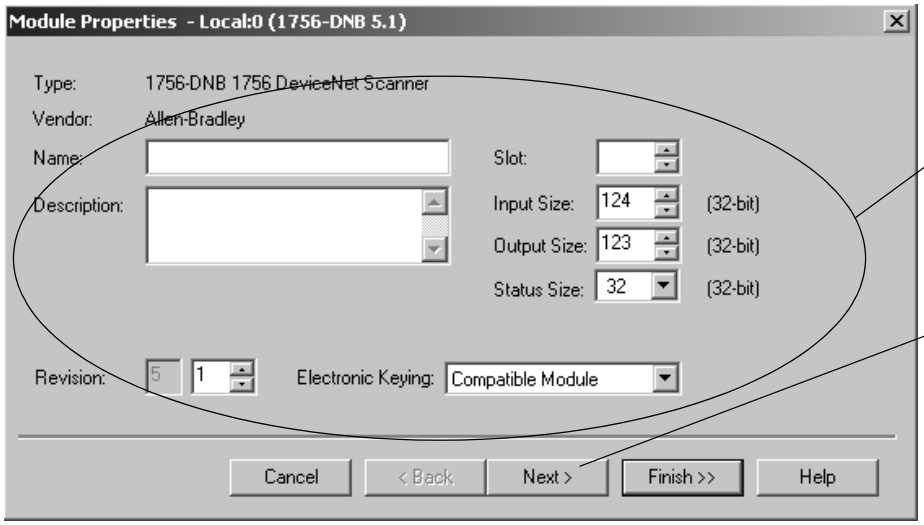


2. Choose the type of scanner.

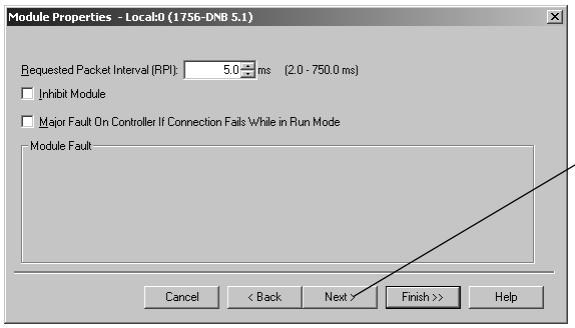


3. Select the major revision of the scanner.

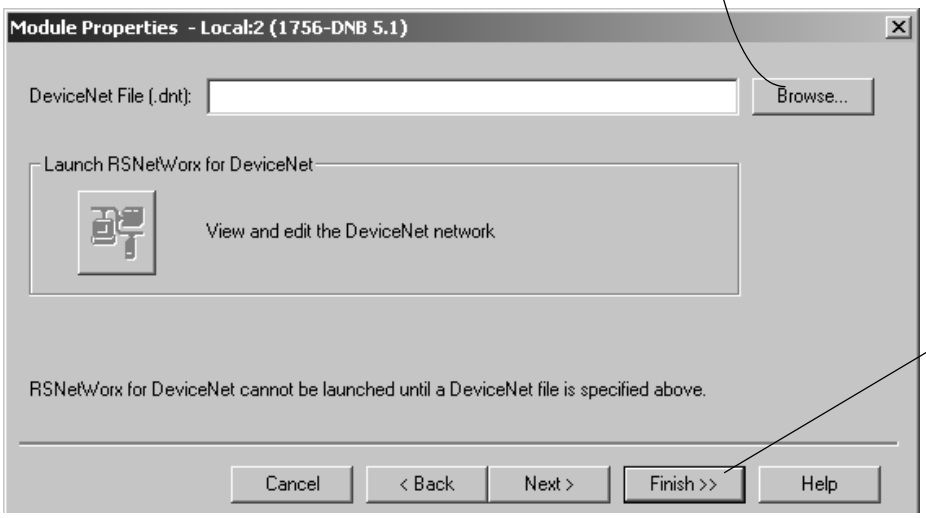
Define the Properties of the Scanner



1. Specify the general properties (name, slot, sizes, and so on).
2. Choose *Next*.



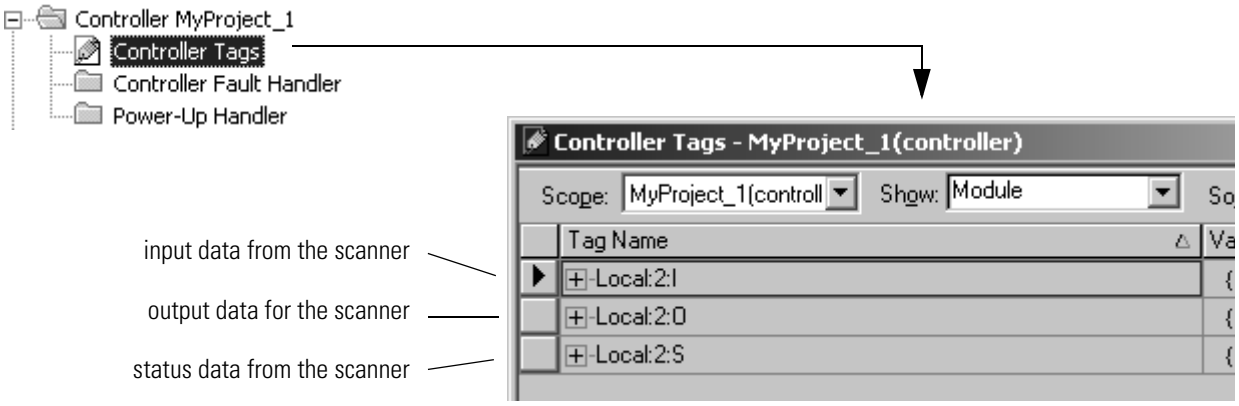
3. Choose *Next*.
4. Choose *Browse* and find the RSNetWorx configuration file for the network (.dnt file). The default path for the file is `...\Program Files\Rockwell Software\RSNetWorxII\Networks`.



5. Choose *Finish*.

Determine the Address of DeviceNet Data

When you add the scanner to the I/O configuration of the controller, RSLogix 5000 software automatically creates a set of tags for the input, output, and status data of the network:



The tags for your DeviceNet data follow this format:

The scanner memory uses this format:

slot	type	.Data	[element]	.bit

Which is this tag in the controller

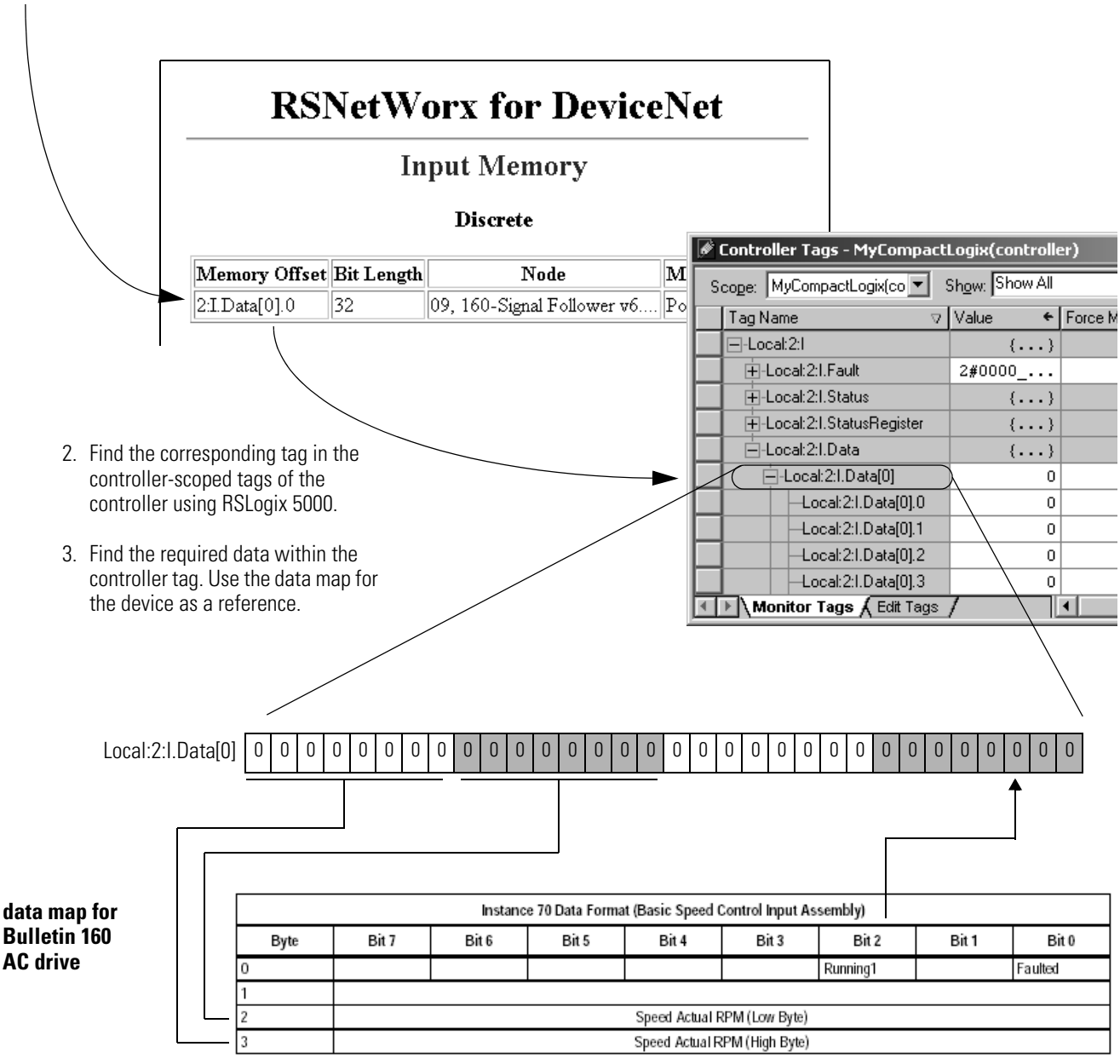
location	:type	.Data	[element]	.bit

= Optional

Where:	**Is:**	
slot	slot number of the scanner	
location	**If you have this scanner:**	**Then location is:**
	local ControlLogix 1756-DNB	Local:*slot_number_of_scanner*
	remote ControlLogix 1756-DNB	*name_of_remote_bridge*:*slot_number_of_scanner*
	CompactLogix™ 1769-SDN	Local:*slot_number_of_scanner*
	SoftLogix™ 5800 1784-PCIDS	Local:*slot_number_of_scanner*
	DriveLogix™/FlexLogix™ 1788-DNBO	name of the scanner in the I/O configuration of the controller
	Linking Device 1788-EN2DN or 1788-CN2DN	name of the linking device in the I/O configuration of the controller
type	**If the data is:**	**Then type is:**
	input from a device	I
	output to a device	O
	status of the network	S
element	specific DINT (DWord, 32-bit integer) within the array	
bit	specific bit within an integer	

To determine the tag name (address) for DeviceNet data:

1. On the report for the network, find the memory address for the input or output data of the device.



data map for Bulletin 160 AC drive

Instance 70 Data Format (Basic Speed Control Input Assembly)								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						Running1		Faulted
1								
2	Speed Actual RPM (Low Byte)							
3	Speed Actual RPM (High Byte)							

Tally Memory Requirements

The 1794-ADN FLEX I/O adapter packs the data of its I/O modules into a contiguous block of input or output bytes. By default, the modules share DINT elements in the scanner.

For example, to determine the amount of scanner memory that is required for your adapter and its I/O modules

1. Add the input bytes of each module + 2 bytes for the adapter.
2. Add the output bytes of each module (0 for the adapter).

Sub Tally

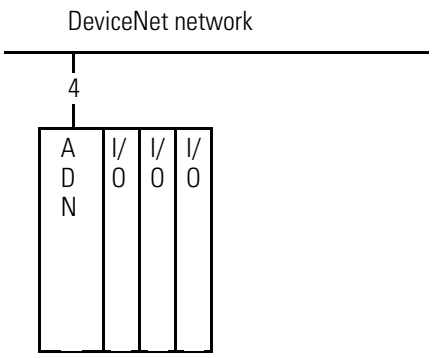
Device	Input Size of Device (bytes)	Output Size of Device (bytes)
FLEX I/O adapter—1794-ADN	2	0
digital output module—1794-OB16D	2	2
digital input module—1794-IB16D	2	0
Total	6	2

3. Add the totals to the main tally.

Main Tally

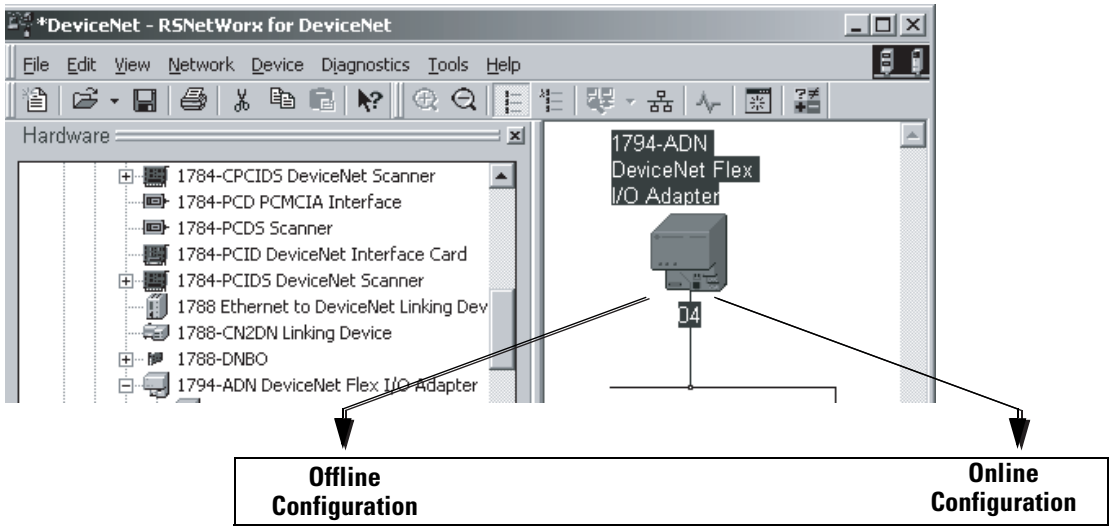
Device	Address	Input Size of Device (bytes)	Input Memory in Scanner (DINTs)	Output Size of Device (bytes)	Output Memory in Scanner (DINTs)
Start/stop Buttons		1	1	1	1
Motor Starter		4	1	4	1
FLEX I/O Adapter w/modules		6	2	2	1
	Total				

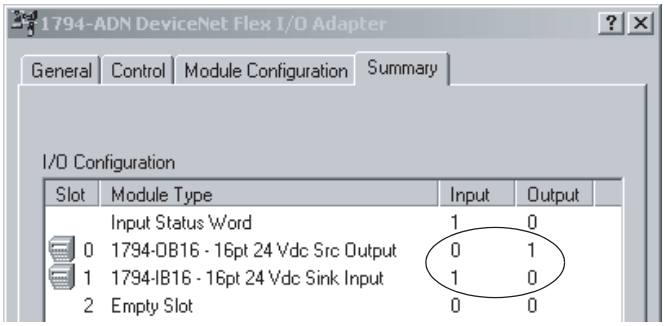
As an option, give each module its own memory location (DINTs) within the scanner. This may make your programming easier. Assign one address for the 1794-ADN and all modules that you connect to it.

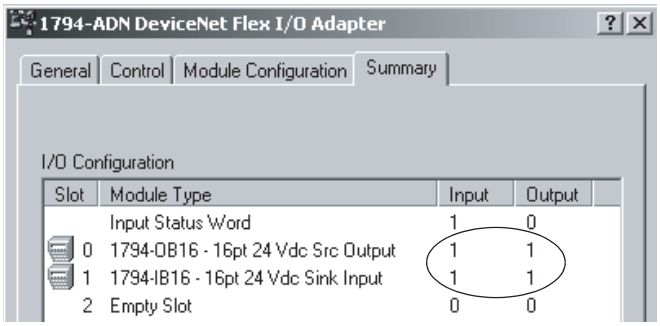


If You Configure the Adapter Offline

If you configure the FLEX I/O adapter offline, check the I/O sizes of each module. For FLEX I/O, RSNetWorx software uses offline I/O sizes that differ from the default values of the modules.

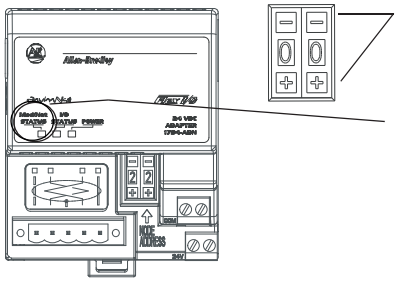






Set the Address of the Adapter

To set the address of the FLEX I/O DeviceNet adapter 1794-ADN:



1. To change the address, press the button above or below a number.
2. Connect the adapter to the network.
3. Turn on power to the adapter.
4. Check the Mode/Net STATUS light.

If:	Then the:
Green (Flashing or Solid)	address is OK
Solid Red	address and/or baud rate conflict with another device
Off	device is waiting to set its baud rate When autobaud is on, the device waits until it hears another device on the network. It then sets its baud rate to that of the other device.

For more information on using DeviceNet in Logix 5000 control systems, see DeviceNet Network Configuration User Manual, publication DNET-UM004.

Configure Your Adapter and Digital Modules on a ControlNet Network

Introduction

This chapter guides you through the steps that are required to configure your FLEX I/O ControlNet adapter and associated modules on a ControlNet network using RSNetworx for ControlNet and RSLogix 5000 software.

For this information:	See page:
Set Up the Hardware	60
Setting a Requested Packet Interval (RPI)	60
Select a Communication Format	61
Add Local and Remote ControlNet Modules	67
Add Distributed I/O	68
Download the Program to the Controller	70
Configure the 1794-ACN15 Adapter	71
Schedule I/O Module Connections	72
Access Module Data via the 1794-ACN15 Adapter	77
Change Configuration Data	79

This chapter describes how a controller controls distributed I/O over ControlNet. The controller requires a communication module to connect to the network. Distributed I/O modules require an adapter to connect to the network.

In this example, we show you how to control FLEX I/O over ControlNet using RSNetworx for ControlNet and RSLogix 5000.

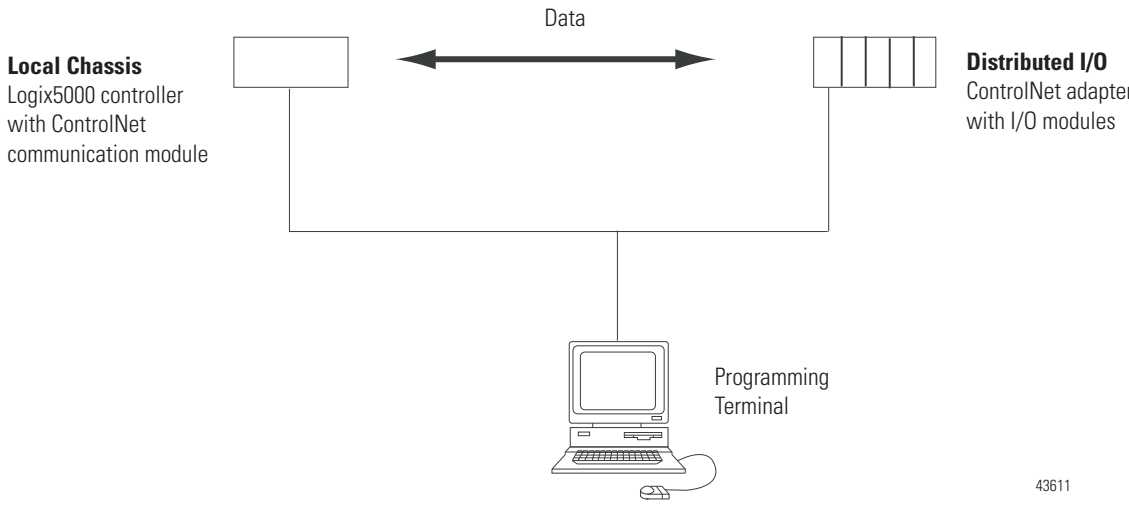
To control distributed I/O over ControlNet, you must:

- Add local and remote ControlNet communication modules to your RSLogix 5000 project.
- Add distributed I/O to your RSLogix 5000 project.
- Schedule the ControlNet network via RSNetWorx for ControlNet.
- Use the I/O information in RSLogix 5000

You can also validate connections to distributed I/O when controlling it over ControlNet. This task is useful when one or more of the connections are not working but is not required, especially when all connections appear to work normally.

Set Up the Hardware

In this example, the Logix 5000 controller uses a ControlNet communication module in the local chassis to connect to the ControlNet network. The distributed (remote) I/O has a ControlNet adapter to connect it to the ControlNet network.



Make sure:

- all wiring and cabling is properly connected
- the communication driver [such as, AB-PCIC(S)-1] is configured for the programming workstation

Setting a Requested Packet Interval (RPI)

When you configure an I/O module, you define the RPI for the module. The RPI specifies the period at which data updates over a connection. For example, an input module sends data to a controller at the RPI that you assign to the module. Configure the RPI in milliseconds.

RPIs are only used for modules that produce or consume data. For example, a local ControlNet communication module does not require an RPI because it is not a data-producing member of the system; it is used only as a bridge.

In Logix 5000 controllers, I/O values update at a period that you configure via the I/O configuration folder of the project. The values update asynchronously to the execution of logic. At the specified interval, the controller updates a value independently from the execution of logic.

Set the RPI only as fast as needed by the application. The RPI determines the number of packets per second on a connection. Each I/O module has a limit of how many packets it can handle per second. If you exceed this limit, the module cannot open any more connections.

Select a Communication Format

When you configure a remote ControlNet communications module or an I/O module, you select a communication format. The communication format that you choose determines the data structure for the tags that are associated with the module. Many I/O modules support different formats. Each format uses a different data structure.

The communication format that you choose also determines:

- Direct or rack-optimized connection
- Ownership of outputs

For a remote ControlNet communications module, you must select one of the formats that are listed below.

Use this communication format with a remote ControlNet communication module:	In these scenarios:
None	• All remote I/O communicating with a controller via the remote ControlNet communication module use a Direct Connection communication format. • The connection is used for scheduled peer interlocking. • When I/O will be predominately direct connections. • When multiple controllers control the outputs in the chassis
Rack optimized	• Some or all remote I/O communicating with a controller via the remote ControlNet communication module use a Rack Optimized communication format. • To minimize ControlNet bandwidth when using large volume of digital I/O. • If only one controller will control the I/O.
Rack optimized - Listen only	• Some or all remote I/O communicating with a controller via the remote ControlNet communication module use a Rack Optimized communication format. • The connection is going to read inputs but is not going to be controlling outputs.

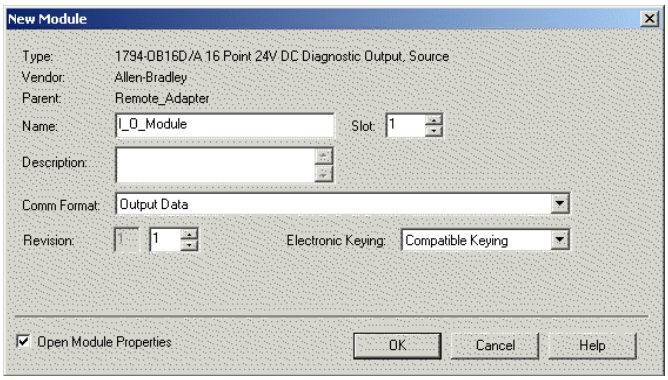
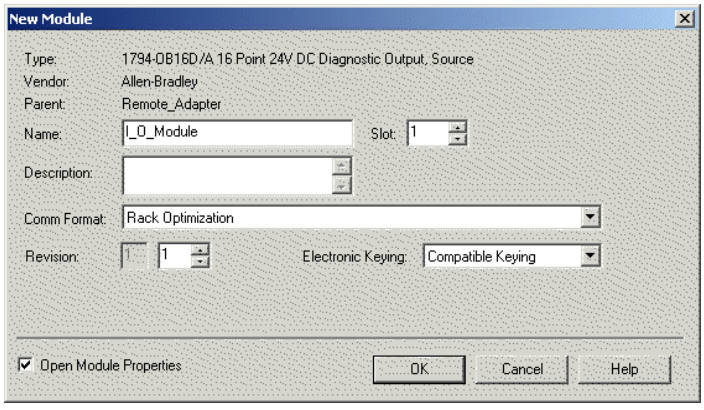
For I/O modules, the available communication formats depend on the module type. In general:

If you have this type of I/O module:	And want:	Select a communication format that specifies:
digital module	a rack-optimized connection	Rack Optimization
	a direct connection or to use specialty features of the module, such as diagnostics, timestamps, or electronic fuses or to only listen to data from the module.	The data your controller needs from the I/O module. For example, if your application uses a 1756-IA16I module in a remote chassis that must provide timestamped input data, you should select the CST Timestamped Input Data communication format. A Listen Only communication format that matches the data the I/O module is broadcasting to other controllers.
analog module	a direct connection or to use specialty features of the module, such as diagnostics, timestamps, or electronic fuses or to only listen to data from the module.	The data your controller needs from the I/O module. For example, if your application uses a 1756-OF6CI module in a remote chassis that must provide floating point output data, you should select the Float Data communication format. A Listen Only communication format that matches the data the I/O module is broadcasting to other controllers.

