FLEX I/O Dual-port EtherNet/IP Adapters

Catalog Numbers 1794-AENTR, 1794-AENTRXT

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual

Original Instructions

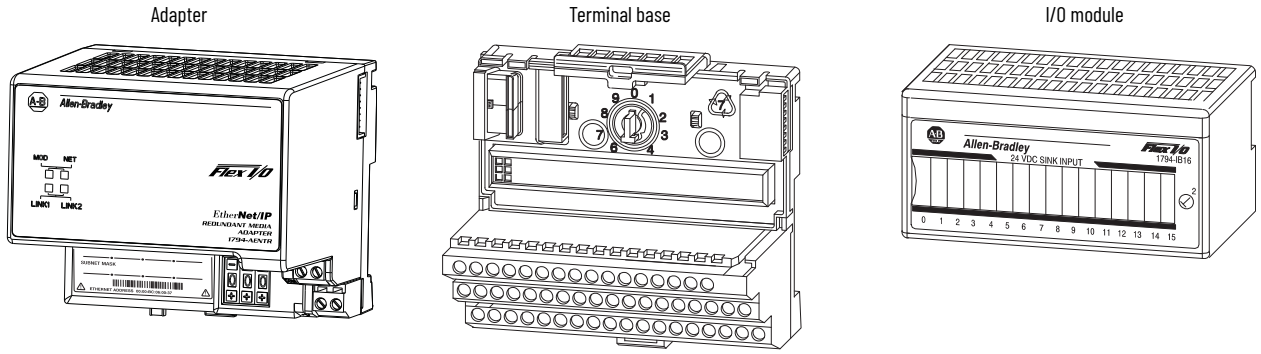
Overview of FLEX I/O and Your Redundant EtherNet/IP Adapter

This chapter provides a description of the FLEX I/O dual-port EtherNet/IP adapters and an overview of how they communicate with programmable controllers.

The FLEX I/O System

The FLEX I/O system is a small, modular I/O system for distributed applications that performs all of the functions of rack-based I/O. Figure 1 shows the components of a FLEX I/O system.

Figure 1 - FLEX I/O System Components



- Adapter – Transfers read and write configuration data to and from the I/O module
- Terminal base – Contains a terminal strip to terminate wiring for two- or three-wire devices
- I/O module – Contains the bus interface and circuitry that is needed to perform specific functions that are related to your application

The FLEX system consists of an adapter, terminal base unit, DIN rail, power supply, and adapter cabling components. You can use up to eight terminal bases per adapter.

For detailed instructions on how to set up and install your module, see Install Your FLEX I/O Adapter on page 13.

Adapter Features

The 1794-AENTR and 1794-AENTRXT adapter features include:

- Use of EtherNet/IP messages encapsulated within standard TCP/UDP/IP protocol
- Common application layer with ControlNet® and DeviceNet®
- Interfacing via Category 5 rated twisted-pair cable
- Half/full duplex 10 Mbit or 100 Mbit operation
- DIN rail mounting
- Communication to and from other FLEX I/O modules on the same DIN rail
- Communication supported by RSLinx® software
- IP address assigned via standard BOOTP/DHCP tools
- I/O configuration via Studio 5000 Logix Designer application
- No network scheduling required
- No routing tables required

Types of Adapters

The adapter refers to the following catalogs.

Catalog Number	Voltage	Module Capacity, Max	Description
1794-AENTR	24V DC	8	Dual-port EtherNet/IP adapter
1794-AENTRXT			Dual-port EtherNet/IP adapter with extended temperatures range

Hardware and Software Compatibility

The adapters and the applications that are described in this manual are compatible with the following firmware revisions and software releases. Contact Rockwell Automation if you need software or firmware updates to use this equipment.