See online help in RSLogix 5000 programming software for specific communication formats per I/O module.

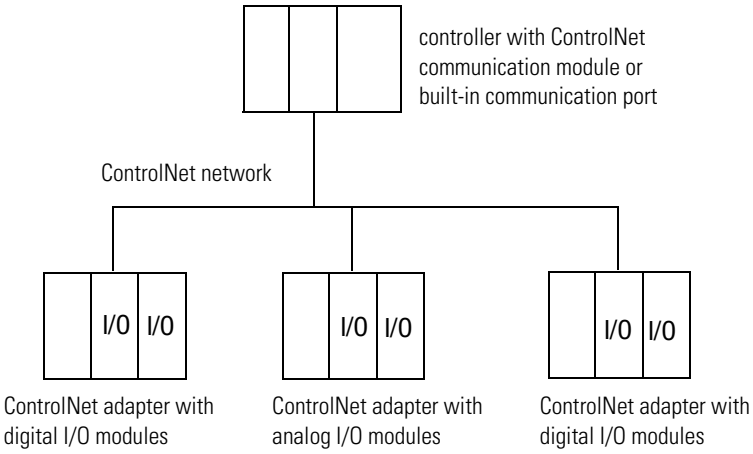
Direct or rack-optimized connection

Logix 5000 controllers use connections to transmit I/O data. These connections can be direct connections or rack-optimized connections.

direct connection	A direct connection is a real-time, data transfer link between the controller and an I/O module - analog or digital. In some cases (for example, with some modules) this connection enables your controller to collect more data from an I/O module. For example, with a direct connection, the controller can collect diagnostic status data from a 1756-IA8D module that would not be collected in a rack-optimized connection. The controller maintains and monitors the connection with the I/O module. Any break in the connection, such as a module fault or the removal of a module while under power, sets fault bits in the data area associated with the module. 
rack-optimized connection	Digital I/O Modules only - A rack-optimized connection consolidates connection usage between the controller and all digital I/O modules in the chassis (or DIN rail). Rather than having individual, direct connections for each I/O module, there is one connection for the entire chassis (or DIN rail). Anytime a remote chassis houses I/O modules that use rack-optimized connections, the remote ControlNet communication module connecting these modules to their owner-controller must also use a rack-optimized connection. However, you can mix direct and rack-optimized connections to the same remote chassis. For example, if your remote chassis houses 6 digital I/O modules and your application requires that you use direct connections for the 3 that require them and rack-optimized connection for the others, you can select direct connections for the 3 that require them and rack-optimized connections for the other 3. In this case, even though you must use a rack-optimized connection for the remote ControlNet communication module the owner-controller still makes direct connections with the 3 I/O modules that are configured as such. You can only make up to 5 rack-optimized connections to one remote ControlNet communication module. 

Direct connections for I/O modules

In this example, assume that each distributed I/O module is configured for a direct connection to the controller.



The table below calculates the connections in this example.

System Connections:	Amount:
Controller to local ControlNet communication module	0
Controller to ControlNet adapter[1]	0
direct connection for digital I/O modules	4
direct connection for analog I/O modules	2
total connections used:	6

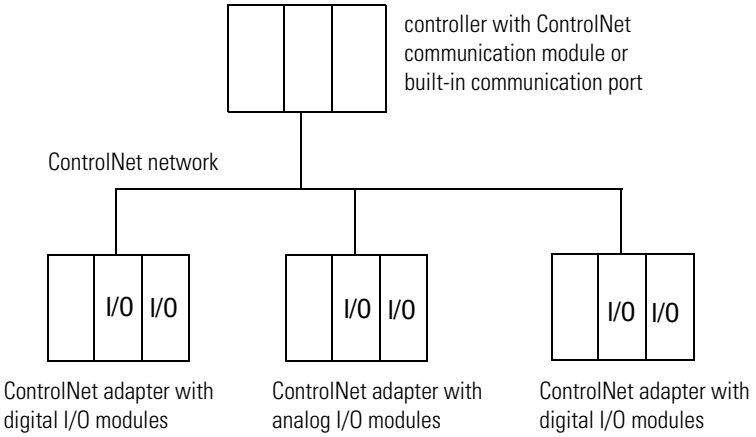
[1] In this example, the remote ControlNet adapter uses the *None* communications format.

TIP If you have a high number of modules, direct connections to each module may not be feasible because the module supports a finite number of connections and packets per second, and direct connections may require more resources than the module has available.

In this case, use rack-optimized connections to conserve connection use and network traffic.

Rack-optimized connections for I/O modules

In this example, assume that each digital I/O module is configured for a rack-optimized connection to the controller. Analog modules must be configured for direct connections.



The table below calculates the connections in this example.

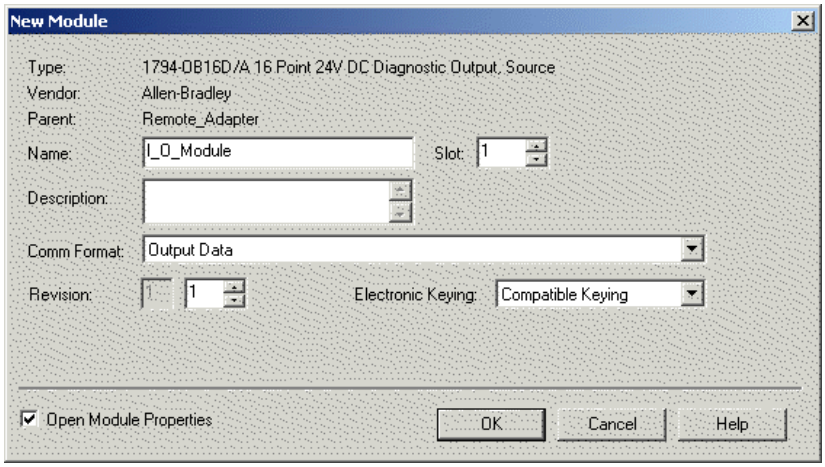
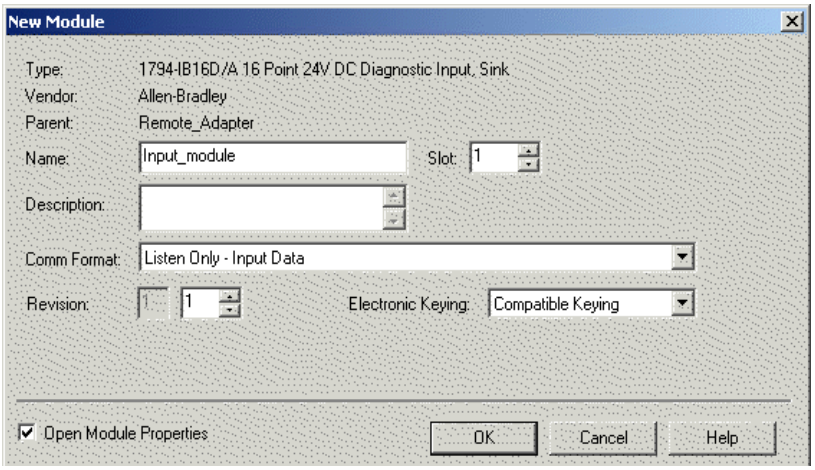
System Connections:	Amount:
Controller to local ControlNet communication module	0
Controller to ControlNet adapters with digital modules (rack-optimized connection to each adapter)	2
Controller to ControlNet adapter with analog modules (direct connection for each analog I/O module)	0 2
total connections used:	4

The rack-optimized connection conserves connections, but can limit the status and diagnostic information that is available from the digital I/O modules.

To increase the number of available connections, use a rack-optimized connection to any remote adapter with multiple digital I/O modules that allow rack-optimized connection, instead of direct connections to those I/O modules.

Ownership

In a Logix 5000 system, modules multicast data. This means that multiple modules can receive the same data simultaneously from one module. When you choose a communication format, you have to choose whether to establish an owner or listen-only relationship with the module.

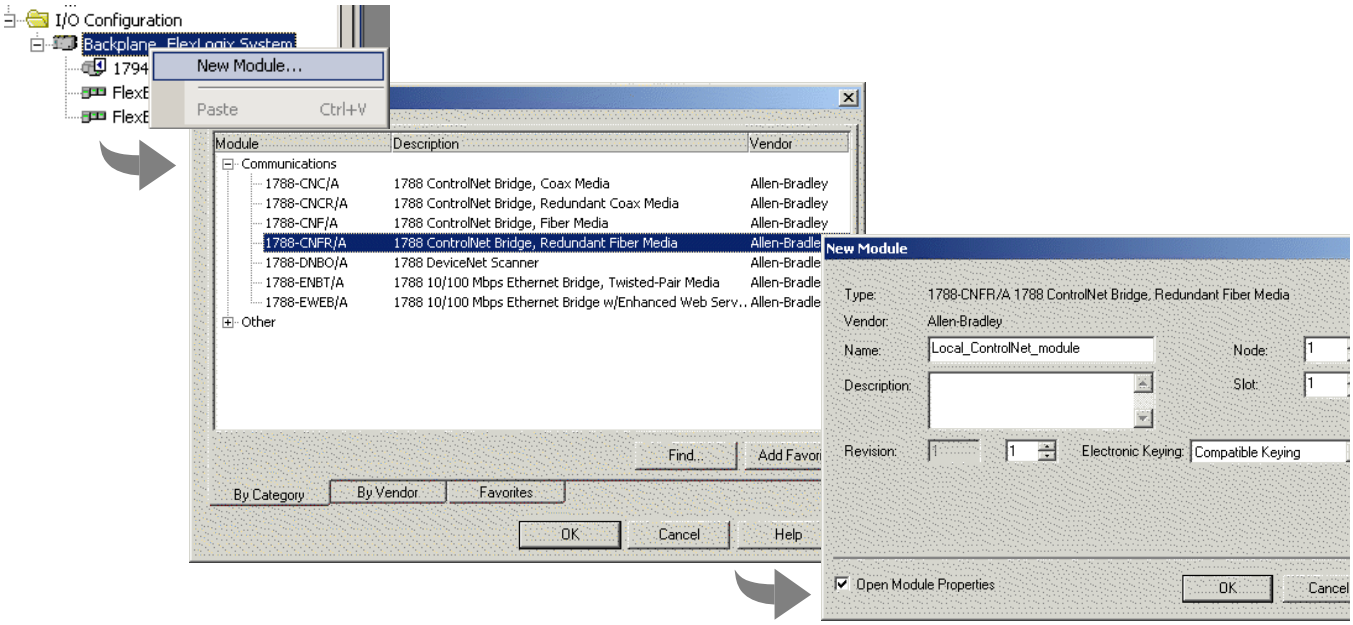
owner controller	The controller that creates the primary configuration and communication connection to a module. The owner controller writes configuration data and can establish a connection to the module. The owner controller is the only device that controls the outputs. 
	An I/O connection where another controller owns/provides the configuration data for the I/O module. A controller using a listen-only connection only monitors the module. It does not write configuration data and con only maintain a connection to the I/O module when the owner controller is actively controlling the I/O module. 

Add Local and Remote ControlNet Modules

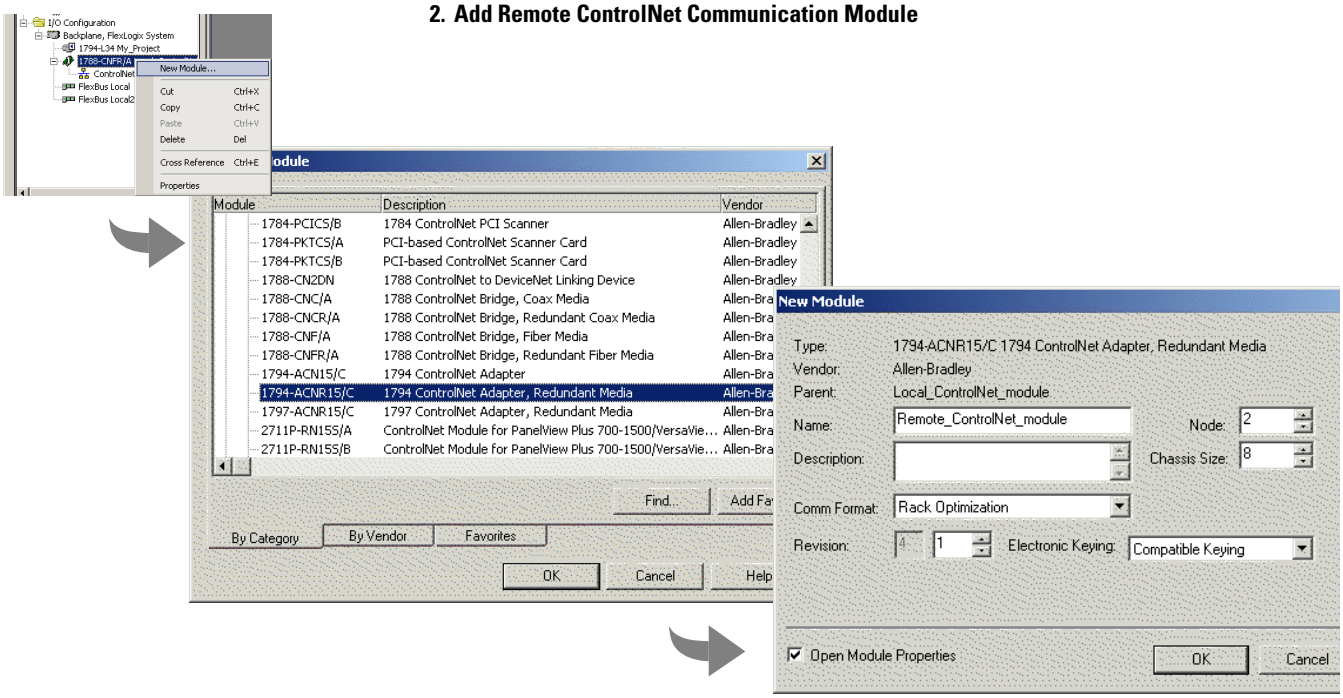
Before you can connect to and control distributed I/O, you must add local and remote ControlNet communication modules. The type of distributed I/O determines your choice of a remote ControlNet adapter. The figures below shows a brief series of screens that are used when adding local and remote ControlNet communication modules to an RSLogix 5000 project.

For more detailed information on how to add local and remote ControlNet modules to your project, refer to publication CNET-UM001.

1. Add Local ControlNet Communication Module



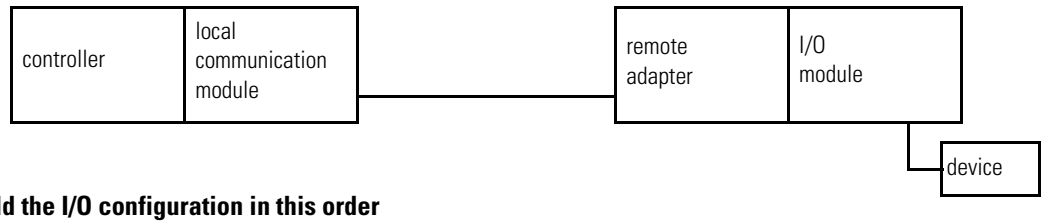
2. Add Remote ControlNet Communication Module



Add Distributed I/O

To communicate with the I/O modules in your system, you add bridge, adapter, and I/O modules to the I/O Configuration folder of the controller. Within the I/O Configuration folder, you organize the modules into a hierarchy (tree/branch, parent/child).

For a typical distributed I/O network…

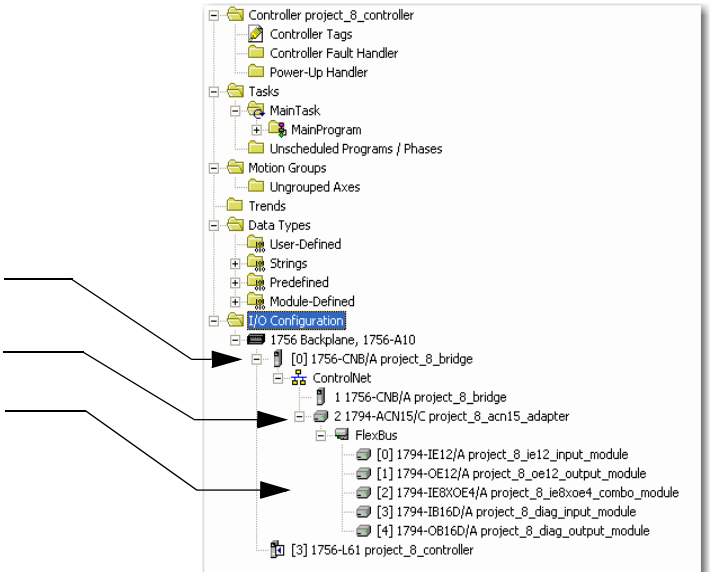


…you build the I/O configuration in this order

A. Add the local communication module (bridge).

B. Add the remote adapter for the distributed I/O chassis or DIN rail.

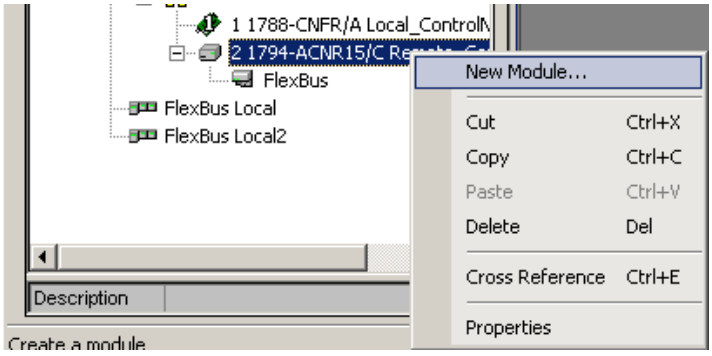
C. Add the distributed I/O module.



Do these steps to add distributed I/O to your RSLogix 5000 project:

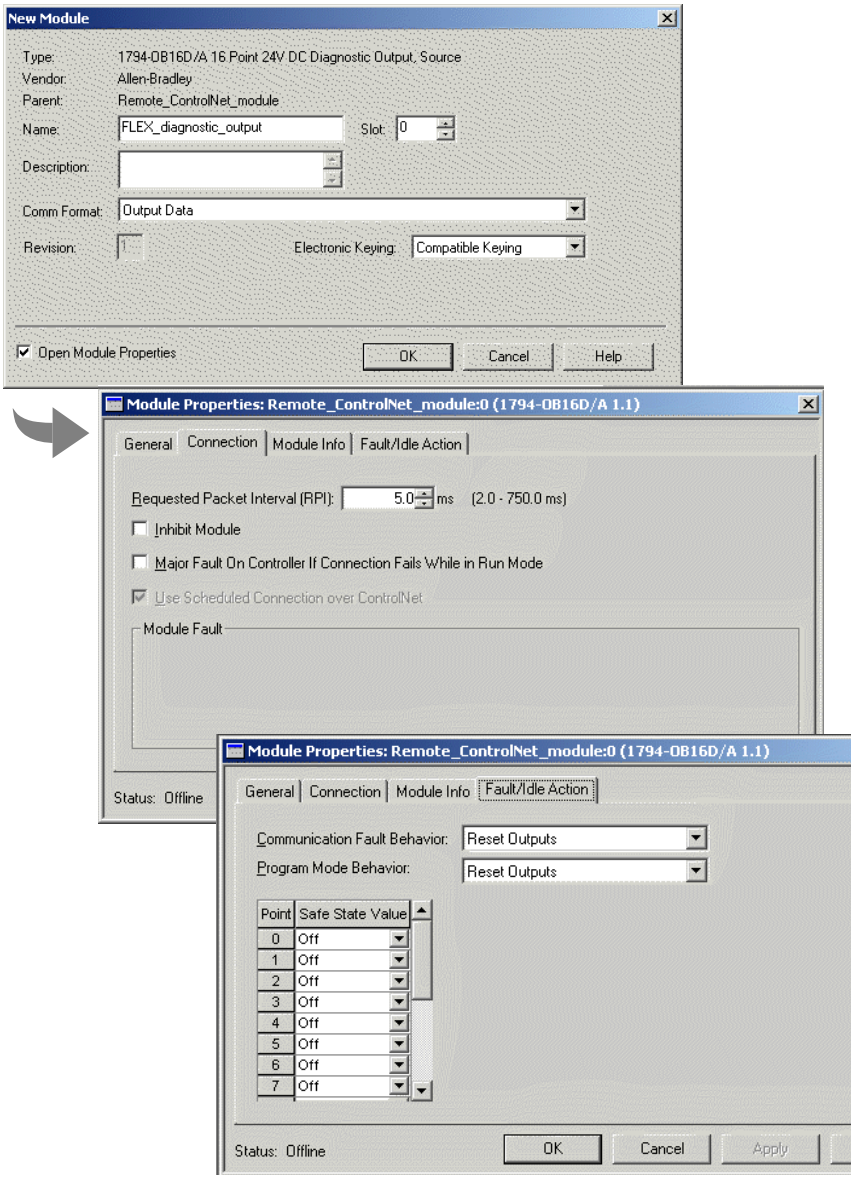
1. Add the local ControlNet communications modules, add the ControlNet adapter for the distributed I/O.

2. Add the distributed I/O module.



3. Configure the distributed I/O module. Depending on the distributed I/O type, the configuration screens differ.

To:	Do this:
Use the module's default configuration.	Specify the general information about the module (name, comm format, RPI, and others) and click *Finish*.
Customize the configuration.	Specify the general information about the module (name, comm format, RPI, and others). Then use the Tabs to step through subsequent screens to configure such parameters as filter times and fault actions. If the Open Module Properties is checked, clicking OK will automatically take you to next tab.

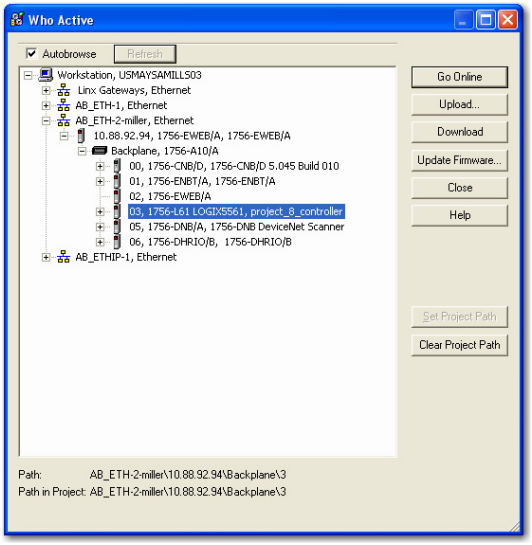


After you complete adding all FLEX I/O modules to your project file, you must download the project to your Logix 5000 controller.

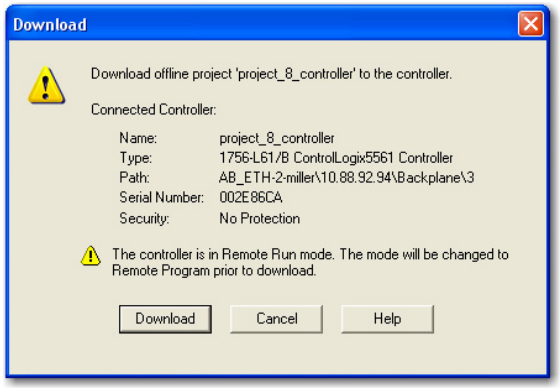
Download the Program to the Controller

Follow this procedure to download the program you saved to the ControlLogix controller.

1. From the main menu, choose Communications>Who-Active.
2. Select the processor slot in the chassis.
3. From the Who Active dialog, choose Set Project Path.

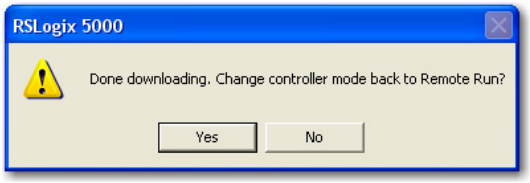


4. From the Who Active dialog, choose Download to see the Download dialog.

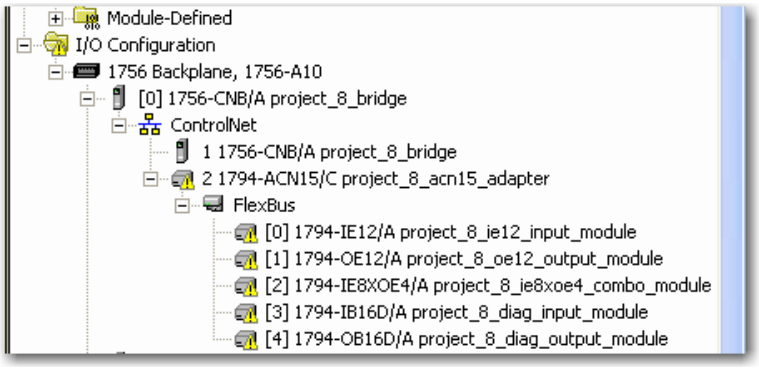


5. From the Download dialog, choose Download.

   You see this RSLogix 5000 dialog.



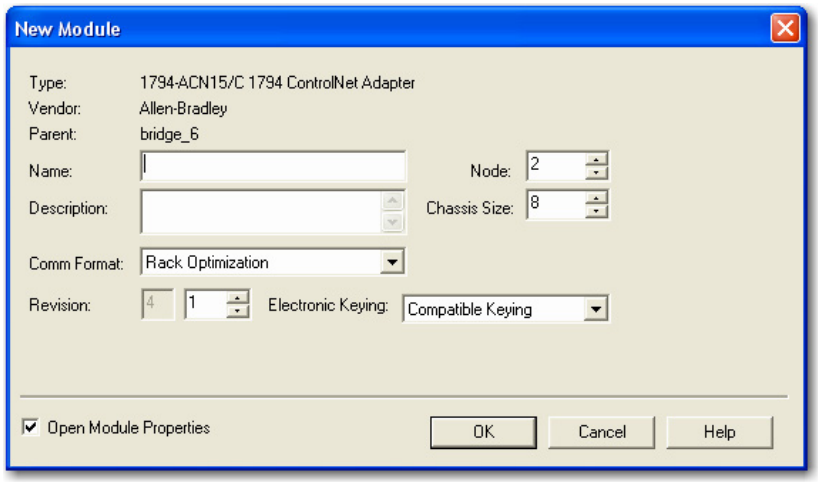
Notice that the 1756-CNB Bridge is now on line, but the rest of the I/O configuration (adapter and I/O modules) connections are not scheduled (notice the yellow triangles).



Configure the 1794-ACN15 Adapter

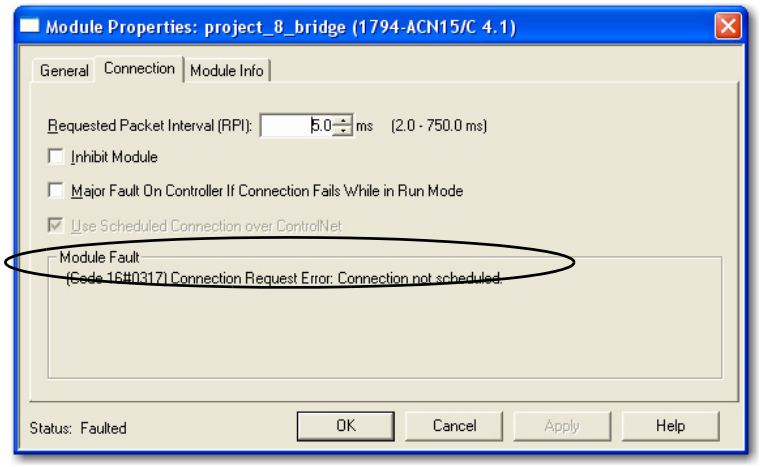
You have now built the I/O tree in RSLogix 5000, and the RSLogix 5000 software used the chassis size from the 1794-ACN15 General Tab. Now you must download this new chassis size value into the 1794-ACN15 adapter hardware. This procedure will synchronize the chassis size value from the RSLogix 5000 software into the 1794-ACN15 adapter.

1. Highlight the 1794-ACN15 adapter, and right-click to choose Properties.



Verify the node address and the chassis size.

2. Click the Connection tab.

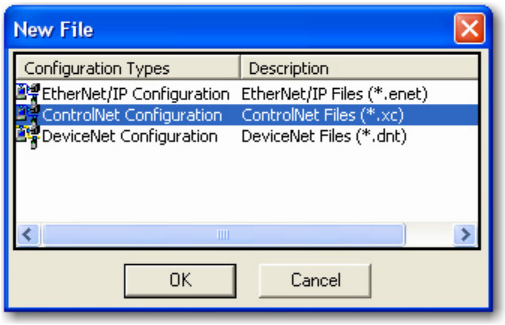


Notice that the connection request error is still present because we haven't scheduled any of the I/O module connections yet. You do that through RSNetWorx for ControlNet.

Schedule I/O Module Connections

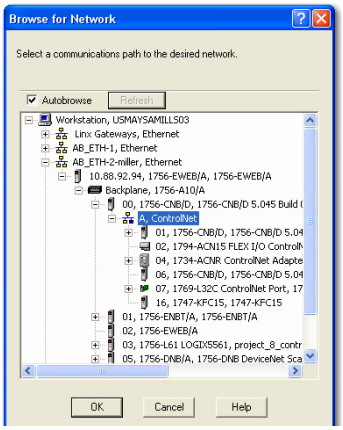
Use these procedures to schedule I/O module connections.

1. Start RSNetWorx for ControlNet.
2. From the File menu, choose New.

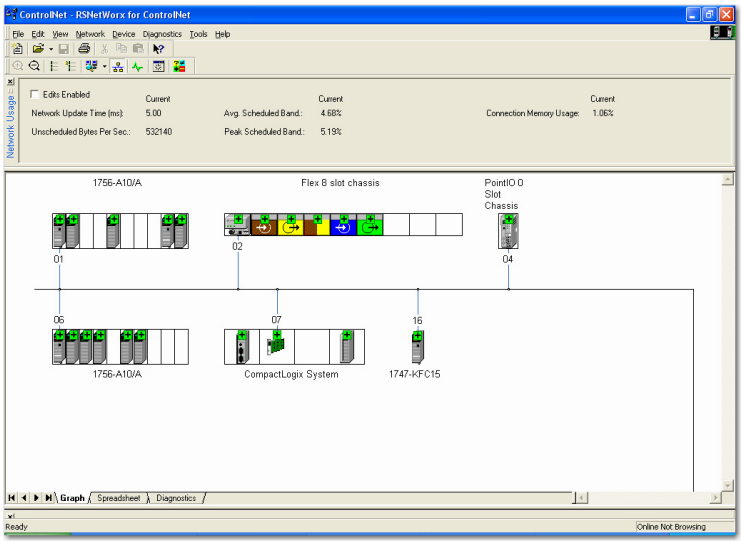


3. Click OK.
4. Choose Network>Online.

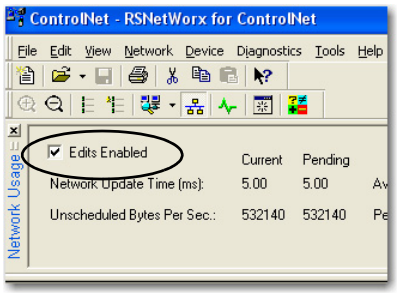
5. Browse to ControlNet Selection dialog.



6. Click OK.
When you are online, you see the following dialog.

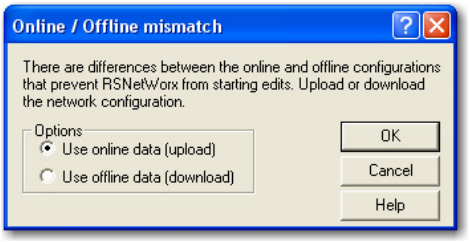


7. Choose Edits Enabled in the top left of the dialog.



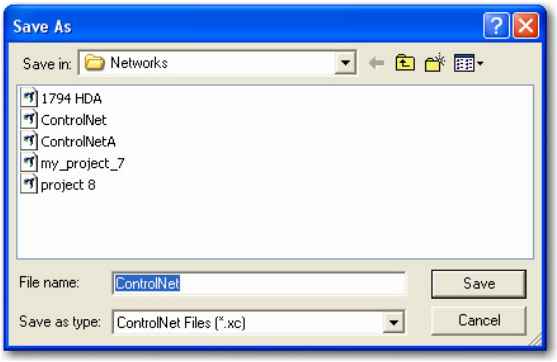
File and Save.

You see the Online/Offline mismatch window.

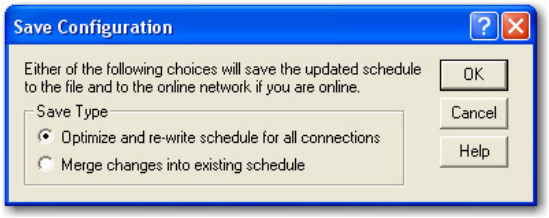


8. Click OK.

9. Give the RSNetWorx file a unique name, if desired.

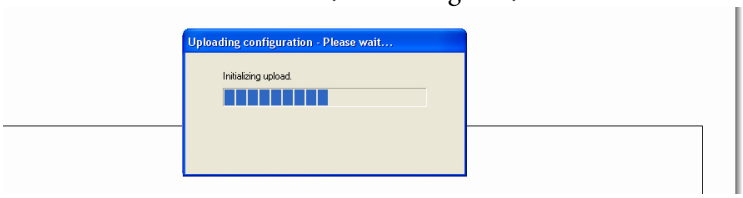


10. If the file exists, you are prompted before overwriting it.

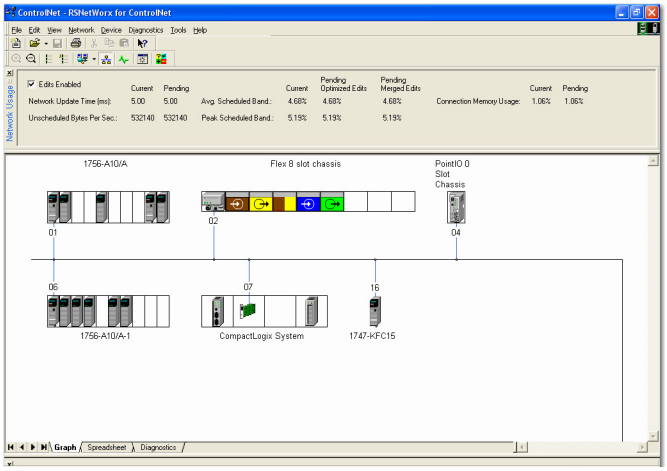


11. Click OK.

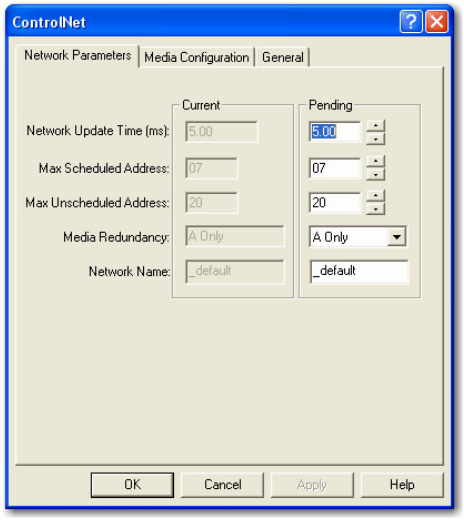
12. The network is verified, and configured,



13. The network and connections are now scheduled.



14. From the main menu, choose Network>Properties. The _default dialog appears.



Specify the following information on network parameters:

15. Specify a value for Network Update Time - the repetitive time interval in which data can be sent on the link.

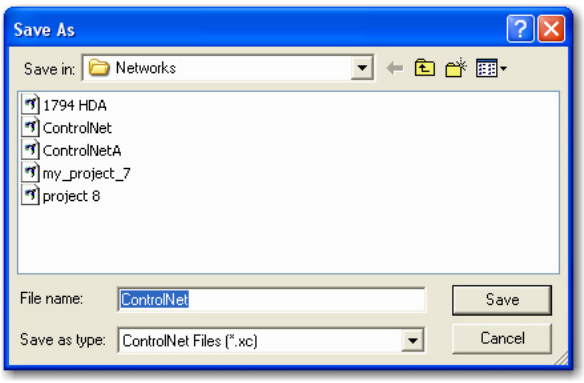
16. Specify a value for Max Scheduled Address - the highest number node that has scheduled connections to it.

17. Specify a value for Max Unscheduled Address - the node with the highest MAC ID that can use unscheduled time on the link.

    These values are set to 99 by default. Change these values to what is installed in your system. This saves you time because the controller will not have to search for all node addresses.

18. Specify a value for Media Redundancy on channel A, B or A and B.

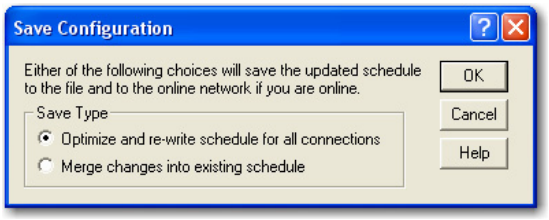
19. Click OK to see the Save As dialog.



20. Click Save to see the Save As dialog.

21. From the Save As dialog, enter a name and location for the file, and click Save.

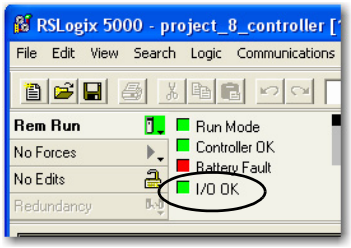
    You see the Save Configuration dialog.



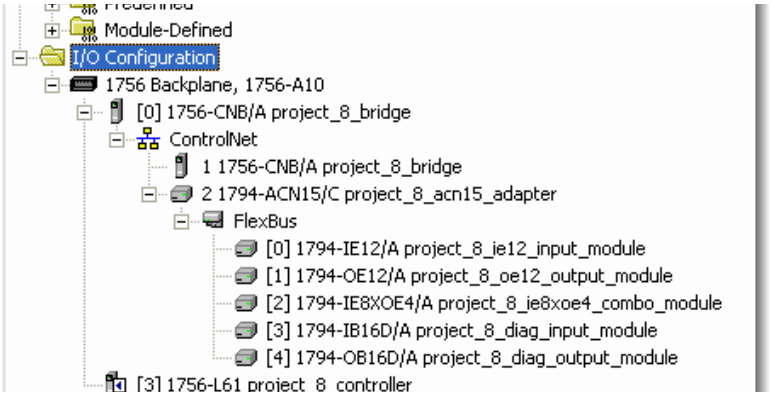
22. Click OK.

23. Minimize the RSNetworx for Controlnet window, and open your RSLogix 5000 window.

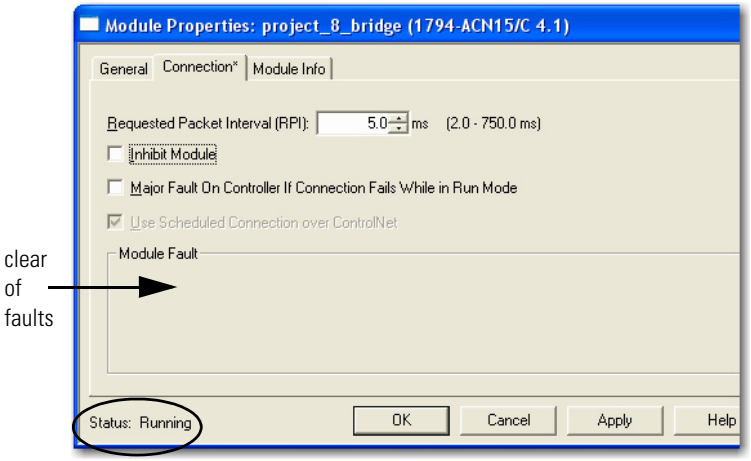
24. Notice the I/O OK is solid green in your RSLogix 5000 project.



25. Notice that all yellow warning triangles are gone in the I/O Configuration once connections are scheduled...



26. Notice that the Status in the 1794-ACN15 Module Properties dialog is Running with no faults.



Access Module Data via the 1794-ACN15 Adapter

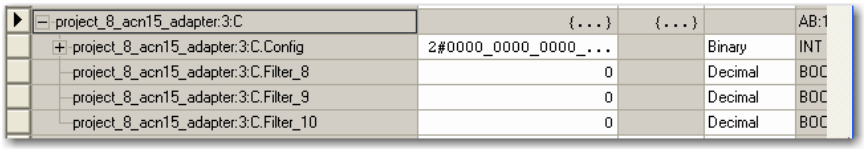
Use the following information to use the 1794 FLEX I/O ControlNet adapter data in the ladder logic program.

- ACN15 = the name you gave to your ControlNet adapter
- # = slot number of FLEX I/O module (0...7)
- C = configuration, I = input, O = output

When there is no slot number, that is the rack-optimized data.

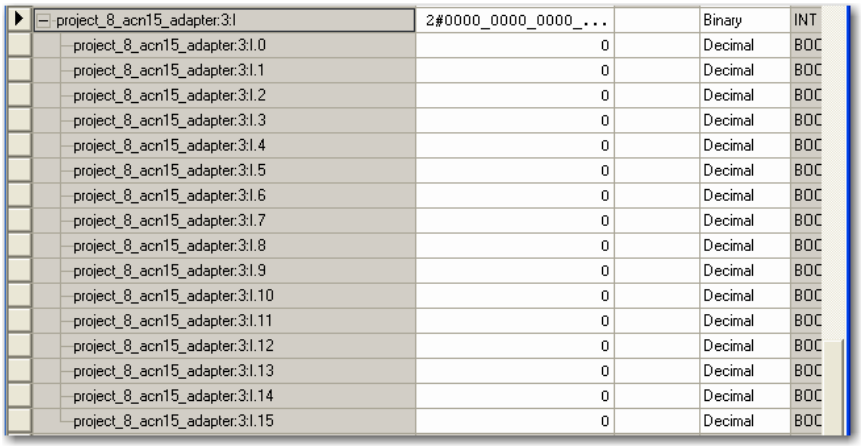
Here are some typical sample configuration data examples.

ACN15:3:C (1794-IB16D module) configuration data



project_8_acn15_adapter:3:C	{...}	{...}		AB:1
project_8_acn15_adapter:3:C.Config	2#0000_0000_0000_...		Binary	INT
project_8_acn15_adapter:3:C.Filter_8	0		Decimal	BOC
project_8_acn15_adapter:3:C.Filter_9	0		Decimal	BOC
project_8_acn15_adapter:3:C.Filter_10	0		Decimal	BOC

ACN15:2:I (1794-IB16D module) input data

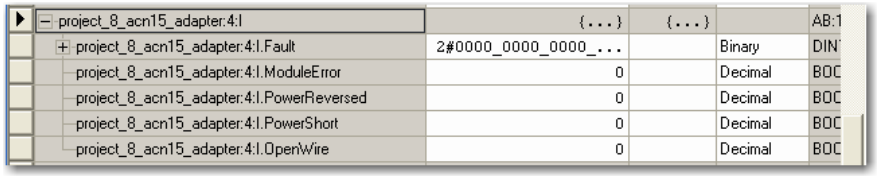


project_8_acn15_adapter:3:I	2#0000_0000_0000_...		Binary	INT
project_8_acn15_adapter:3:I.0	0		Decimal	BOC
project_8_acn15_adapter:3:I.1	0		Decimal	BOC
project_8_acn15_adapter:3:I.2	0		Decimal	BOC
project_8_acn15_adapter:3:I.3	0		Decimal	BOC
project_8_acn15_adapter:3:I.4	0		Decimal	BOC
project_8_acn15_adapter:3:I.5	0		Decimal	BOC
project_8_acn15_adapter:3:I.6	0		Decimal	BOC
project_8_acn15_adapter:3:I.7	0		Decimal	BOC
project_8_acn15_adapter:3:I.8	0		Decimal	BOC
project_8_acn15_adapter:3:I.9	0		Decimal	BOC
project_8_acn15_adapter:3:I.10	0		Decimal	BOC
project_8_acn15_adapter:3:I.11	0		Decimal	BOC
project_8_acn15_adapter:3:I.12	0		Decimal	BOC
project_8_acn15_adapter:3:I.13	0		Decimal	BOC
project_8_acn15_adapter:3:I.14	0		Decimal	BOC
project_8_acn15_adapter:3:I.15	0		Decimal	BOC

ACN15:4:O (1794-OB16D module) configuration data

project_8_acn15_adapter:4:C	{...}	{...}		AB:1
project_8_acn15_adapter:4:C.SSData	2#0000_0000_0000_...		Binary	INT

ACN15:4:I (1794-OB16D module) input data



project_8_acn15_adapter:4:I	{...}	{...}		AB:1
project_8_acn15_adapter:4:I.Fault	2#0000_0000_0000_...		Binary	DIN
project_8_acn15_adapter:4:I.ModuleError	0		Decimal	BOC
project_8_acn15_adapter:4:I.PowerReversed	0		Decimal	BOC
project_8_acn15_adapter:4:I.PowerShort	0		Decimal	BOC
project_8_acn15_adapter:4:I.OpenWire	0		Decimal	BOC

ACN15:4:O (1794-OB16D module) output data

project_8_acn15_adapter:4:O	{...}	{...}		AB:1
project_8_acn15_adapter:4:O.Data	2#0000_0000_0000_...		Binary	INT

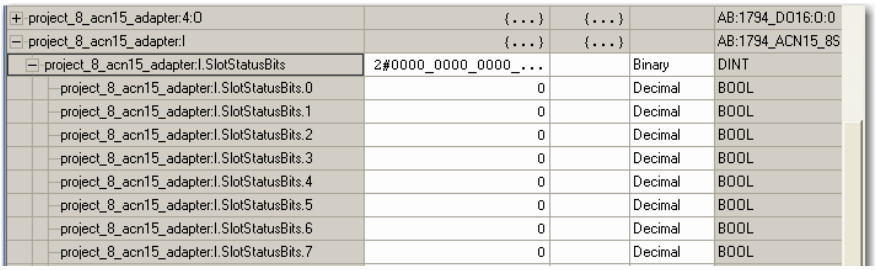
TIP It is also possible to send configurations via CIP™ messages.

Use the controller tags in your ladder program to read input data or write output data.

Slot Status Bits

The Slot Status bits display the connection status for each of the FLEX I/O modules that use a rack-optimized connection.

- Adapter:I:slot status bits :3 and :4 correspond to the rack-optimized connection in the 1794-ACN15 slots 3 and 4.
- Each of the other bits corresponds to a FLEX I/O module that may be installed in the I/O backplane.



+ project_8_acn15_adapter:4:O	{...}	{...}		AB:1794_DO16:O:0
− project_8_acn15_adapter:I	{...}	{...}		AB:1794_ACN15_8S
− project_8_acn15_adapter:I.SlotStatusBits	2#0000_0000_0000_...		Binary	DINT
project_8_acn15_adapter:I.SlotStatusBits.0	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.1	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.2	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.3	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.4	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.5	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.6	0		Decimal	BOOL
project_8_acn15_adapter:I.SlotStatusBits.7	0		Decimal	BOOL

In this example, the 1794-ACN15 adapter is using three direct connections; slot 0 is a 1794-IE12 module, slot 1 is a 1794-OE12 module, and slot 2 is a 1794-IB8XOB4 module. Slot 3 is a 1794-IB16D, and slot 4 is a 1794-OB16D module, both connected using rack-optimized connections. All modules are installed and operating correctly with (0 = no error). A 1 would indicate “no connection error,” (typically, module removed or missing).

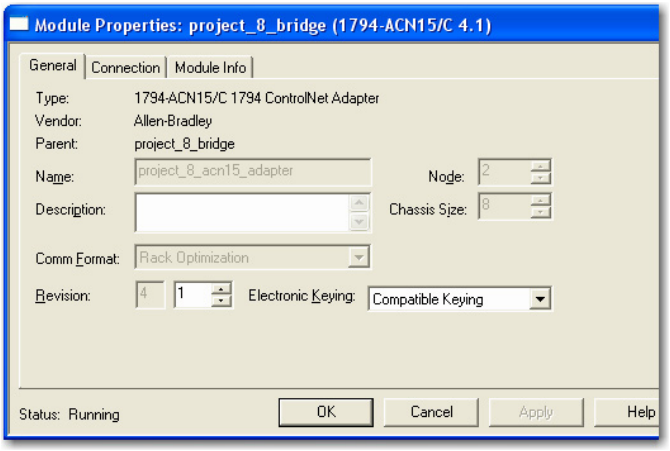
Change Configuration Data

One way to change the configuration data for a 1794 FLEX I/O module:

1. Enter the new configuration data (#:C) into the controller tags.
2. Select Module or Adapter in the I/O configuration tree.
3. Right-click Properties.