Table 1 - Hardware and Software Compatibility

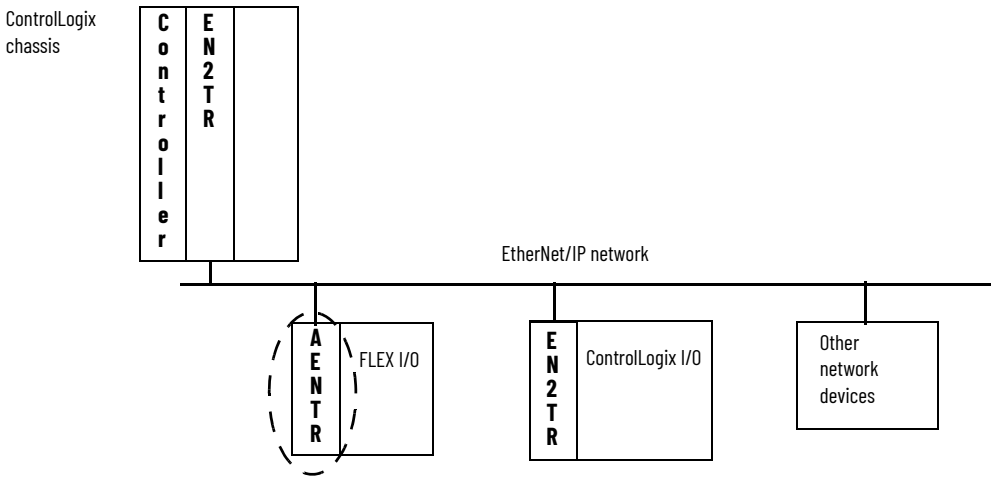
Product	Firmware Revision/ Software Version
FLEX I/O redundant EtherNet/IP adapter	1.xx or higher
ControlLogix® 5560, ControlLogix 5570, GuardLogix® 5560, and GuardLogix 5570 controllers	20 or higher
ControlLogix 5580 and GuardLogix 5580 controllers	28 or higher
CompactLogix® 5370 and Compact GuardLogix 5370 controllers	20 or higher
CompactLogix 5380 and Compact GuardLogix 5380 controllers	28 or higher
CompactLogix 5480 controller	32 or higher
Studio 5000 Logix Designer application	20 or higher
RSLinx software	2.59 or higher

See FLEX I/O and FLEX I/O-XT Selection Guide, publication 1794-SG002, a for description and overview of the 1794 series FLEX I/O and FLEX I/O-XT modules and compatible control platforms.

What the Adapter Does

The 1794-AENTR and 1794-AENTRXT adapters perform two primary tasks:

- Control of real-time I/O data (implicit messaging). The adapter serves as a bridge between I/O modules and the network.



- Support of messaging data for configuration and programming information (explicit messaging).

Use of the Common Industrial Protocol (CIP)

The 1794-AENTR and 1794-AENTRXT adapters use CIP™. CIP is the application layer protocol that is specified for EtherNet/IP, the Ethernet Industrial Protocol, as well as for ControlNet and DeviceNet. It is a message-based protocol that implements a relative path to send a message from the producing device in a system to the consuming devices.

The producing device contains the path information that steers the message along the proper route to reach its consumers. Since the producing device holds this information, other devices along the path simply pass this information; they do not need to store it.

This has two significant benefits:

- You do not need to configure routing tables in the bridging modules, which greatly simplifies maintenance and module replacement.
- You maintain full control over the route that is taken by each message, which enables you to select alternative paths for the same end device.

Understand the Producer/ Consumer Model

The CIP Producer/Consumer networking model replaces the old source/destination (master/slave) model. The Producer/Consumer model reduces network traffic and increases speed of transmission. In traditional I/O systems, controllers poll input modules to obtain their input status. In the CIP system input modules are not polled by a controller. Instead, they produce (multicast) their data either upon a change of state (COS) or periodically. The frequency of update depends upon the options that are chosen during configuration and where on the network that the input module resides. The input module, therefore, is a producer of input data and the controller is a consumer of the data.

The controller can also produce data for other controllers to consume. The produced and consumed data is accessible by multiple controllers over the EtherNet/IP network. This data exchange conforms to the Producer/Consumer model.

Specify the Requested Packet Interval (RPI)

The RPI is the update rate that is specified for a particular piece of data on the network. The RPI can be specified for the adapter and include all of the I/O modules communicating through it (using a rack-optimized connection) or specified for a particular module (using direct connection). When you add a module or an adapter to the I/O configuration of a controller, you must enter the RPI as a parameter. This value specifies how often to produce the data for that device. For example, if you specify an RPI of 50 ms, it means that every 50 ms the device should send its data to the controller or the controller should send its data to the device.

RPIs are only used for devices that produce data. For example, a ControlLogix EtherNet/IP bridge in the same chassis as the controller does not require an RPI because it is not a data-producing member of the system; it is used only as a bridge to remote racks.

Rack-optimized and Direct Connection Support

The 1794-AENTR and 1794-AENTRXT adapters support both direct and rack-optimized connections. A direct connection is a real-time data transfer link between the controller and the device that the configuration data references. Direct connection messaging occurs at a cyclic rate that is specified by the RPI during configuration. A rack-optimized connection is a grouping of data from multiple I/O module into a single block of data sent over a single connection at the same data rate.

Rack-optimized connections reduce the total number of connections that are needed to transfer data when using many I/O modules in a system. The following example illustrates the benefit of rack-optimized connections.

Assume you have set up a system that contains eight discrete I/O modules interfaced to an adapter. If you use direct connections to transfer data to each of these I/O modules, you need eight connections to transfer all of the data, one to each of the eight I/O modules. If you use a rack-optimized connection to transfer the data, you only need a single connection – The connection to the adapter.

IMPORTANT Although rack-optimized connections offer an efficient way to use resources, there are a few limitations on their use:

- You can only use rack-optimized connections to send data to and from discrete I/O modules. Analog I/O requires direct connections.
- Rack-optimized connections can contain I/O data and status information only. Additional module information, such as diagnostics, is not available through a rack-optimized connection.
- All data is sent simultaneously at the RPI rate of the adapter.

See EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007, for more information on connections.

Mixing Rack-optimized and Direct Connections

You can mix communication formats for different I/O modules communicating through the same adapter. I/O modules set up to use rack optimization communicates at the rate of the RPI configured for the 1794-AENTR or 1794-AENTRXT adapter. I/O modules that are configured for direct communication communicate at their own set RPIs and ignore the adapter RPI.

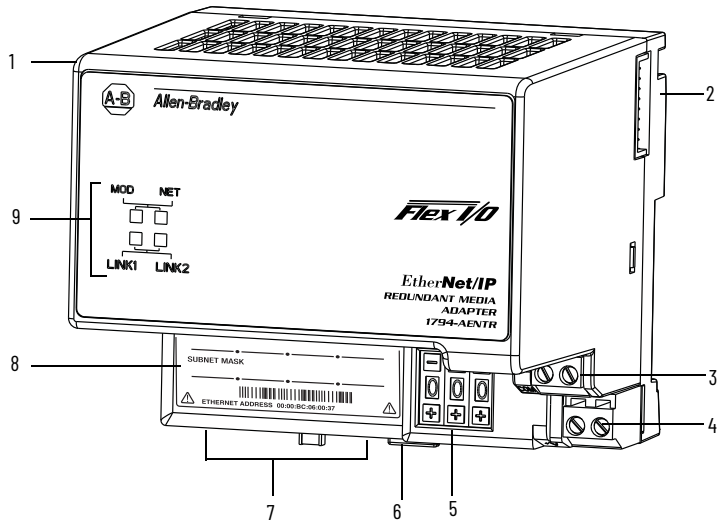
Install Your FLEX I/O Adapter

This chapter describes how to physically install the 1794-AENTR or 1794-AENTRXT adapter on a DIN rail, panel, or wall, and connect it to the EtherNet/IP network.

Module Components

Use Figure 2 to identify the external features of the FLEX I/O EtherNet/IP adapter.

Figure 2 - Dual-port EtherNet/IP Adapter – 1794-AENTR, 1794-AENTRXT



Component Identification			
1	Dual-port EtherNet/IP adapter	6	Module locking tab
2	Flexbus connector	7	Network cable RJ45 connectors (underside)
3	24V common connections	8	MAC ID label
4	24V DC connections	9	Status indicators
5	IP address switches		

- Use a Dynamic Host Configuration Protocol (DHCP) server, such as Rockwell Automation® DHCP.
- Retrieve the IP address (if previously set) from nonvolatile memory.