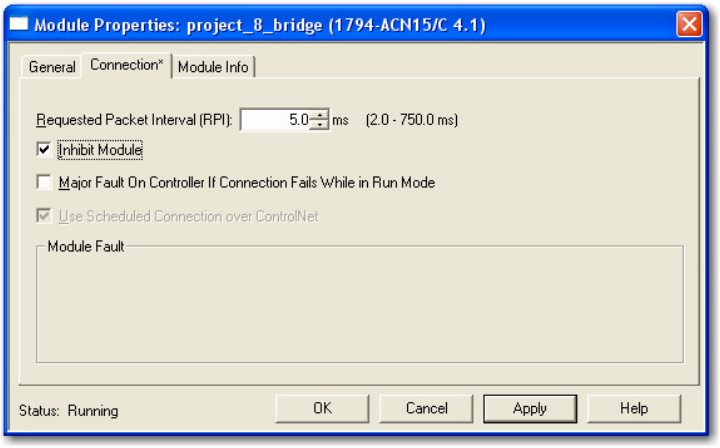
IMPORTANT When your first add an I/O module to the I/O configuration, the default parameters are assigned. To change these default values, you must modify the controller reference tags associated with the I/O module. To download the new configuration, you must reinitiate the connection to the I/O module. This download is best achieved by inhibiting and uninhibiting the module.

4. Select Properties.



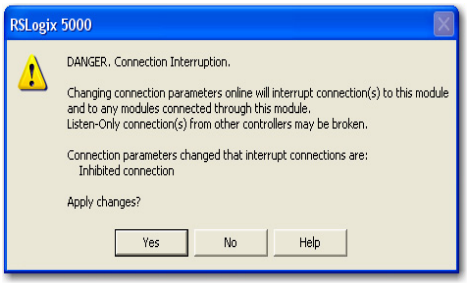
5. Click the Connection tab.

6. Check the Inhibit Module checkbox.



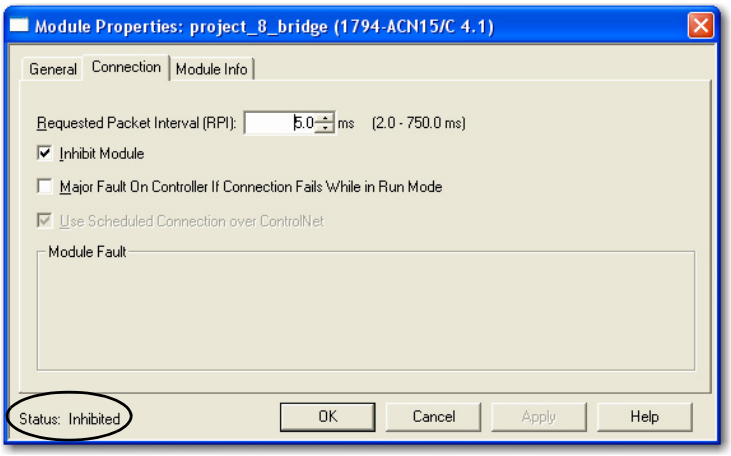
When you inhibit an adapter, all modules are inhibited. When you inhibit a module, only the module is inhibited, not the whole rack.

7. Click Apply.

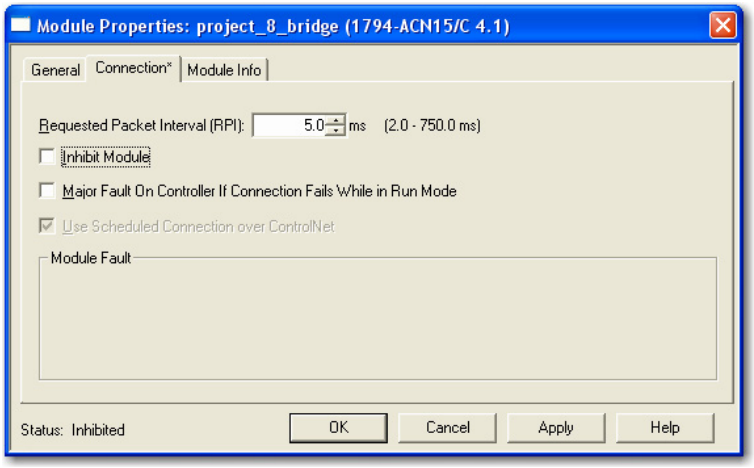


8. Click OK to confirm disabling the connection.

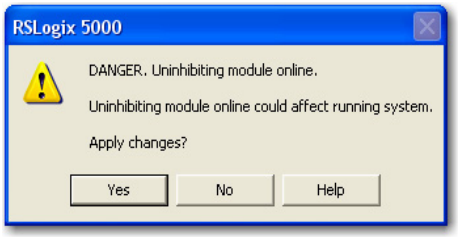
   The connection is now inhibited.



9. Uncheck the Inhibit Module checkbox to disable the inhibit module function.

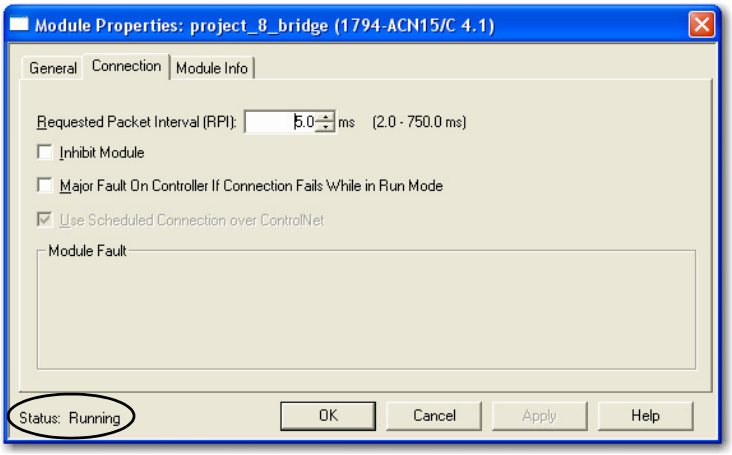


10. Click Apply to download the configuration data.



11. Click Yes.

12. The connection status is now Running, and the module is using the updated configuration data.



Configure your Digital Module on an EtherNet/IP Network

How to Use This Chapter

This chapter describes how a controller controls distributed I/O over an EtherNet/IP network. The controller requires a communication module to connect to the network. Distributed I/O modules require an adapter to connect to the network.

Topic	See Page
How to Use This Chapter	83
Set Up the Hardware	84
Select a Requested Packet Interval (RPI)	84
Select a Communication Format	85
Add Distributed I/O	90
Download the Program to the Controller	91
Access Distributed I/O	93
Determining Required Network Parameters	95
Assigning Network Parameters via the BOOTP/DHCP Utility	96
Using Other Methods to Assign Network Parameters	99
Duplicate IP Address Detection	102
IP Address Swapping	104

In this example, we show you how to control FLEX I/O over Ethernet using RSNetWorx for Ethernet and RSLogix 5000 software.

To control distributed I/O over Ethernet, you must:

- Add local and remote Ethernet communication modules to your RSLogix 5000 project.
- Add distributed I/O to your RSLogix 5000 project.
- Schedule the Ethernet network via RSNetWorxRSNetWorx for Ethernet.
- Use the I/O information in RSLogix 5000 software.

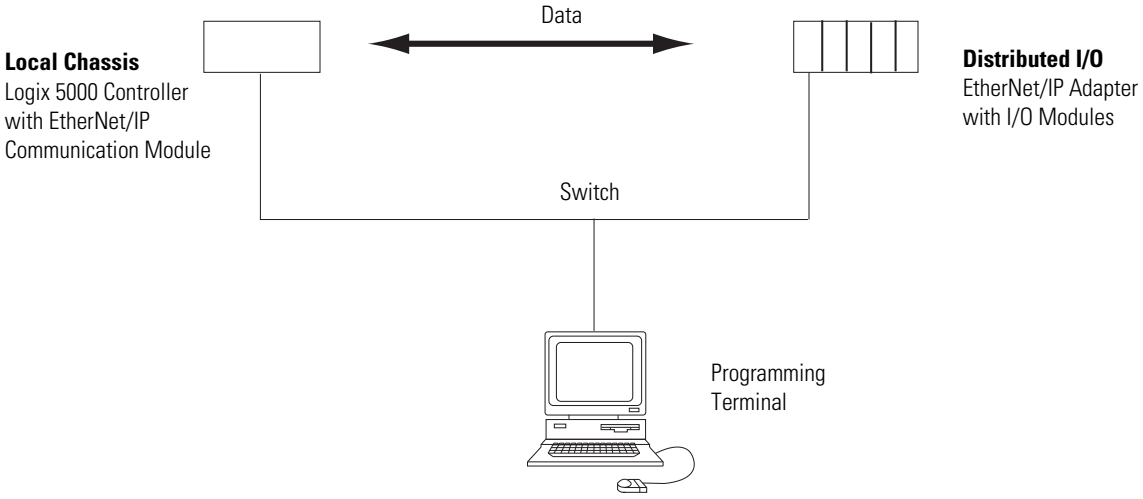
You can also validate connections to distributed I/O when controlling it over Ethernet. This task is useful when one or more of the connections are not

working but is not required, especially when all connections appear to work normally.

When you first install a Rockwell Automation EtherNet/IP module (right out of the box), the module is BOOTP/DHCP enabled.

Set Up the Hardware

In this example, the Logix 5000 controller has an EtherNet/IP communication module to connect to the EtherNet/IP network. The distributed (remote) I/O has an EtherNet/IP adapter to connect it to the EtherNet/IP network.



The Logix 5000 controller can communicate with each I/O module directly (direct connection). Or you can configure a rack-optimized connection to the EtherNet/IP adapter to send data to any digital I/O modules.

Make sure:

- the IP addresses are set for each EtherNet/IP module
- all wiring and cabling is properly connected
- the communication driver (such as, AB-ETHIP-1) is configured for the programming workstation

For more information on the Ethernet Adapter and FLEX I/O in an Ethernet network, refer to publication ENET-UM006.

Select a Requested Packet Interval (RPI)

When you configure an I/O module, you define the requested packet interval (RPI) rate for the module.

The RPI specifies the period at which data updates over a connection. For example, an input module sends data to a controller at the RPI that you assign to the module. Configure the RPI in milliseconds.

RPIs are only used for modules that produce data. For example, a local EtherNet/IP communication module does not require an RPI because it is not a data-producing member of the system; it is used only as a bridge.

In Logix 5000 controllers, I/O values update at a period that you configure via the I/O configuration folder of the project. The values update asynchronous to the execution of logic. At the specified interval, the controller updates a value independently from the execution of logic.

Set the RPI only as fast as needed by the application. The RPI also determines the number of packets per second that the module will produce on a connection. Each module has a limit of how many packets it can produce per second. If you exceed this limit, the module cannot open any more connections.

For information on RPI and how it affects the actual packet interval (API), see the EtherNet/IP Performance Application Solution, ENET-AP001.

Select a Communication Format

When you configure an I/O module, you select a communication format for the module. The communication format that you choose determines the data structure for the tags that are associated with the module. Many I/O modules support different formats. Each format uses a different data structure. The communication format that you choose also determines:

- Direct or rack-optimized connection
- Ownership

The available communication formats depend on the type of I/O module. In general:

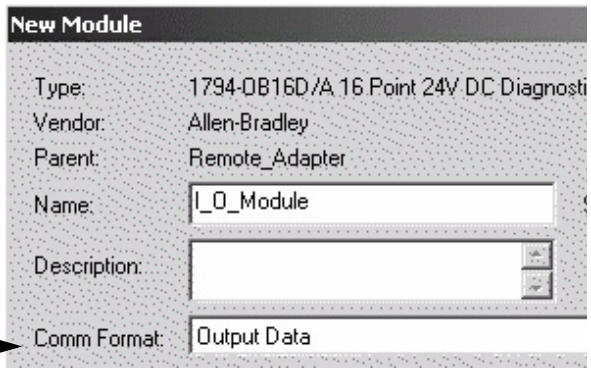
If you have this type of I/O module	And want	Select a communication format that specifies
Digital Module	rack-optimized connection	Rack Optimization
		Scheduled Data... Input Data Output Data
Digital Module	a direct connection	Any connection that is not Rack Optimization
	to use specialty features of the module, such as diagnostics, timestamps, or electronic fuses	Full Diagnostics... CST Timestamped...
Analog Module	a direct connection (only direct connection is supported for analog modules)	Float Data... Integer Data CST Timestamped...

See online help in RSLogix 5000 programming software for specific communication formats per I/O module.

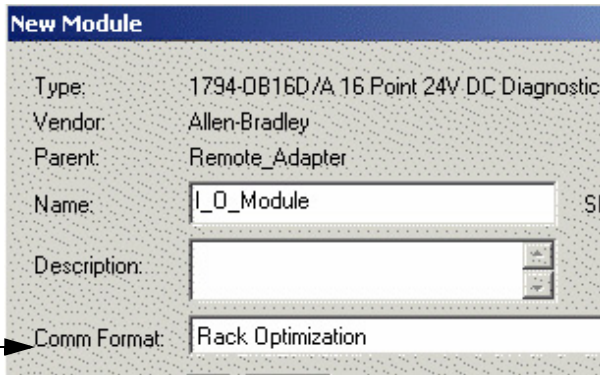
Choose Direct or Rack-optimized Connection

The Logix 5000 controller uses connections to transmit I/O data. These connections can be direct connections or rack-optimized connections.

Term	Definition
Direct Connection	A direct connection is a real-time, data transfer link between the controller and an I/O module. The controller maintains and monitors the connection with the I/O module. Any break in the connection, such as a module fault or the removal of a module while under power, sets fault bits in the data area associated with the module.
Rack-optimized Connection	For digital I/O modules, you can select rack-optimized communication. A rack-optimized connection consolidates connection usage between the controller and all digital I/O modules in the chassis (or DIN rail). Rather than having individual, direct connections for each I/O module, there is one connection for the entire chassis (or DIN rail).



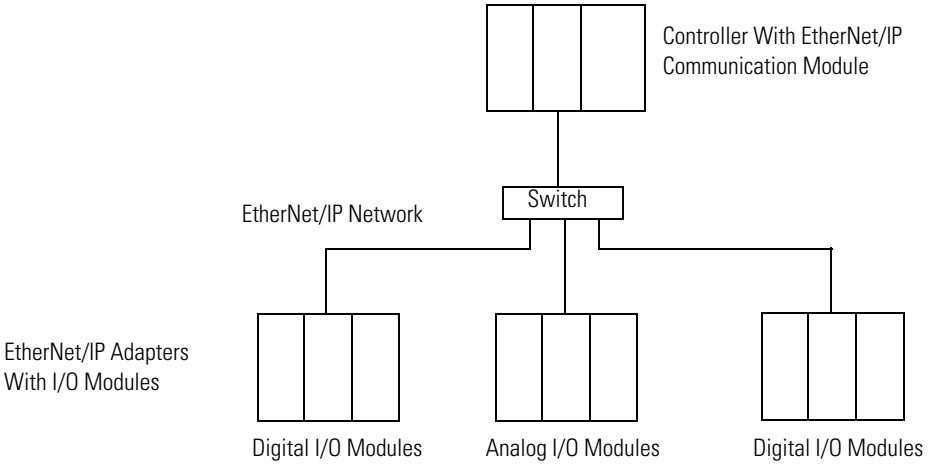
A direct connection is any connection that *does not* use the Rack Optimization Comm Format.



Rack-optimized Connection

Direct Connections For I/O Modules

In this example, assume that each distributed I/O module is configured for a direct connection to the controller.



The following table calculates the connections in this example.

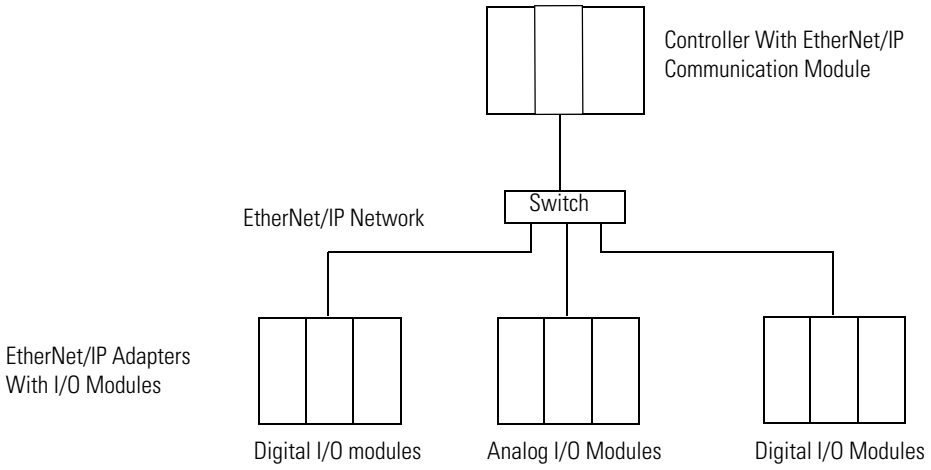
System Connections	Amount
Controller to local EtherNet/IP communication module	0
Controller to EtherNet/IP adapter	
Direct connection for digital I/O module	4
Direct connection for analog I/O module	2
Total connections used	6

If you have many modules, direct connections to each module may not be feasible because you could use up the number of connections and packets per second supported by the module.

See Rack-optimized Connections For I/O Modules on page 86 to conserve connection use and network traffic.

Rack-optimized Connections For I/O Modules

In this example, assume that each digital I/O module is configured for a rack-optimized connection to the controller. Analog modules must be configured for direct connections.



The following table calculates the connections in this example.

System Connections	Amount
Controller to local EtherNet/IP communication module	0
Controller to EtherNet/IP adapter with digital modules (rack-optimized connection to each adapter)	2
Controller to EtherNet/IP adapter with analog modules (direct connection for each analog I/O module)	2
Total Connections used	4

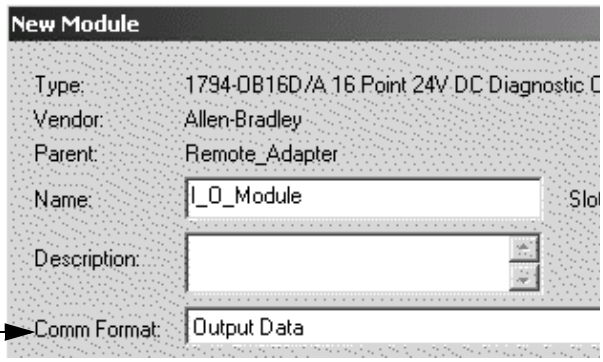
The rack-optimized connection conserves connections, but can limit the status and diagnostic information that is available from the I/O modules.

To optimize the number of available connections, use a rack-optimized connection between any digital I/O that allow it and the remote adapter that connects the distributed I/O to the controller via the communication module.

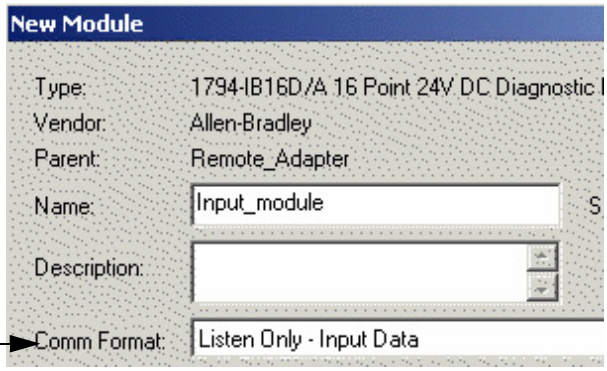
Ownership

In a Logix 5000 system, modules multicast data. This means that multiple modules can receive the same data simultaneously from one module. When you choose a communication format, you have to choose whether to establish an owner or listen-only relationship with the module

Owner controller	The controller that creates the primary configuration and communication connection to a module. The owner controller writes configuration data and can establish a connection to the module.
Listen-only connection	An I/O connection where another controller owns/provides the configuration data for the I/O module. A controller using a listen-only connection only monitors the module. It does not write configuration data and can only maintain a connection to the I/O module when the owner controller is actively controlling the I/O module.



An owner connection is any connection that *does not* include Listen-Only in its Comm Format.



Listen-only Connection

If the module is also in the I/O configuration of another controller, then select the Listen Only version of the Comm Format (for example, Listen Only - Input Data).

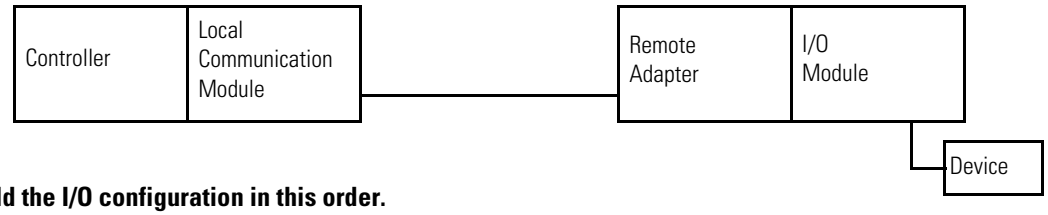
Select a Remote Adapter

The remote adapter that you use depends on the distributed I/O you use. When using FLEX I/O modules, you use the FLEX I/O adapter, cat. no. 1794-AENT, which requires the BOOTP utility.

Add Distributed I/O

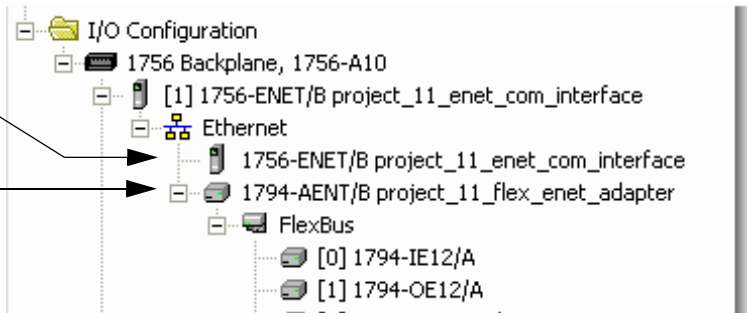
To communicate with the I/O modules in your system, you add bridge, adapter, and I/O modules to the I/O Configuration folder of the controller. Within the I/O Configuration folder, you organize the modules into a hierarchy (tree/branch, parent/child).

For a typical distributed I/O network, you build the I/O configuration in this order.

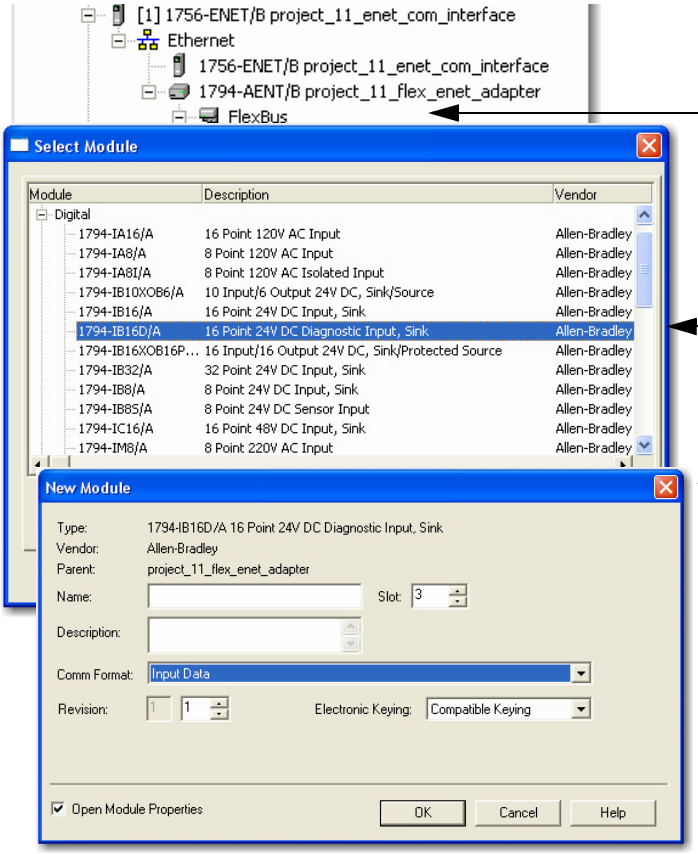


…you build the I/O configuration in this order.

1. Add the local communication module (bridge).
2. Add the remote adapter for the distributed I/O chassis or DIN rail.
3. Add the I/O module.



Add a Module



1. Right-click the level (branch) to which you want to add the module and choose New Module.
2. Choose the module.
3. Configure the module.

To	Do this
Use the default configuration	Specify the general information about the module (name, comm format, and so on) and click Finish.
Customize the configuration	Specify the general information about the module (name, comm format, and so on). Then use the tabs to step through subsequent screens.

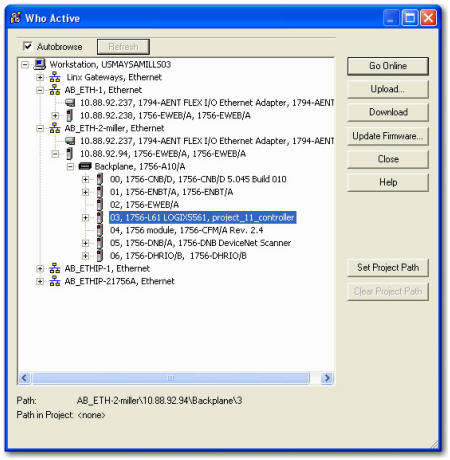
The Comm Format selection that you make when you add a communication module and its I/O modules is based on whether you want rack-optimized or direct connections to each distributed I/O module. In general:

If the distributed I/O is	Select this format for the remote adapter	Select this format for the distributed I/O module
Digital	Rack Optimization	Rack Optimization
Analog	None	An appropriate direct-connection format.