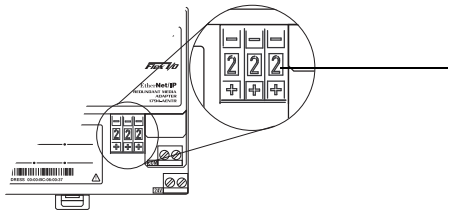
The adapter reads the thumbwheel switches first to determine if the switches are set to a valid number. You set the node address by using the three-position pen-push thumbwheel switch using a pen tip.

Press a pen tip into the center and perpendicular to the + or the - button to change the number. You only need a small amount of force to press the button (approximately 2 N).

When the switches are set to a valid number, the adapter IP address is 192.168.1.xxx (where xxx represents the number set on the switches). The adapter subnet mask is 255.255.255.0. The adapter gateway address is set differently depending on the firmware revision:

- For firmware revision 1.013 and earlier, when the address switches are set to 001...254, the adapter gateway address is set to 0.0.0.0.
- For firmware revision 1.014, when the address switches are set to 001, the adapter gateway address is set to 0.0.0.0. When the address switches are set to 002...254, the adapter gateway address is set to 192.168.1.1.

The adapter does not have a host name that is assigned, or use any Domain Name System (DNS) when using the thumbwheel settings.

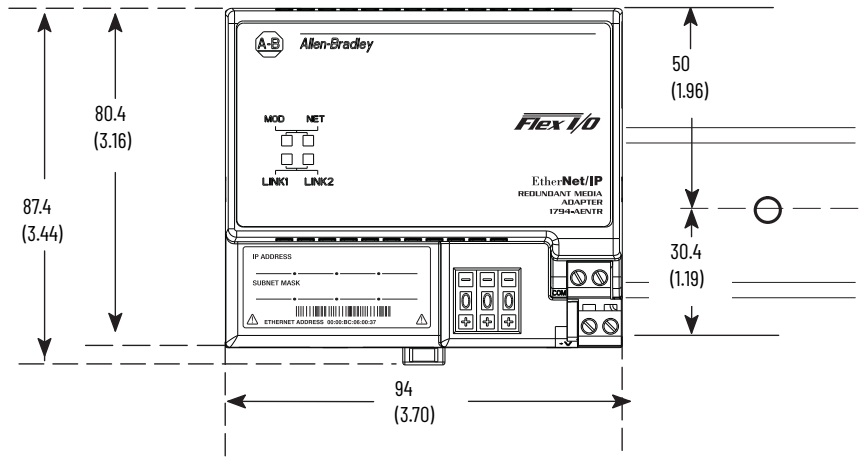


If you set the switches to an invalid number (such as 000, or a value greater than 254), the adapter checks to see if you enabled DHCP.

Mounting Dimensions

The module has the following mounting dimensions.

1794-AENTR shown



Millimeters
(Inches)

1794-AENTR, 1794-AENTRXT
87.4 H x 94 W x 92 D
(344 H x 3.7 W x 3.6 D)

Configure the Adapter for Your EtherNet/IP Network

This chapter describes how to configure the 1794-AENTR or 1794-AENTRXT adapter for the ControlLogix 5580 system.

Configuration Requirements

Before you can use your 1794-AENTR or 1794-AENTRXT adapter, you must configure its IP address, and optionally, its subnet mask and gateway address. You can use the Rockwell Automation BOOTP/DHCP utility to perform the configuration. You can also use generic BOOTP software or, within some limitations, a DHCP server. You can use the thumbwheel switches on the module to set the IP address.

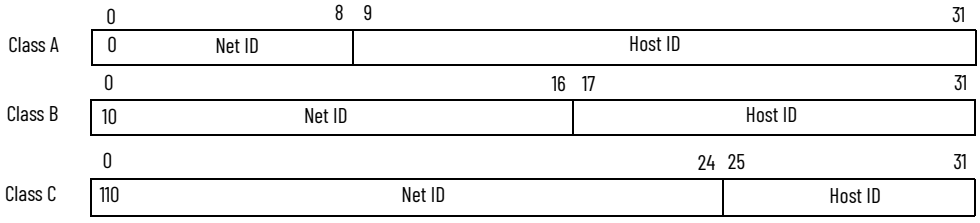
IMPORTANT When using the BOOTP protocol, you must enter the Ethernet hardware address of your adapter. Rockwell Automation assigns each 1794-AENTR or 1794-AENTRXT adapter a unique 48-bit hardware address at the factory. The address is printed on a label on the front of your 1794-AENTR or 1794-AENTRXT adapter. It consists of six hexadecimal digits that are separated by colons. This address is fixed by the hardware and cannot be changed.