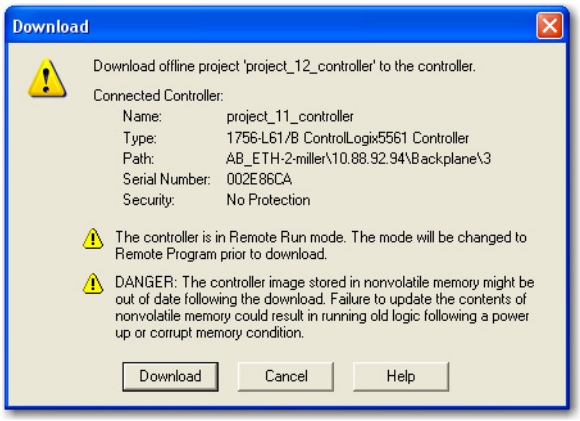
Download the Program to the Controller

Follow this procedure to download the program you saved to the ControlLogix controller.

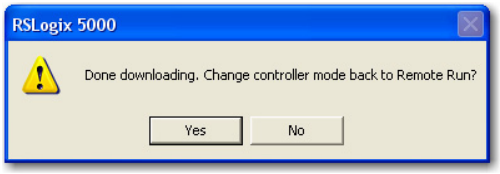
1. From the main menu, choose Communication>Who-Active.
2. Select the processor slot in the chassis.
3. From the Who-Active dialog, choose Set Project Path.



4. From the Who Active dialog, choose Download to see the Download dialog.



5. From the Download dialog, choose Download.



6. Click OK.

7. Your system is now up and running.

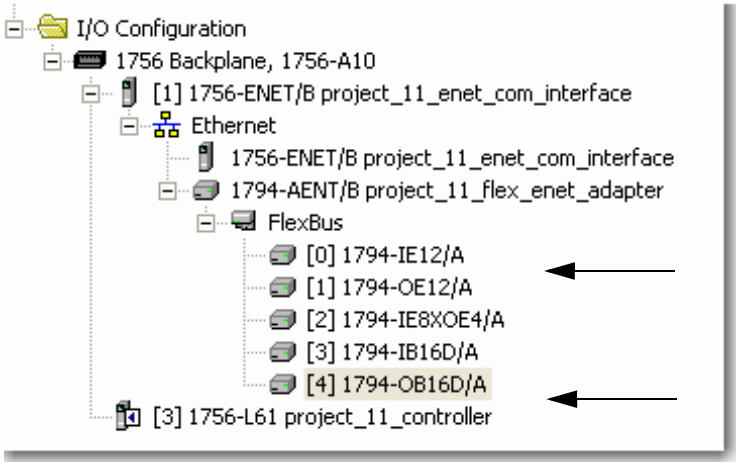
Access Distributed I/O

I/O information is presented as a structure of multiple fields, which depend on the specific features of the I/O module. The name of the structure is based on the location of the I/O module in the system. Each I/O tag is automatically created when you configure the I/O module through the programming software. Each tag name follows this format:

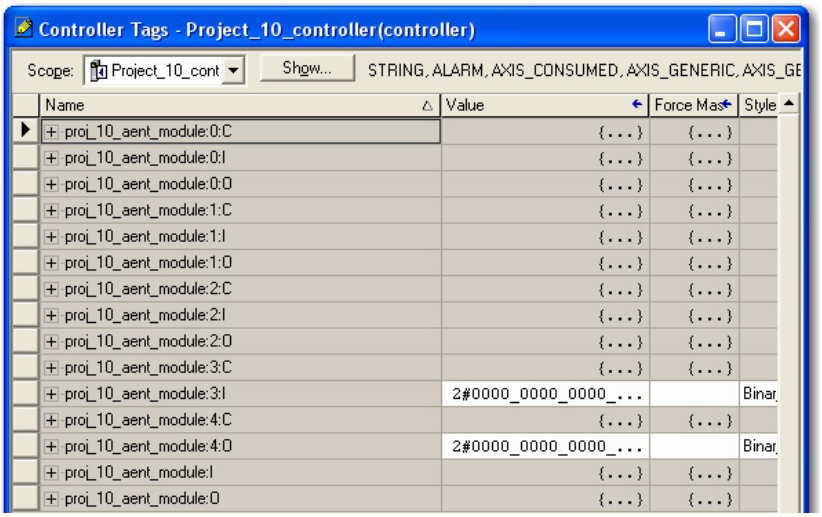
Location:SlotNumber:Type.MemberName.SubMemberName.Bit where:

This address variable:	Is:
Location	Identifies network location LOCAL = local DIN rail or chassis ADAPTER_NAME = identifies remote adapter or bridge
SlotNumber	Slot number of I/O module in its chassis
Type	Type of data I = input O = output C = configuration S = status
MemberName	Specific data from the I/O module; depends on the type of data the module can store For example, Data and Fault are possible fields of data for an I/O module. Data is the common name for values the are sent to or received from I/O points.
SubMemberName	Specific data that is related to a MemberName.
Bit (optional)	Specific point on the I/O module; depends on the size of the I/O module (0…31 for a 32-point module)

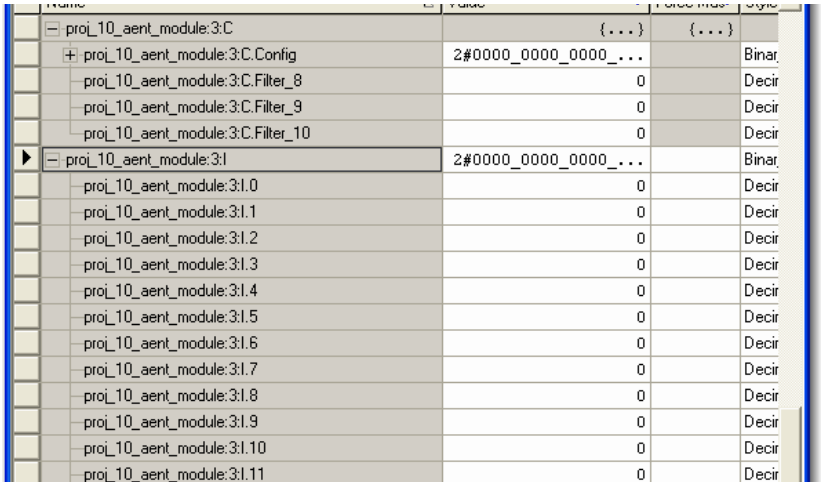
EXAMPLE



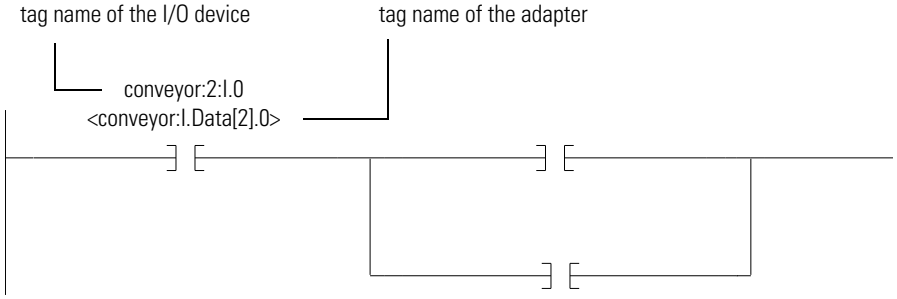
Example 1



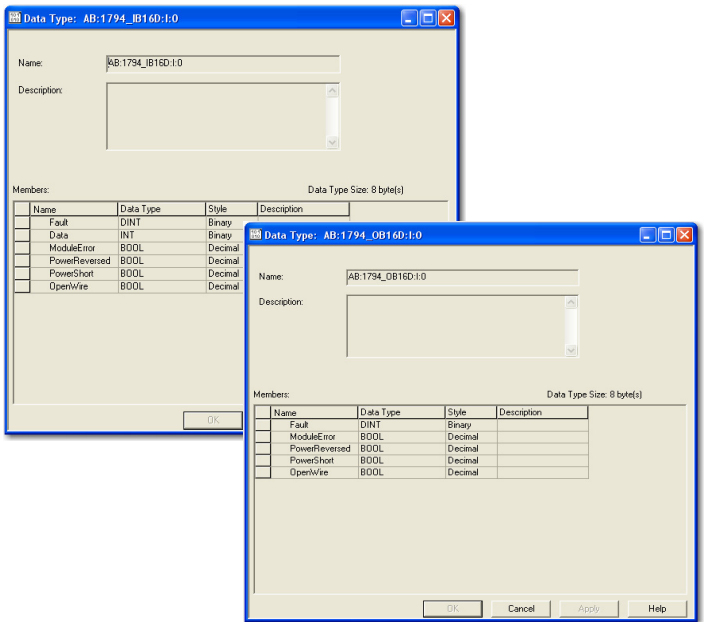
Example 2



When you choose rack optimization for an I/O module, its tags are created as aliases for the tags of the adapter. In your logic, you see the tag of the device as aliases for a tag of the adapter. (The tag name of the adapter is in angle brackets).



Data types with tag names are produced by the program.



General Information About IP Addresses

The following information outlines steps that you must take if initially configuring your EtherNet/IP network.

Determining Required Network Parameters

To operate on an EtherNet/IP network, you must define these parameters.

EtherNet/IP Parameter:	Description:
IP address	The IP address uniquely identifies the module. The IP address is in the form xxx.xxx.xxx.xxx where each xxx is a number between 0…255. These are reserved values that you cannot use: • 127.0.0.1 • 0.0.0.0 • 255.255.255.255
subnet mask	Subnet addressing is an extension of the IP address scheme that allows a site to use one network ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom network ID portion and host ID portion. This field is set to 0.0.0.0 by default. If you change the subnet mask of an already-configured module, you must cycle power to the module for the change to take effect.
gateway	A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. This field is set to 0.0.0.0 by default.

If you use DNS addressing, or reference the module via host name in MSG instructions, define these parameters:

EtherNet/IP Parameter:	Description:
host name	A host name is part of a text address that identifies the host for a module. The full text address of a module is *host_name.domain_name*.
domain name	A domain name is part of a text address that identifies the domain in which the module resides. The full text address of a module is host_name.domain_name. The domain name has a 48-character limit. If you specify a DNS server, you must enter a domain name. Also, if you send email from the module, some mail relay servers require a domain name be provided during the initial handshake of the SMTP session.
primary DNS server address secondary DNS server address	This identifies one or more DNS servers, if used in the network. You must have a DNS server configured if you specified a domain name or a host name in the module's configuration. The DNS server converts the domain name or host name to an IP address that can be used by the network. The 1756-ENBT requires a DNS server address. For more information on DNS addressing, see EtherNet/IP Network Devices User Manual, publication ENET-UM006.

Check with your Ethernet network administrator to determine if you must specify all of the above parameters.

To configure these network parameters, the recommended method is to use the Rockwell Automation BOOTP/DHCP utility. If this utility is not available, there are other methods that you can use.

Assigning Network Parameters via the BOOTP/DHCP Utility

By default, the EtherNet/IP module is BOOTP enabled. The BOOTP/DHCP utility is a standalone program that is in the:

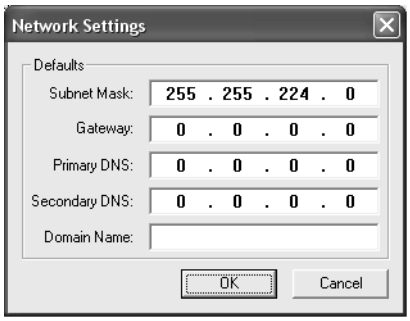
- BOOTP-DHCP Server folder in the Rockwell Software program folder on the Start menu (the utility is automatically installed when you install RSLinx® software)
- Tools directory on the RSLogix 5000 installation CD.

IMPORTANT Before you start the BOOTP/DHCP utility, make sure you have the hardware (MAC) address of the module. The hardware address is on a sticker that is on the side of the EtherNet/IP module. The hardware address in a format similar to: 00-0b-db-14-55-35.

This utility recognizes BOOTP-enabled devices and provides an interface to configure a static IP address for each device.

To use the BOOTP/DHCP utility:

1. Start the BOOTP/DHCP software.
2. Select Tool → Network Settings.

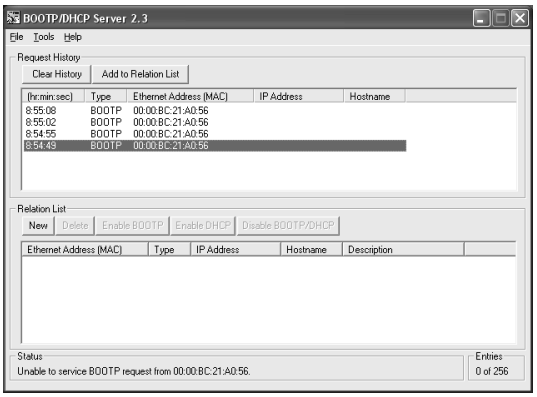


If appropriate for your network, enter the subnet mask, gateway address, primary/secondary server addresses, and roman name. Click OK.

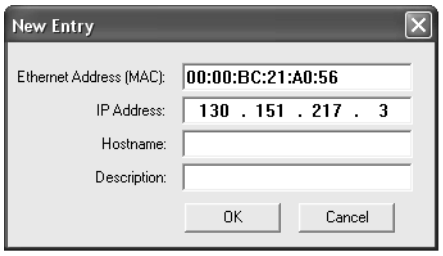
In the Request History panel, you see the hardware addresses of modules issuing BOOTP requests.

3. Double-click the hardware (MAC) address of the module you want to configure.

The hardware address is on a sticker that is on the side of the EtherNet/IP module. The hardware address will be in a format similar to: 00-0b-db-14-55-35.



The New Entry window appears with the module's Ethernet Address (MAC).



4. Enter the IP address or the host name. You can also enter a description of the module. Click OK

5. To permanently assign this configuration to the module, highlight the module and click the Disable BOOTP/DHCP button.

   When power is recycled, the module uses the configuration that you assigned and not issue a BOOTP request.

   If you do not select the Disable BOOTP/DHCP button, on a power cycle, the host controller clears the current IP configuration and will again begin sending BOOTP requests.

Using Other Methods to Assign Network Parameters

Other methods to assign network parameters include:

If you are working in these conditions	Use this method for assigning network parameters	See publication
• a BOOTP server is not available • the EtherNet/IP module is connected to another NetLinx network	RSLinx software	ENET-UM006
• the RSLogix 5000 project is online with the controller that communicates to or through the EtherNet/IP module	RSLogix 5000 software	
• DHCP is enabled (not BOOTP) for the EtherNet/IP module	DHCP software	

Other considerations that might affect your choice of method include:

- whether the network is isolated from or integrated into the plant/enterprise network
- size of the network

  For large networks, even isolated networks, it might be more convenient and safer to use a BOOTP/DHCP server rather than RSLogix 5000 or RSLinx software. It might also offer fewer opportunities for assigning duplicate IP addresses.

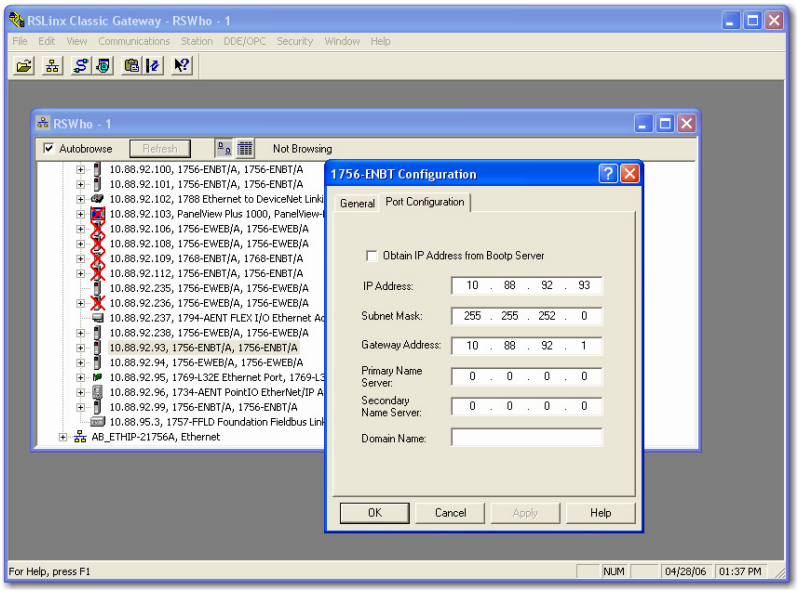
- company policies and procedures dealing with plant floor network installation and maintenance
- level of involvement by IT personnel in plant floor network installation and maintenance
- type of training offered to control engineers and maintenance personnel

If you use the Rockwell Automation BOOTP or DHCP server in an uplinked subnet where an enterprise DHCP server exists, a module may get an address from the enterprise server before the Rockwell Automation utility even sees the module. You might have to disconnect from the uplink to set the address and have the module remember its static address before reconnecting to the uplink. This is not a problem if you have node names that are configured in the module and leave DHCP enabled.

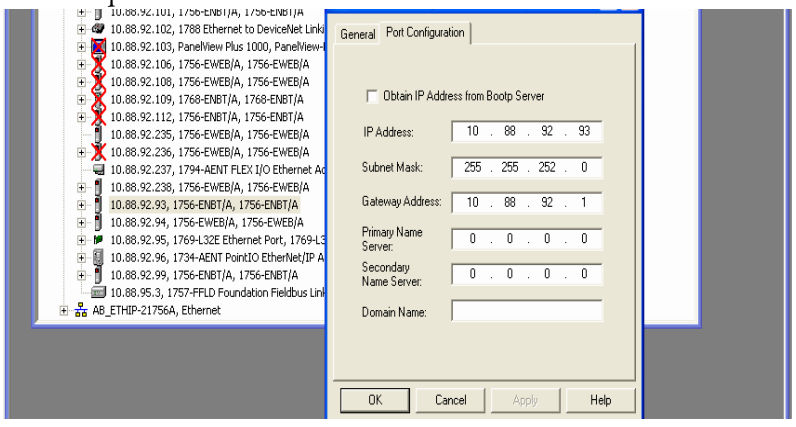
Using RSLinx software to set the IP Address

To use RSLinx to configure the EtherNet/IP module:

1. Make sure that the module is installed and powered up.
2. Start RSLinx. The RSWho window opens. Navigate in RSWho to the Ethernet network.
3. Right-click on the EtherNet/IP module (not the controller, if there is one) and select Module Configuration.



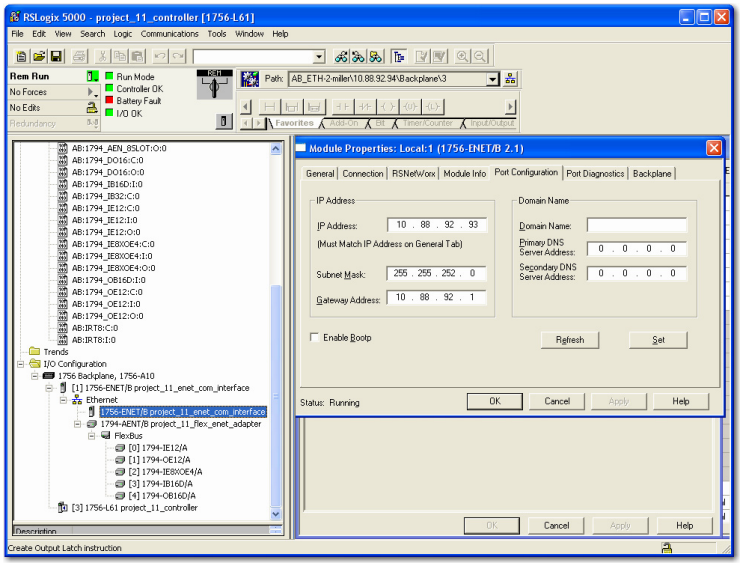
4. Select the Port Configuration tab, choose Status Network Configuration type, and enter the IP address and the other network parameters, if needed.
5. Also, select the Static radio button to permanently assign this configuration to the port. If you select Dynamic, on a power cycle, the controller clears the current IP configuration and will again begin sending BOOTP requests.



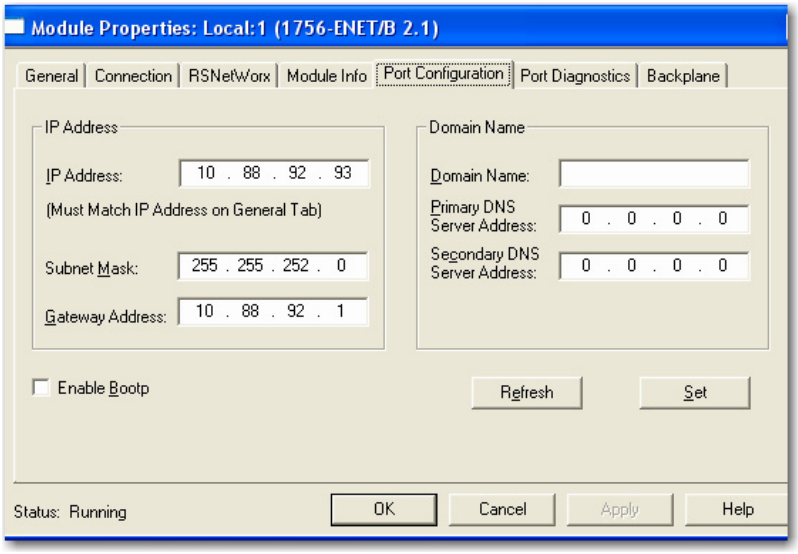
Using RSLogix 5000 software to set the IP Address

To use RSLogix 5000 software to configure the EtherNet/IP module:

1. Make sure the module in installed and powered up.
2. Connect to the controller via a serial, or other network, connection.
3. Start RSLogix 5000 software. In the Controller Organizer, select properties for the EtherNet/IP module.



4. Select the Port Configuration tab and specify the IP address and the other network parameters, if needed. Click Apply and then click OK.



This sets the IP address in the hardware. This IP address should be the same IP address that you assigned under the General tab.

On this screen, you can also specify port speed (10 Mbps or 100 Mbps) and duplex mode (autonegotiate, half-duplex, or full-duplex). All modules on the same subnet must be configured for the same port speed and duplex mode.

Using DHCP software to set the IP Address

DHCP (Dynamic Host Configuration Protocol) software automatically assigns IP addresses to client stations logging onto a TCP/IP network. DHCP is based on BOOTP and maintains some backward compatibility. The main difference is that BOOTP allows for manual configuration (static), while DHCP allows for both static and dynamic allocation of network addresses and configurations to newly attached modules.

Be cautious when using DHCP software to configure your module. A BOOTP client, such as the EtherNet/IP modules, can boot from a DHCP server only if the DHCP server is written to also handle BOOTP queries. This is specific to the DHCP software package you use. Check with your system administrator to see if your DHCP package supports BOOTP commands and manual IP allocation.

ATTENTION: The EtherNet/IP module must be assigned a fixed network address. The IP address of this module must not be dynamically provided.

Failure to observe this precaution may result in unintended machine motion or loss of process control.

Duplicate IP Address Detection

These EtherNet/IP modules (and their future revisions) support duplicate IP address detection:

- 1756-ENBT, firmware revision 3.2 and greater
- 1788-ENBT, firmware revision 2.1 and greater
- 1756-EWEB, firmware revision 2.2 and greater (For more information about this module, see the EtherNet/IP Web Server Module User Manual, publication ENET-UM527.)

When you change the IP address or connect one of these modules to an EtherNet/IP network, the module checks to make sure that the IP address that is assigned to this module is not the same as that for any other device already on the network. If the module determines that there is a conflict (some other device on the network already has the IP address), the EtherNet/IP port of the module goes into conflict mode, where the module's:

- OK indicator blinks red.
- network (NET) indicator is solid red.
- front display indicates the conflict (1756-ENBT only).
  The display scrolls: "*OK <IP_address_of_this_module> Duplicate IP <Mac_address_of_duplicate_node_detected>*"

  For example: OK 10.88.60.196 Duplicate IP - 00:00:BC:02:34:B4

To correct this conflict, use the instructions in this chapter to change the IP address of the module. Then cycle power to the module or reset the module (such as disconnecting the EtherNet/IP cable and reconnecting the cable).

There is also the possibility that two modules can detect a conflict simultaneously. If this occurs, remove the module that has the incorrect IP address or correct its conflict. To get the second module out of conflict mode, cycle power to the module or disconnect its EtherNet/IP cable and reconnect the cable.