If you change or replace the 1794-AENTR or 1794-AENTRXT adapter, you must enter the new Ethernet hardware address of the adapter when you configure the new adapter.

IP Address

The IP address identifies each node on the IP network (or system of connected networks). Each TCP/IP node on a network (including the 1794-AENTR or 1794-AENTRXT adapter) must have a unique IP address.

The IP address is 32 bits long and has a Net ID part and a Host ID part. Networks are classified A, B, C, or other. The class of the network determines how an IP address is formatted.



You can distinguish the class of the IP address from the first integer in its dotted-decimal IP address as follows:

Range of First Integer	Class	Range of First Integer	Class
0…127	A	192…223	C
128…191	B	224…255	other

Each node on the same physical network must have an IP address of the same class and must have the same Net ID. Each node on the same network must have a different Host ID thus giving it a unique IP address.

IP addresses are written as four decimal integers (0…255) separated by periods where each integer gives the value of 1 byte of the IP address.

ATTENTION: The 1794-AENTR or 1794-AENTRXT adapter must be assigned a fixed network address. The IP address of this adapter must not be dynamically provided.
Failure to observe this precaution may result in unintended machine motion or loss of process control.

Implicit Protection Mode

Implicit Protection Mode helps prevent configuration changes that can affect system behavior and cause unintended and unforeseen changes.

This security enhancement is automatically triggered as soon as one of the following occurs:

- When an adapter has an open I/O mode connection in a RUN mode
- When an I/O module in the rack has an open I/O connection

In Protection Mode, the device deactivates services that could disrupt the operation of the device. For example, configuration operations or firmware updates are disabled to not impact the operation of the device.

Enter and Exit Implicit Protection Mode

The adapter enters Implicit Protection Mode as soon as I/O connections are established through or to the adapter. The adapter exits Implicit Protection Mode as soon as all I/O connections through or to the adapter are stopped.

Restrictions Imposed By Implicit Protection Mode

When the adapter is in Implicit Protection Mode, it helps prevent the following actions:

- Changing Ethernet configuration settings
- Changing IP address settings
- Disabling/enabling the Ethernet ports
- Updating the module firmware
- Performing a module factory reset and an adapter reset
- Disabling/enabling the web server
- Disable/enabling the Simple Network Management Protocol (SNMP) server
- Changing the settings on the Identity, Network, and Services pages under the Configuration tab in the web server
- Changing the web server login password

Perform Tasks When Restricted

If the adapter is in Implicit Protection Mode and you attempt to perform any of the restricted tasks, you are alerted that such a task cannot be performed because the adapter is in Implicit Protection Mode.

The following are example alerts that result from an attempt to set IP values on the adapter when the adapter is in Implicit Protection Mode:

IMPORTANT Protection Mode is not configurable.