Duplicate detection scenarios

- The behavior of devices that are in conflict over an IP address varies depending on whether connections have been established to either of the modules and whether both modules support duplicate IP address detection:
- If both modules support duplicate IP address detection, the module that powers up first and uses the IP address, keeps the IP address. The other module will detect a conflict, give up the IP address, and enter conflict mode.
- If both modules support duplicate IP address detection and both modules power up at roughly the same time, both modules give up the IP address and enter conflict mode.
- If one module supports duplicate IP address detection and a second module does not, the second module generally keeps it IP address, regardless of which module obtains the IP address first. The module that supports duplicate IP address detection will detect the conflict and give up the IP address.

IP Address Swapping

These EtherNet/IP modules (and their future revisions) support IP address swapping in ControlLogix redundancy systems:

- 1756-ENBT, firmware revision 3.1 and greater
- 1756-EWEB, firmware revision 2.2 and greater

During a switchover in ControlLogix redundancy systems, these modules swap their IP addresses with their partner modules in the other redundant chassis.

For more information about IP address swapping, see the ControlLogix Redundancy System User Manual, publication 1756-UM523.

Interpret the Indicators

Introduction

This chapter provides the following:

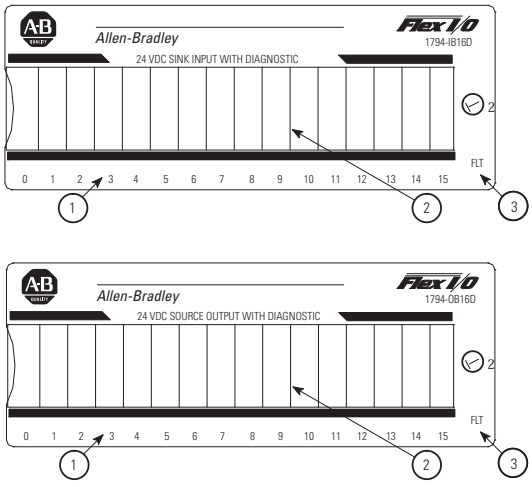
For Information About	See Page
About the Indicators	105
1794-IB16D Diagnostic Functional Details	106
1794-OB16D Diagnostic Functional Details	109

About the Indicators

The diagnostic modules have indicators that let you check the module health and operational status. The following status can be checked with the indicators.

- Channel I/O Status - This indicator displays the ON/OFF state of the input channel, and channel wiring fault conditions:
  - Off indicates that the channel is off with no faults.
  - Yellow indicates that the channel is on with no faults.
  - Red indicates either a channel open or short condition.
- Module Fault Status- This indictor turns red for any individual input/output channel open, short, or module reverse power conditions.

  With no fault, the module fault status indicator turns off.



Where:
1 = Channel bicolor Status indicator
2 = Insertable label for writing individual input/output designations
3 = Module bicolor Fault Indicator

1794-IB16D Diagnostic Functional Details

The 1794-IB16D input module provides 16 points of 24V DC sinking input with open wire and short circuit diagnostic features. Each input signal has an associated sensor power connection. The module monitors current and voltage at each input channel sensor power terminal.

Two module indicators and four diagnostic bits report fault conditions:

- the module Fault indicator and the individual faulted channel indicator also turn red under open and short conditions.
- the module Fault indicator turns red for reverse user power conditions.
- the open bit is set for open sensor and wiring conditions.
- the short bit is set for shorted sensor and wiring conditions.
- the reverse power bit is set for reverse polarity user power conditions.
- the module fault bit is set for any open, short, or reverse power conditions detected.

Diagnostic Capabilities

The module's diagnostic capability depends on the connected sensor type.

For 2-wire sensors and contact input devices (for example, switches):

- an open fault will be detected when an open occurs on either the sensor-power wire, the input signal wire, or the input sensor field device.
- a shorted circuit from a sensor-power wire to common fault (-V) is detected as a short fault (no voltage at the sensor-power port).
- a shorted circuit from the sensor-power wire to the input-signal wire cannot be detected. It appears as an on/active input device.
- a shorted circuit from the input-signal wire to common (-V), with the input sensor field device in the off-state (field device contacts open), cannot be detected. It appears as an off/inactive input sensor device.
- a shorted circuit from the input-signal wire to common (-V), with the input sensor field device in the on-state (field device contacts closed), is detected as a short fault if the sensor field device can pass the sensor power short circuit current.
- a shorted 2-wire input sensor field device (contact field device) cannot be detected. It appears as an on/active input field device.
- a shorted circuit from a sensor-power wire, an input sensor wire, or the input-sensor field device to the DIN rail or chassis ground cannot be detected.

A dummy resistor must be placed across the contacts of contact input devices (for example, switches). Use 20 kΩ resistors.

Fault	Device State		Fault Indicators		Error Bit Status	Conditions
	Field Device	Input Status	Module Fault	Channel Fault		

Open	OFF or ON	OFF	Red	Red	Open wire and Module	No current in Sensor Power terminal- Missing sensor, cut Sensor Power or Input Signal wire
Short	OFF	OFF	Red	Red	Short and Module	Shorted Sensor Power/ Common
	OFF	ON	OFF	Yellow	None	Shorted Sensor Power/ Input Signal
	OFF	OFF	OFF	OFF	None	Shorted Input Signal/ Common
	ON	OFF	Red	Red	Short and Module	Shorted Input Signal/ Common[1]
Reverse User Power	OFF or ON	OFF	Red	OFF	Reverse and Module	User power supply wiring is reversed

[1] If sensor can pass Sensor Power short circuit current

For 3-wire sensors:

- an open fault will be detected when an open occurs on either the sensor-power wire, the sensor (-V) wire, or the high-current portion of the input sensor field device.
- an open on the input-signal wire or low-current portion of the input sensor field device will not be detected, and will be seen as an off/inactive input sensor field device.
- a shorted circuit from the sensor-power wire to sensor common (-V) is detected as short fault (no voltage at the sensor-power port).
- a shorted circuit from the sensor-power wire to the input-signal wire cannot be detected. It will appear as an on/active input device.
- a shorted circuit from the input-signal wire to sensor common (-V), with the input sensor field device in the off-state, cannot be detected. It will appear as an off/inactive input sensor device.
- a shorted circuit from the input-signal wire to sensor common (-V), with the input sensor field device in the on-state, is detected as a short fault if the sensor field device can pass the sensor power short circuit current.
- a shorted 3-wire input sensor device may or may not be detected, depending on which portion of the input sensor device is shorted.
- a shorted circuit to the DIN rail or chassis ground cannot be detected.

Fault	Device/Input State		Indicators		Error Bit Status	Conditions
	Field Device	Input Status	Module Fault	Channel Fault		
Open	OFF	OFF	Red	Red	Open wire and Module	No current in Sensor Power terminal- Missing sensor, cut Sensor Power or Common wire
	OFF or ON	OFF	OFF	OFF	None	Cut Input Signal wire
Short	OFF	OFF	Red	Red	Short and Module	Shorted Sensor Power/ Common
	OFF	ON	OFF	Yellow	None	Shorted Sensor Power/ Input Signal
	OFF	OFF	OFF	OFF	None	Shorted Input Signal/ Common
	ON	OFF	Red	Red	Short and Module	Shorted Input Signal/ Common[1]
Reverse User Power	OFF or ON	OFF	Red	OFF	Reverse and Module	User power supply wiring is reversed

[1] If sensor can pass Sensor Power short circuit current

Diagnostic Functions for the 1794-IB16D

Each unused sensor port requires a dummy resistor to mask the channel diagnostic function.

Diagnostic Functions for the 1794-IB16D

Ext. Power	Wiring	Input Status	Channel LED Status	Open Wire Error Bit	Short Error Bit	Rev. Error Bit	Module Error Bit/LED
OFF	Open	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Short	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Normal	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
ON	Open	Off	RED	1	0	0	1/RED
		On	RED/YEL	1	0	0	1/RED
	Short	Off	RED	0	1	0	1/RED
		On	RED/YEL	0	1	0	1/RED
	Normal	Off	Off	0	0	0	0/OFF
		On	YEL	0	0	0	0/OFF
REV	Open	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Short	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Normal	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED

The module monitors each sensor-power port for current and voltage. It turns on the channel red LED and sets (1) the error bit when 1) the module detects a short circuit (no voltage at the sensor-port), and 2) the module detects an open wire (no current at the sensor-port).

1794-OB16D Diagnostic Functional Details

Two module indicators and four diagnostic bits report fault conditions:

- the module fault indicator illuminates red and the individual faulted channel indicator also illuminates red under output ON state open and output OFF state short conditions.
- the module fault indicator illuminates red for reverse user power conditions.
- the open bit is set for open load and wiring conditions in the output OFF state.
- the short bit is set for shorted load and wiring conditions in the output ON state.
- the reverse power bit is set for reverse polarity user power conditions.
- the module fault bit is set for any open, short, or reverse power conditions detected.

The module's diagnostic capability depends on whether the output is energized (ON) or de-energized (OFF).

Fault	Device/Output Status		Fault Indicators		Error Bit Status	Conditions
	Field Device Status	Output Status	Module Fault	Channel Fault		
Open	OFF	OFF	Red	Red	Open wire and Module	No current in output terminal-missing dummy resistor or field device, cut output channel or Common wire
	OFF	ON	OFF	Yellow	None	Can't detect an open in the ON-state
Short	OFF	ON	Red	Red	Short and Module	Short - output to Common
	OFF	OFF	OFF	OFF	None	Can't detect a short in the OFF-state
Reverse User Power	OFF	OFF or ON	Red	OFF	Reverse and Module	User power supply wiring is reversed

Diagnostic Functions for the 1794-OB16D

ATTENTION: Each unused output port requires a dummy resistor (20 kΩ ±10%, 1/8 W) to mask the channel diagnostic function.

Diagnostic Functions for the 1794-OB16D

Ext. Power	Wiring	Output Status	Channel LED Status	Open Wire Error Bit	Short Error Bit	Rev. Error Bit	Module Error Bit/LED
OFF	Open	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Short	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Normal	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
ON	Open	Off	RED	1	0	0	1/RED
		On	YEL	0	0	0	0/OFF
	Short	Off	Off	0	0	0	0/OFF
		On	RED	0	1	0	1/RED
	Normal	Off	Off	0	0	0	0/OFF
		On	YEL	0	0	0	0/OFF
REV	Open	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Short	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Normal	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED

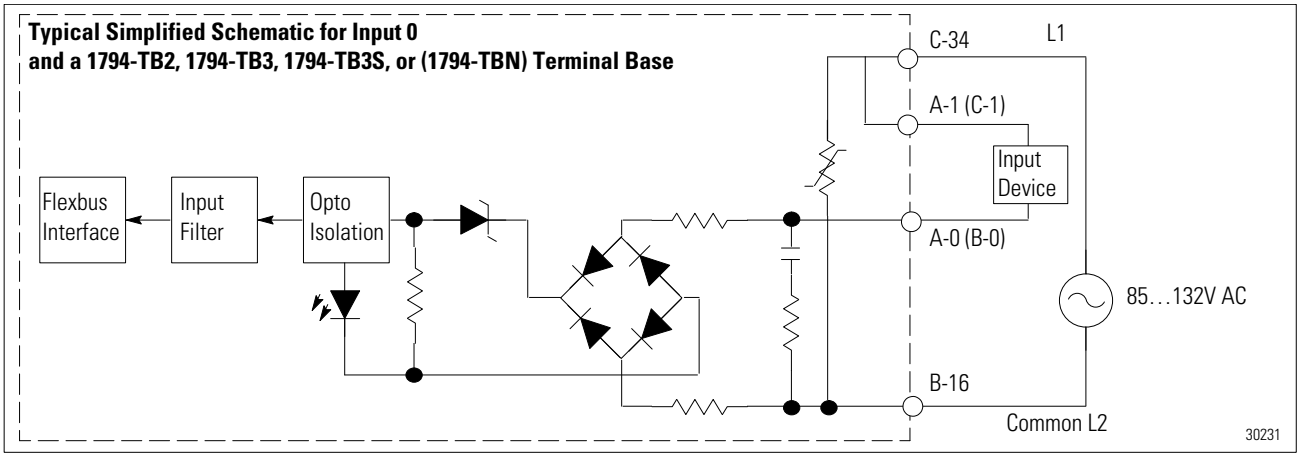
The module monitors each output channel. It turns on the channel red indicator and sets (1) the error bit when 1) the module detects a short circuit (the output signal is active at a channel and the corresponding output voltage is low), and 2) the module detects an open wire (the output signal is inactive at a channel and the corresponding output voltage is high).

Simplified Schematics of FLEX I/O Digital Modules

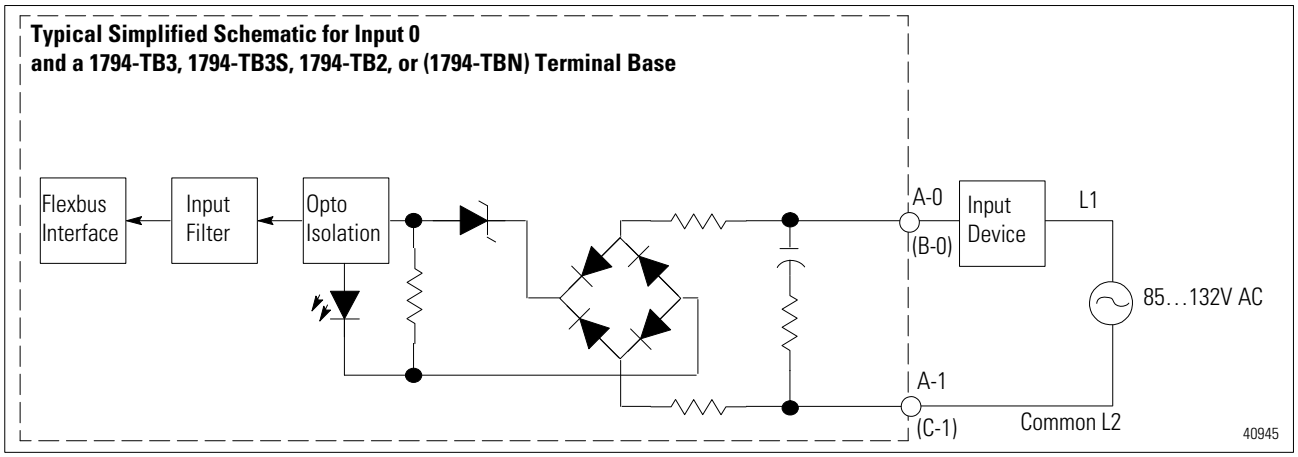
Find Your Module

Voltage category:	Catalog number:	Input/ output:	I/O points:	Module description:	See page:
AC modules					
120V AC	**1794-IA8**	Input	8	120V AC 8 input module	112
	1794-IA8I			120V AC 8 isolated input module	112
	1794-IA16		16	120V AC 16 input module	113
	1794-OA8	Output	8	120V AC 8 output module	113
	1794-OA8I			120V AC 8 isolated output module	114
	1794-OA16		16	120V AC 16 output module	114
220V AC	**1794-IM8**	Input	8	220V AC 8 input module	115
	1794-OM8	Output		220V AC 8 output module	115
DC modules					
24V DC	**1794-IB8**	Input	8	24V DC 8 sink input module	116
	1794-IB16	Input	16	24V DC 16 sink input module	116
	1794-IB16D	Input	16	24V DC 16 sink diagnostic input module	117
	1794-IB32	Input	32	24V DC 32 sink input module	118
	1794-IV16	Input	16	24V DC 16 source input module	121
	1794-IB10XOB6	Input/output	10 in/6 out	24V DC 10 input/6 2 A output combo module	119
	1794-IB16XOB16P	Input/output	16 in/16 out	24V DC combo module, 16 sink inputs, 16 source outputs, protected	120
	1794-OB8	Output	8	24V DC 8 source output module	121
	1794-OB8EP			24V DC electronically fused 8 2 A output module	122
	1794-OB16		16	24V DC 16 source output module	122
	1794-OB16D			24V DC 16 source diagnostic output module	123
	1794-OB16P			24V DC 16 protected source output module	123
	1794-OB32P		32	24V DC 32 protected source output module	124
	1794-OV16		16	24V DC 16 sink output module	125
	1794-OV16P			24V DC 16 protected sink output module	125
48V DC	**1794-IC16**	Input		48V DC 16 sink input module	126
	1794-OC16	Output		48V DC 16 source output module	126
24V DC	**1794-OW8**	Output	8	24V DC 8 relay output module	126

1794-IA8 120V AC 8 Input Module

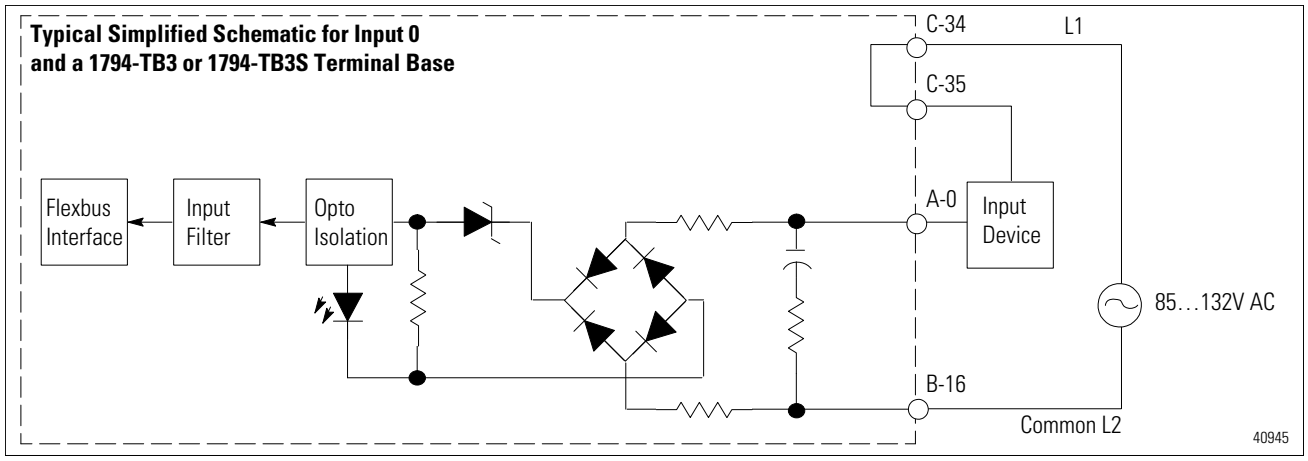


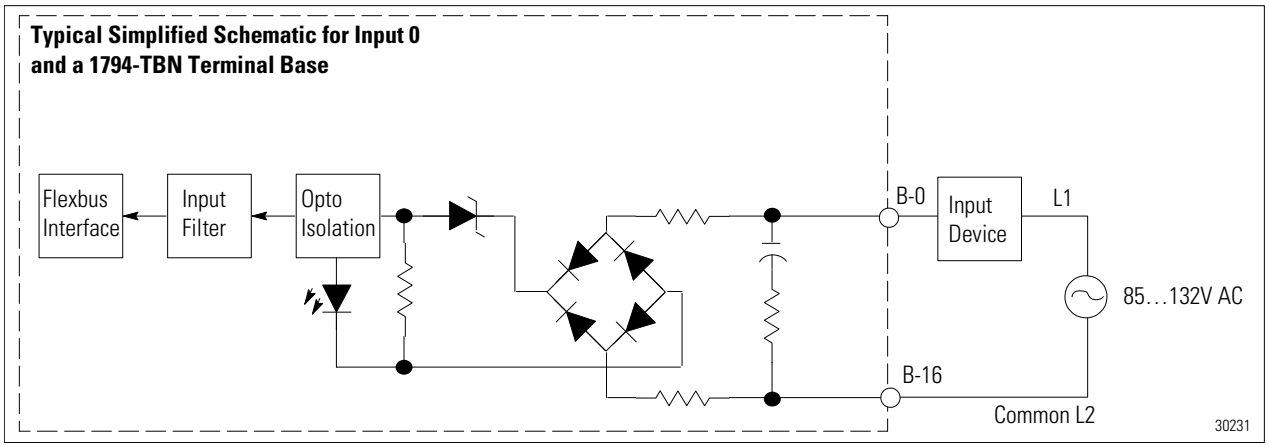
1794-IA8I 120V AC 8 Input Module



Note: To maintain isolation, separate AC sources must be used with each channel. Auxiliary terminal strips are required for all terminal base units.

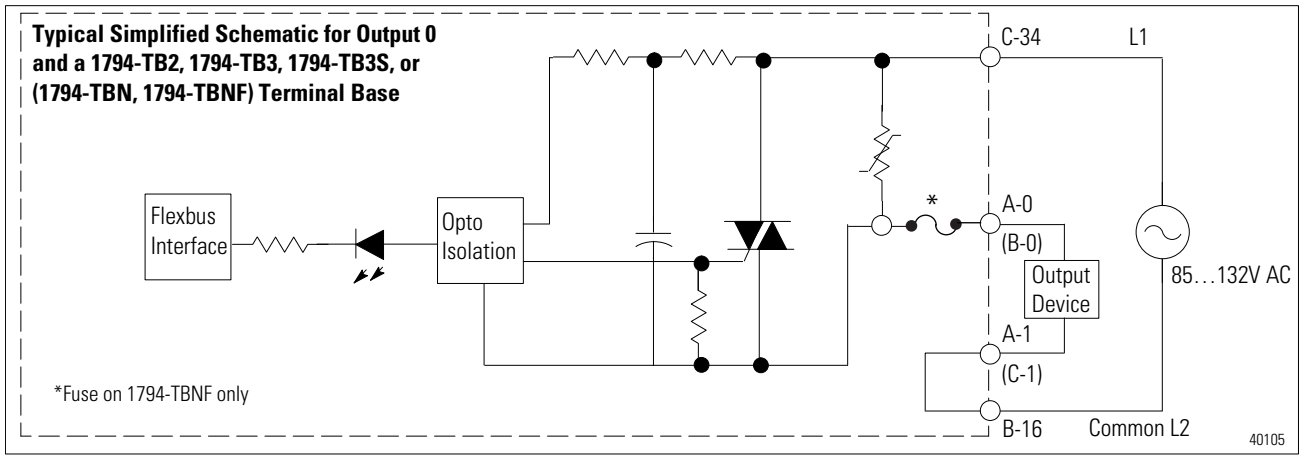
1794-IA16 120V AC 16 Input Module



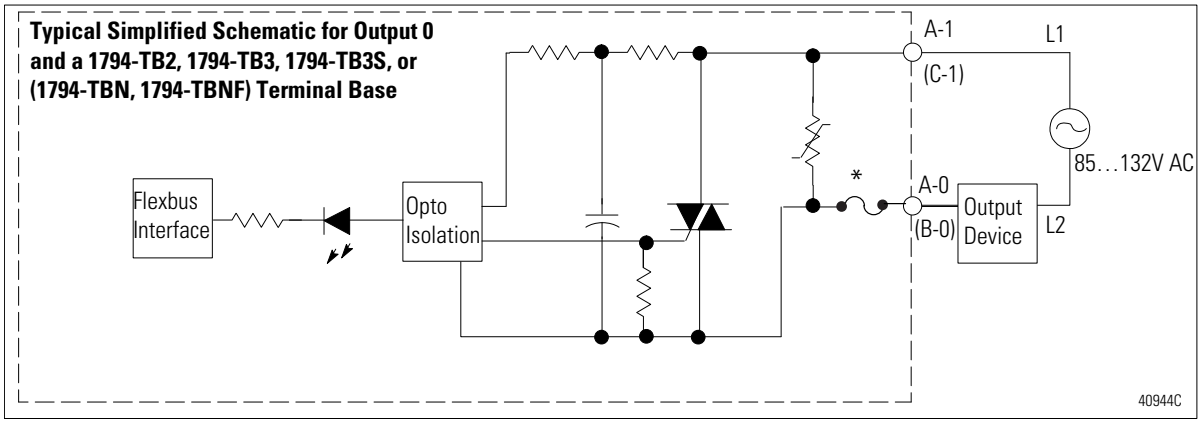


Note: Auxiliary terminal strips are required when using the 1794-TBN with the 1794-IA16 module.

1794-OA8 120V AC 8 Output Module



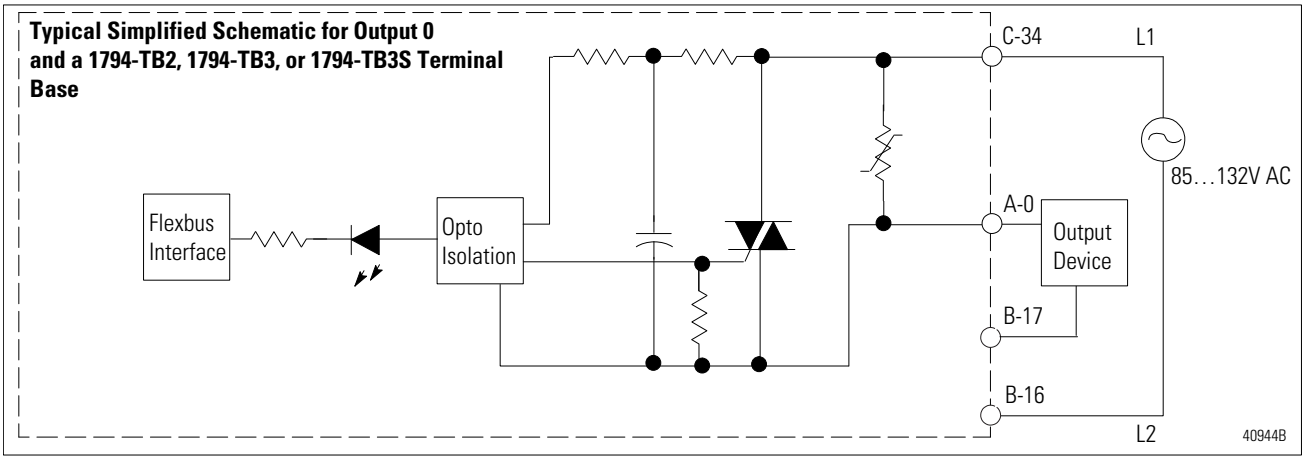
1794-OA8I 120V AC 8 Output Module

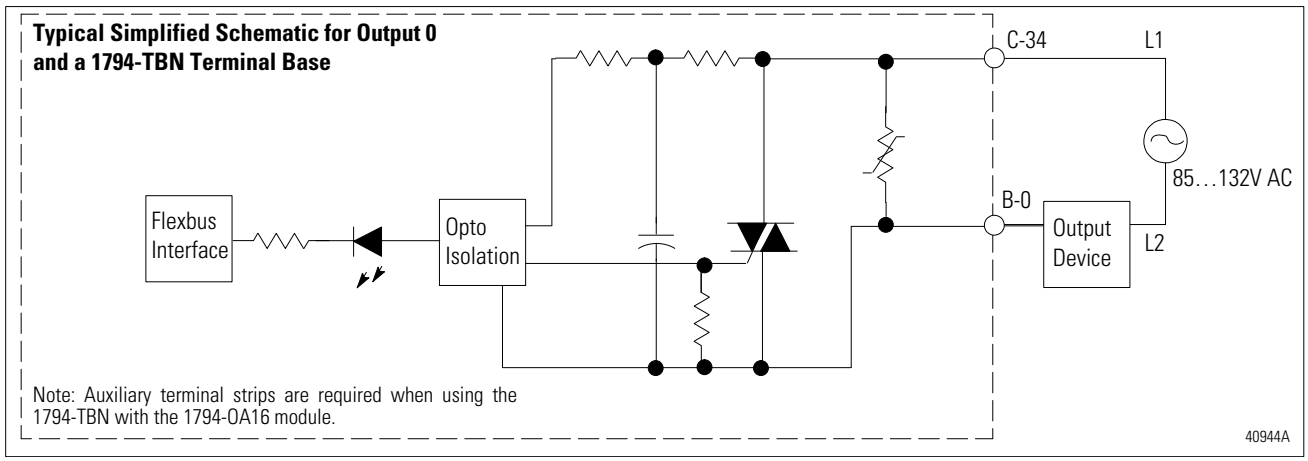


Note: To maintain isolation, separate AC sources must be used with each channel. Auxiliary terminal strips are required for all terminal base units.

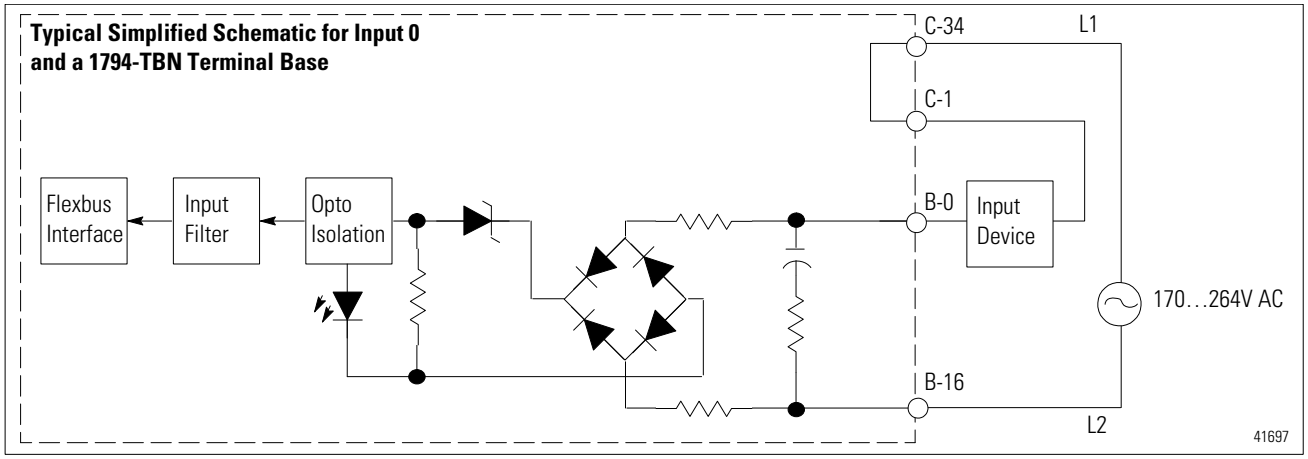
* Fuse on 1794-TBNF only

1794-OA16 120V AC 16 Output Module

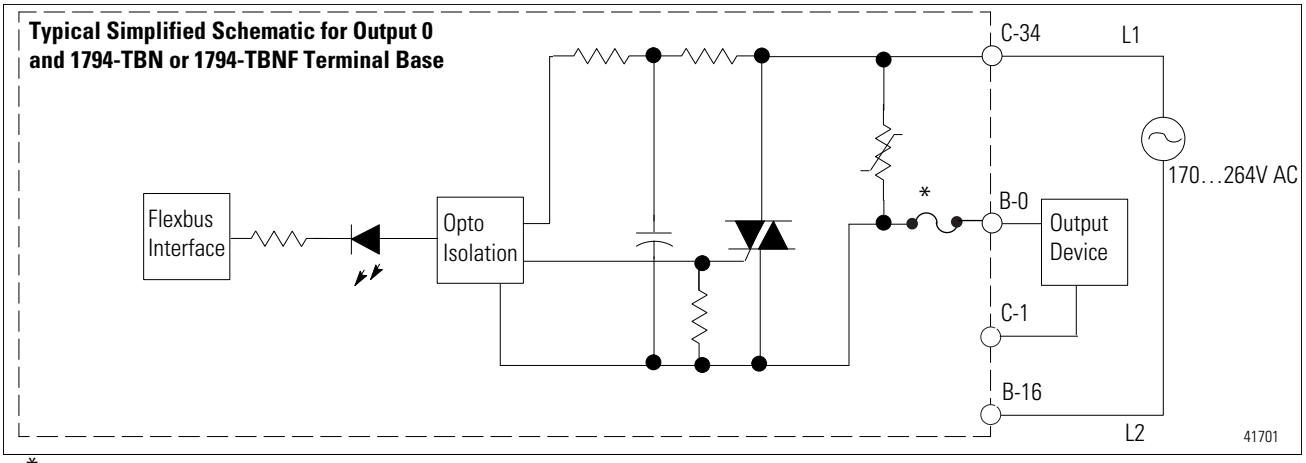




1794-IM 8 220V AC 8 Input Module



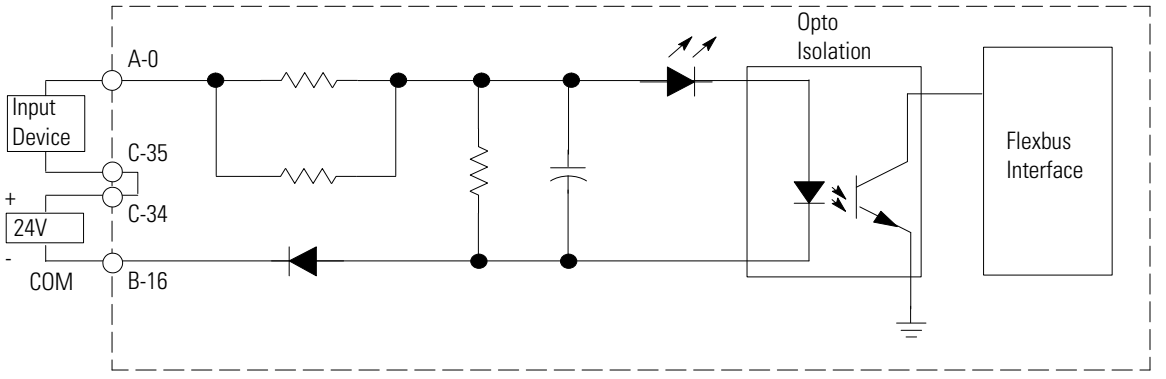
1794-OM8 220V AC 8 Output Module



* Fuse on 1794-TBNF only

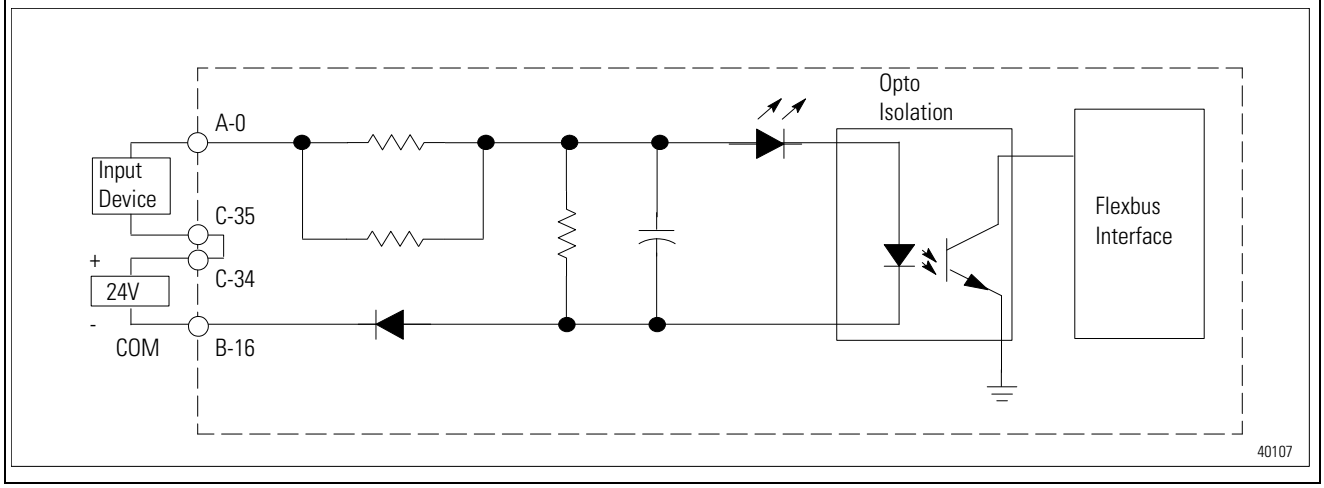
1794-IB8 24V DC 8 Input Module

Typical Simplified Schematic for Input 0 and a 1794-TB3 or 1794-TB3S Terminal Base



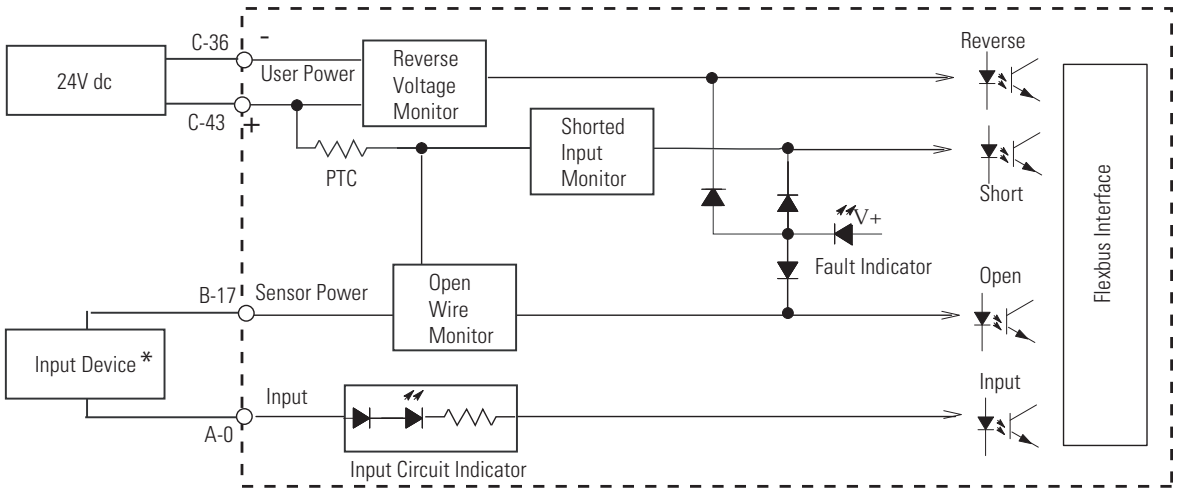
1794-IB16 24V DC 16 Input Module

Typical Simplified Schematic for Input 0 and a 1794-TB3 or 1794-TB3S Terminal Base



1794-IB16D 24V DC 16 Diagnostic Input Module

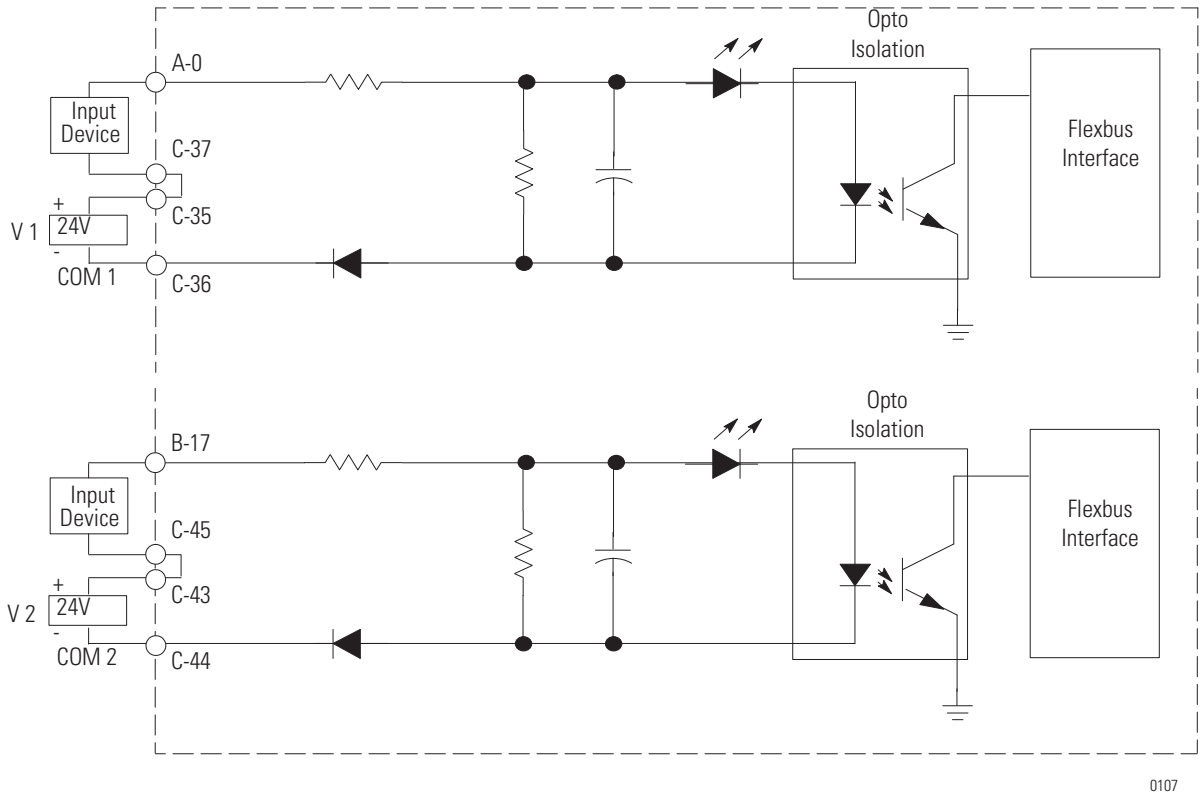
Typical Simplified Schematic for Input 0 and a 1794-TB32 or 1794-TB32S Terminal Base



* Use a 20 KΩ dummy resistor on unused input channels and on inputs that have hard-contact input devices. The dummy resistors can be placed between sensor power and the input channel, or between sensor power and common.

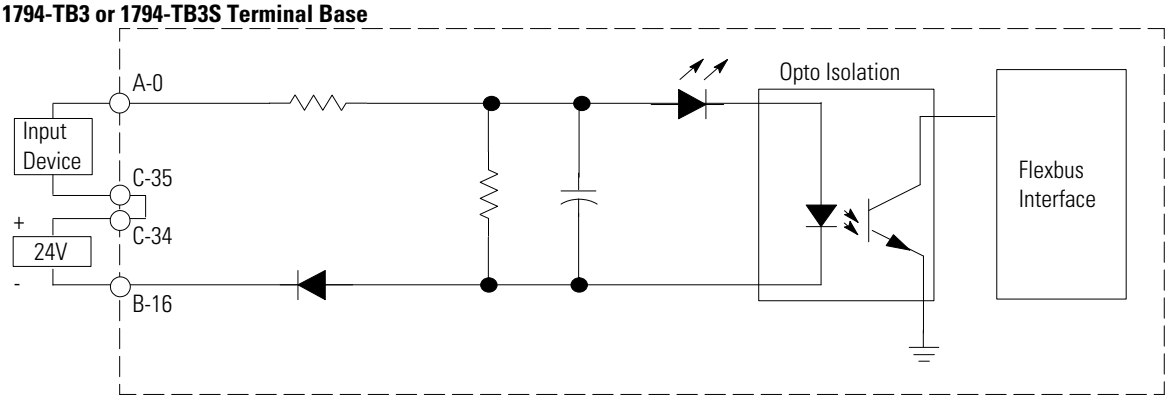
1794-IB32 24V DC 32 Input Module

Typical Simplified Schematic for Input 0 and Input 16 and a 1794-TB32 or 1794-TB32S Terminal Base

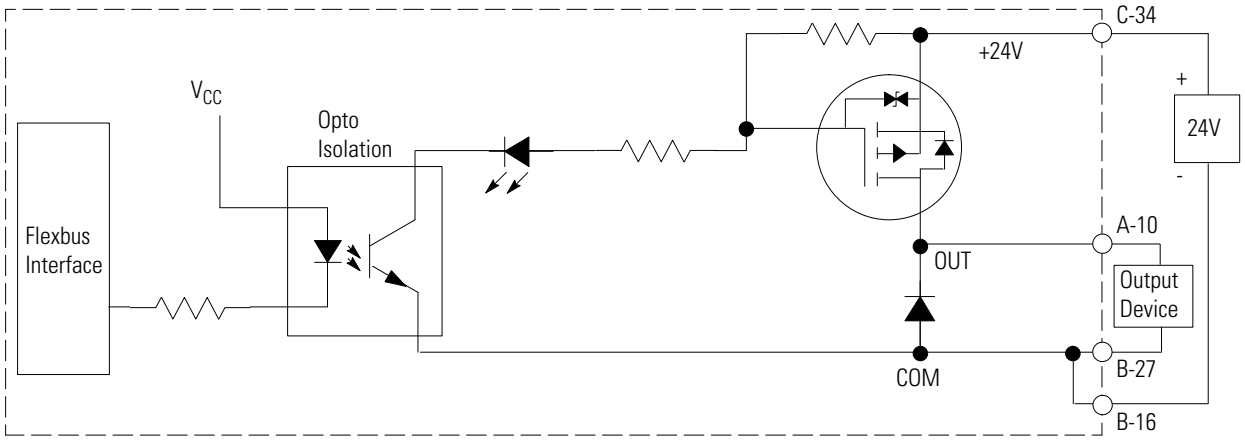


1794-IB10XOB6 24V DC 8 10 Input/6 2 A Output Module

Typical Simplified Schematic for Input 0 and a 1794-TB3 or 1794-TB3S Terminal Base

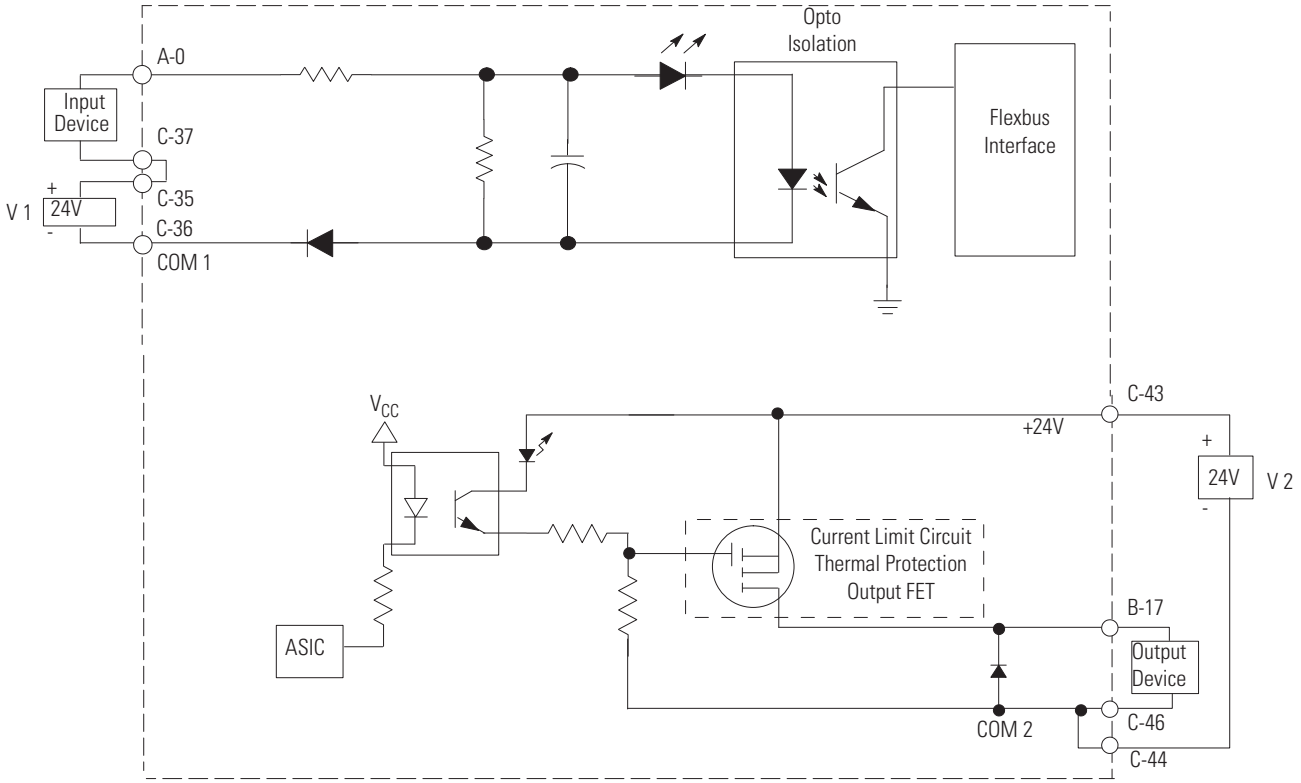


Typical Simplified Schematic for Output 0 and a 1794-TB3 or 1794-TB3S Terminal Base



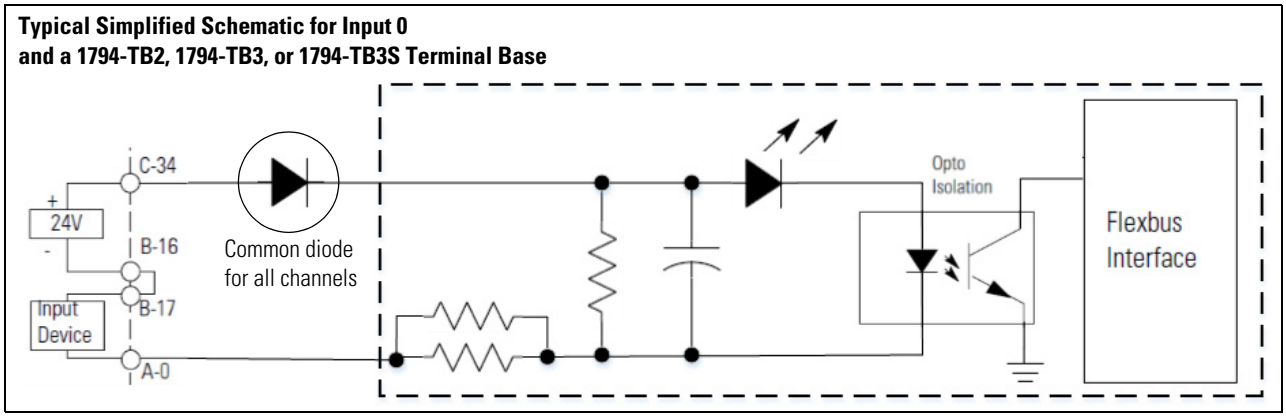
1794-IB16XOB16P 24V DC 16 Input/16 Output Module

Typical Simplified Schematic for Input 0 and Output 16 and a 1794-TB32 or 1794-TB32S Terminal Base



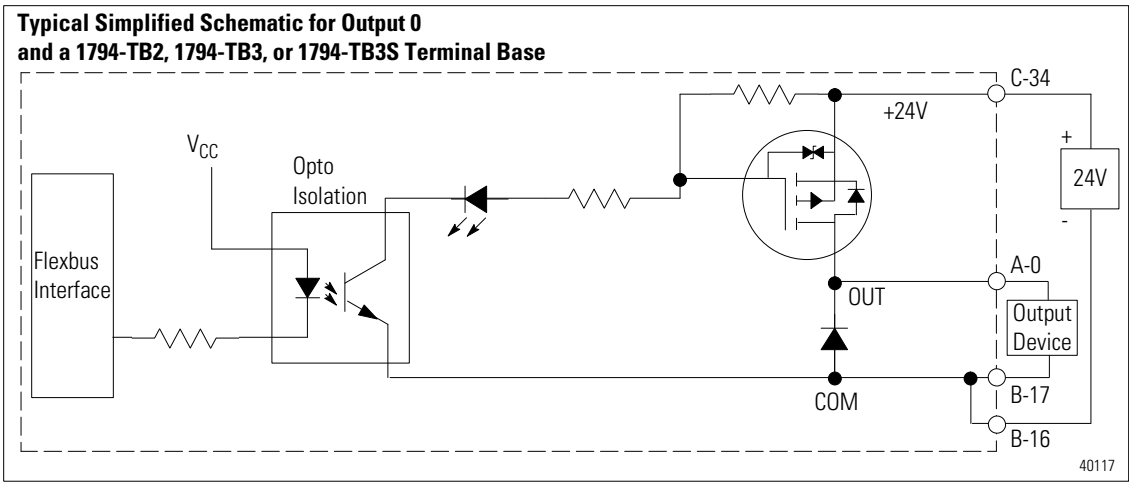
1794-IV16 24V DC 16 Source Input Module

Typical Simplified Schematic for Input 0
and a 1794-TB2, 1794-TB3, or 1794-TB3S Terminal Base



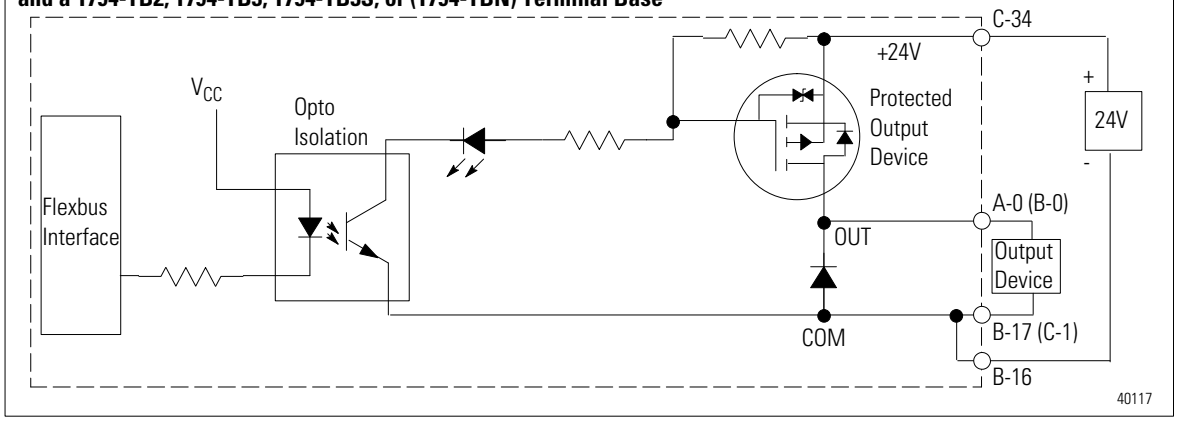
1794-OB8 24V DC 8 Output Module

Typical Simplified Schematic for Output 0
and a 1794-TB2, 1794-TB3, or 1794-TB3S Terminal Base



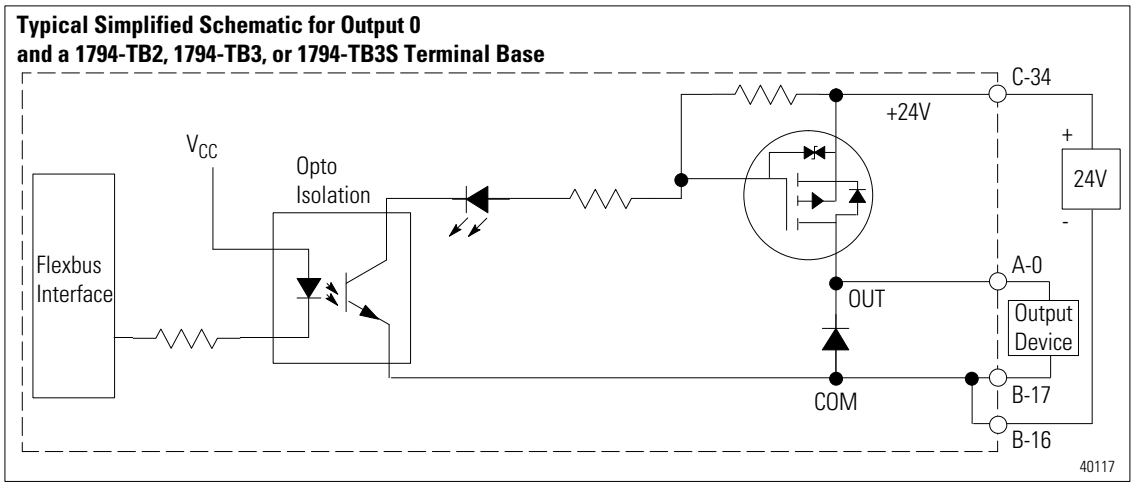
1794-OB8EP 24V DC Electronically Protected 8 Output Module

Typical Simplified Schematic for Output 0
and a 1794-TB2, 1794-TB3, 1794-TB3S, or (1794-TBN) Terminal Base



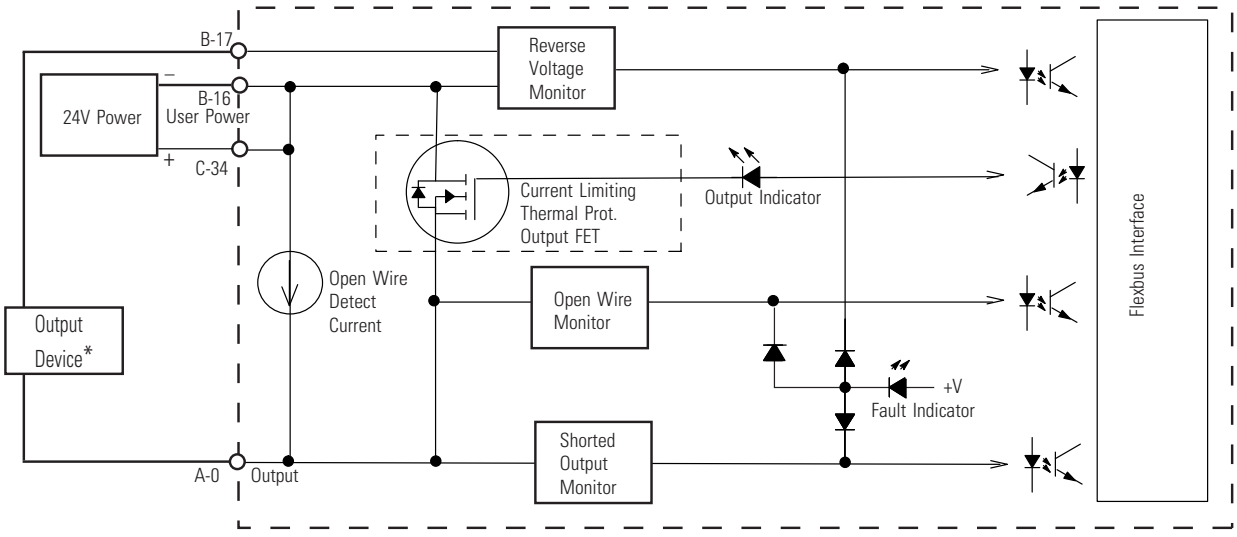
1794-OB16 24V DC 16 Output Module

Typical Simplified Schematic for Output 0
and a 1794-TB2, 1794-TB3, or 1794-TB3S Terminal Base



1794-OB16D 24V DC 16 Diagnostic Output Module

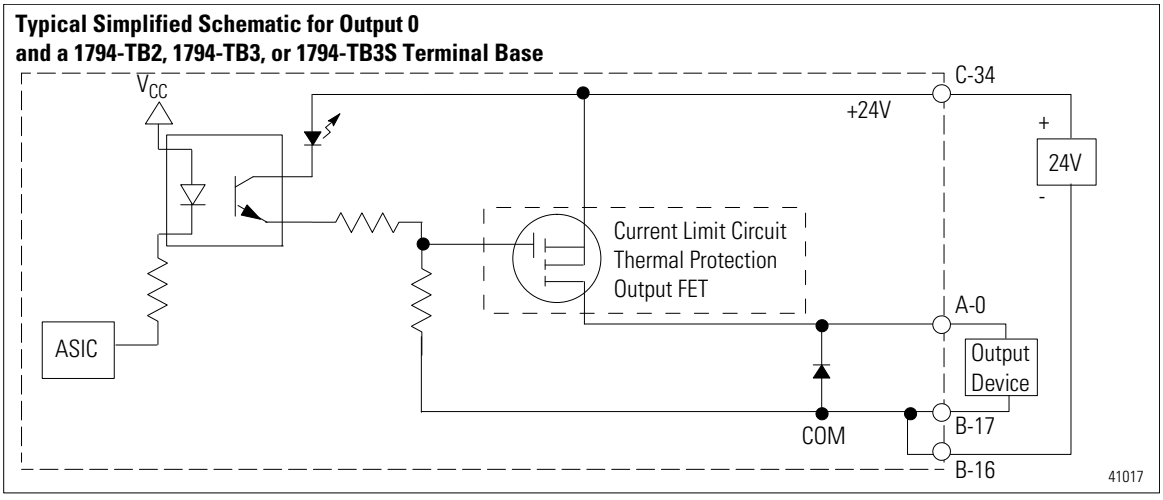
Typical Simplified Schematic for Input 0
and a 1794-TB2, 1794-TB3, 1794-TB3S, or 1794-TB3S Terminal Base



* Use a 10 KΩ dummy resistor on unused output channels.

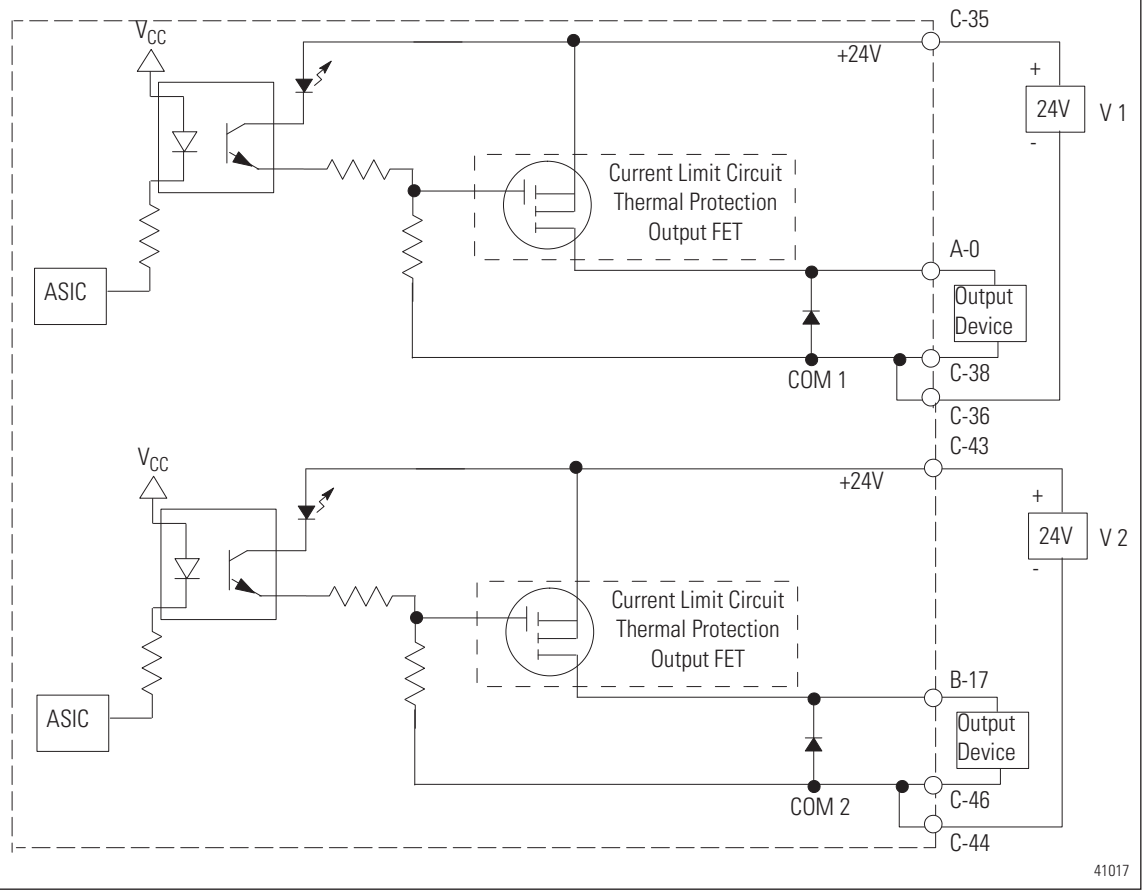
1794-OB16P 24V DC 16 Output Module

Typical Simplified Schematic for Output 0
and a 1794-TB2, 1794-TB3, or 1794-TB3S Terminal Base



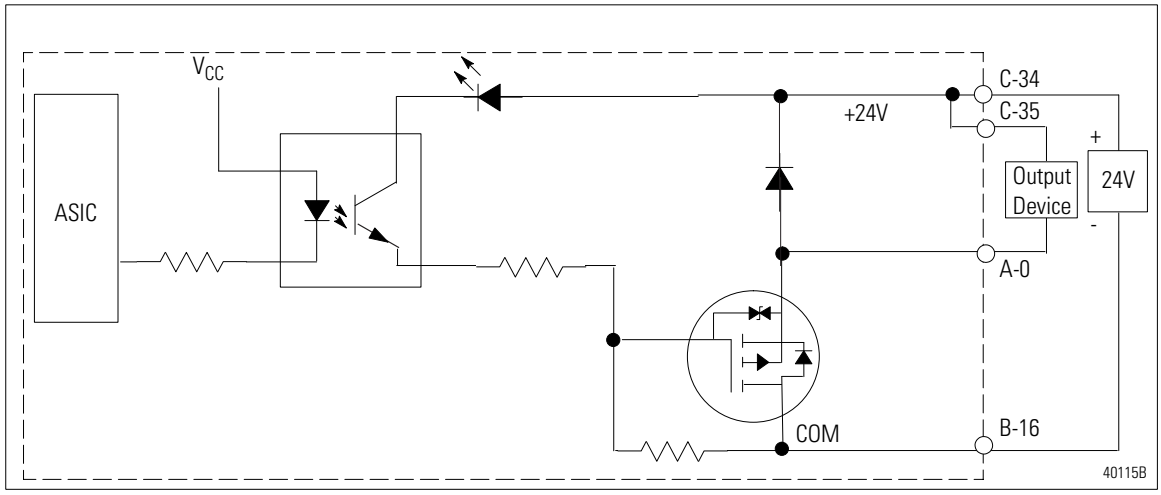
1794-OB32P 24V DC 32 Output Module

Typical Simplified Schematic for Output 0 and Output 16 and a 1794-TB32 or 1794-TB32S Terminal Base



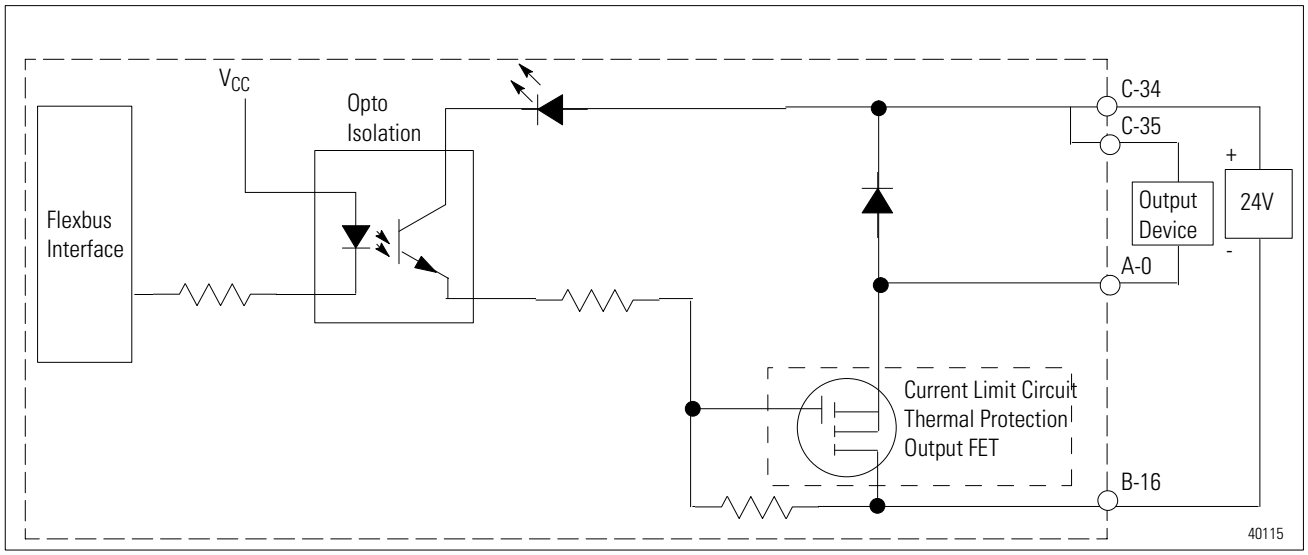
1794-OV16 24V DC 16 Sink Output Module

Typical Simplified Schematic for Output 0 and a 1794-TB3 or 1794-TB3S Terminal Base



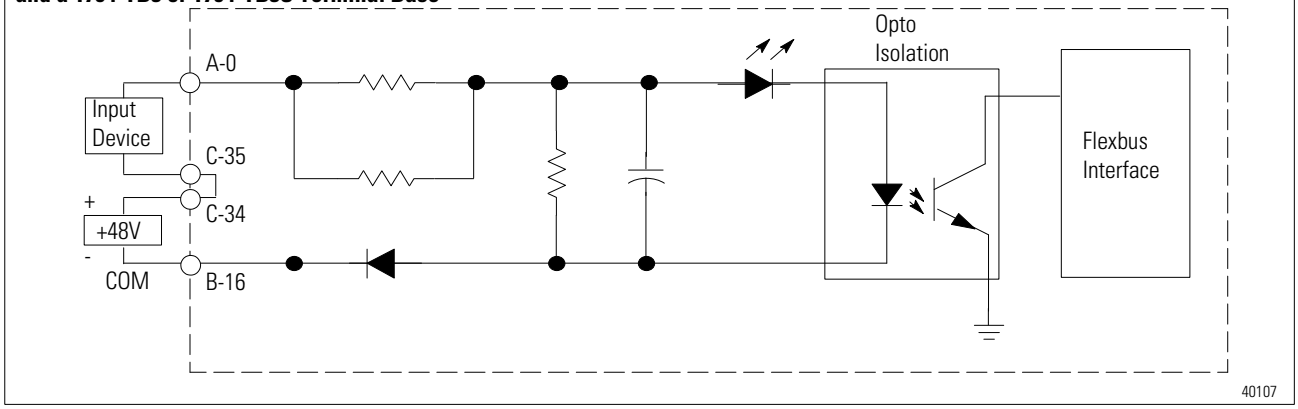
1794-OV16P 24V DC 16 Sink Output Module

Typical Simplified Schematic for Output 0 and a 1794-TB3 or 1794-TB3S Terminal Base



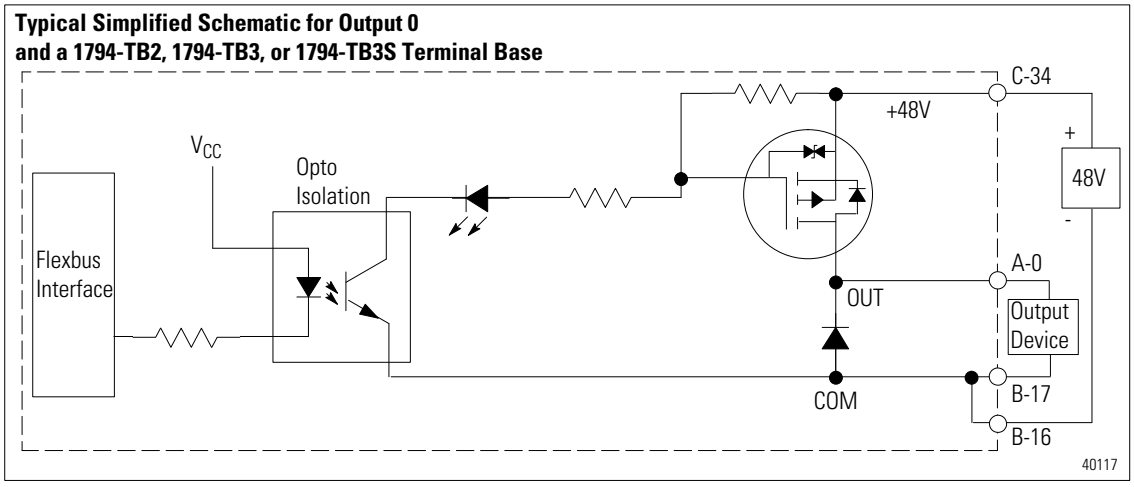
1794-IC 48V DC 16 Input Module

Typical Simplified Schematic for Input 0
and a 1794-TB3 or 1794-TB3S Terminal Base



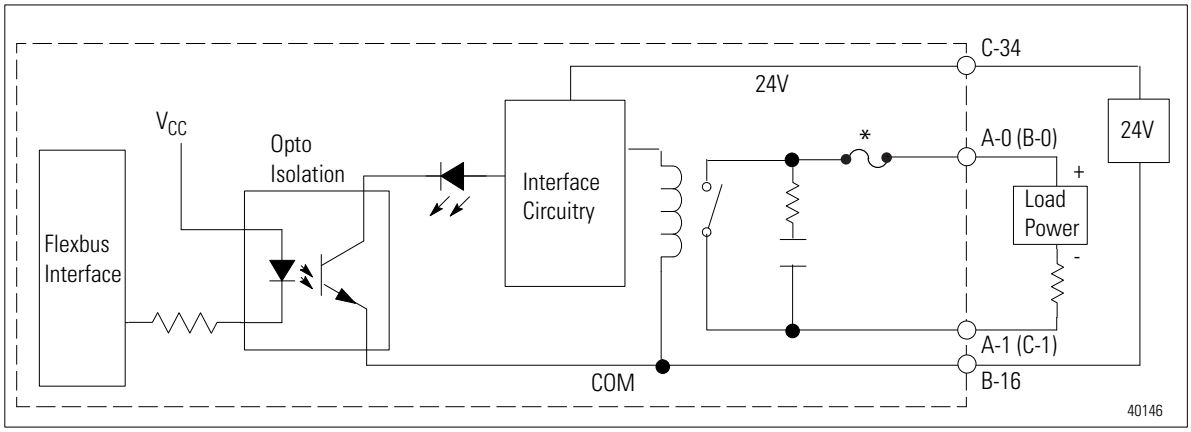
1794-OC 48V DC 16 Output Module

Typical Simplified Schematic for Output 0
and a 1794-TB2, 1794-TB3, or 1794-TB3S Terminal Base



1794-OW8 Relay Output Module

Typical Simplified Schematic for Output 0
and a 1794-TB2, 1794-TB3, 1794-TB3S, or (1794-TBN, 1794-TBNF) Terminal Base



Note: Auxiliary terminal strips are required for all terminal base units except the 1794-TB3 and 1794-TB3S when load power is 24V DC and channel-to-channel isolation is not needed.

* Fuse on 1794-TBNF only

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For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

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Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
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