Rack-optimized Discrete I/O

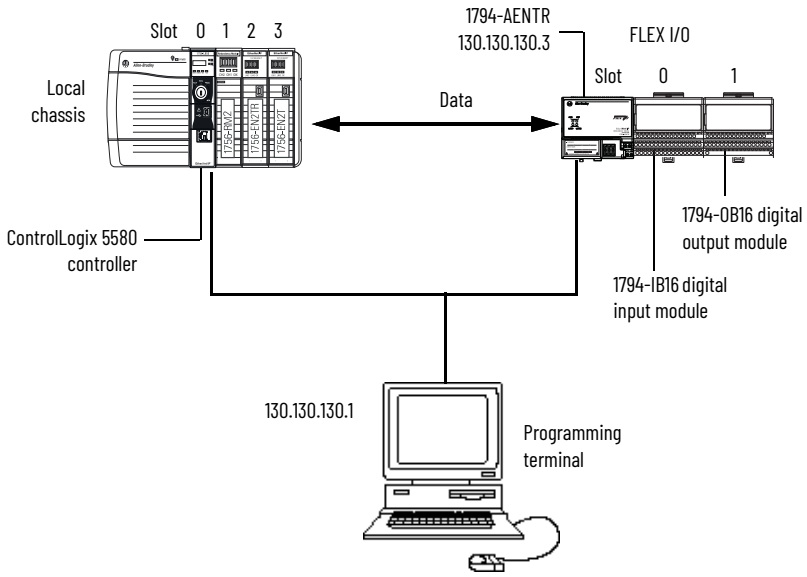
Overview

In this example, a ControlLogix processor communicates with FLEX I/O via the 1794-AENTR adapter using a rack-optimized connection. The processor reads data from all digital input modules and sends data to all digital output modules configured in a rack connection simultaneously.

Set Up the Hardware

In this example, a ControlLogix chassis contains the ControlLogix 5580 controller in slot 0 and a 1756-EN2TR bridge in slot 2. The adapter is mounted on a DIN rail with a 1794-IB16 digital input module and 1794-OB16 digital output module. You also need a power supply (not shown) for the FLEX I/O modules.

Figure 3 - Example Hardware Setup



To work along with this example set up your system as shown in Figure 3.

- In the example application, the ControlLogix 5580 controller is in the slot shown in Figure 3 in the ControlLogix chassis.
- Verify the IP addresses for your programming terminal, the controller network, and the 1794-AENTR adapter.
- Verify the position (slot) of the I/O modules on the DIN rail.
- Verify that all wiring and cabling is properly connected.
- Make sure that your communication driver (for example, AB_ETH-1 or AB-ETHIP-1) is configured in RSLinx as described in Appendix B.

Before You Begin

You must complete the following tasks before you can configure the adapter and modules:

1. Create a Studio 5000 Logix Designer application project.
2. Add the ControlLogix 5580 controller to the project.

Analog I/O with Direct Connection

Overview

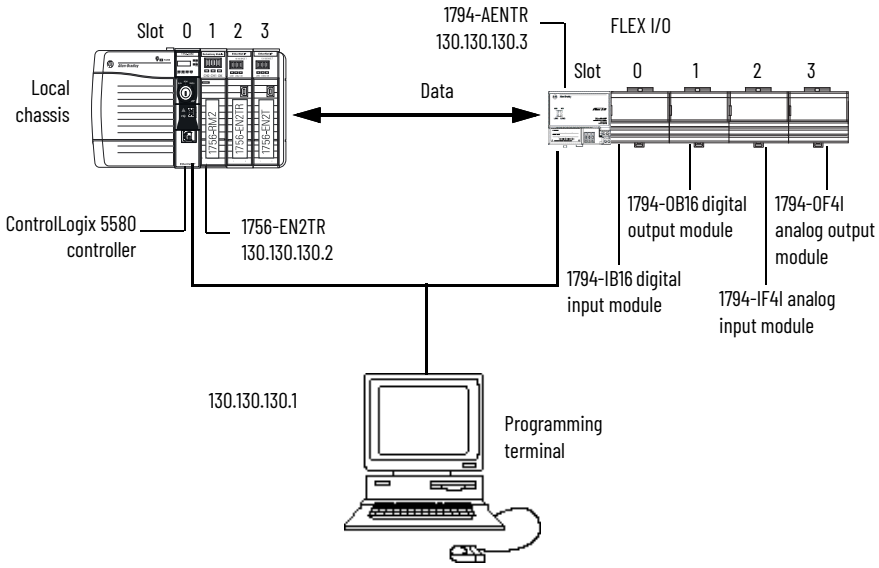
In this example you add analog input and output modules to the FLEX I/O configured with two digital I/O modules in the previous chapter. Analog modules default to direct connection, so you open a direct connection to each analog module while still using a single rack-optimized connection for the two digital I/O modules.

To test the system, the example of the previous chapter is modified to send a signal to one of the analog output channels and read the signal back in through one of the analog input channels.

Set Up the Hardware

Change the system hardware setup of the previous chapter to that shown in Figure 4, adding the FLEX I/O analog input and output modules to the DIN rail with the 1794-AENTR adapter and digital I/O modules.

Figure 4 - Example Hardware Setup



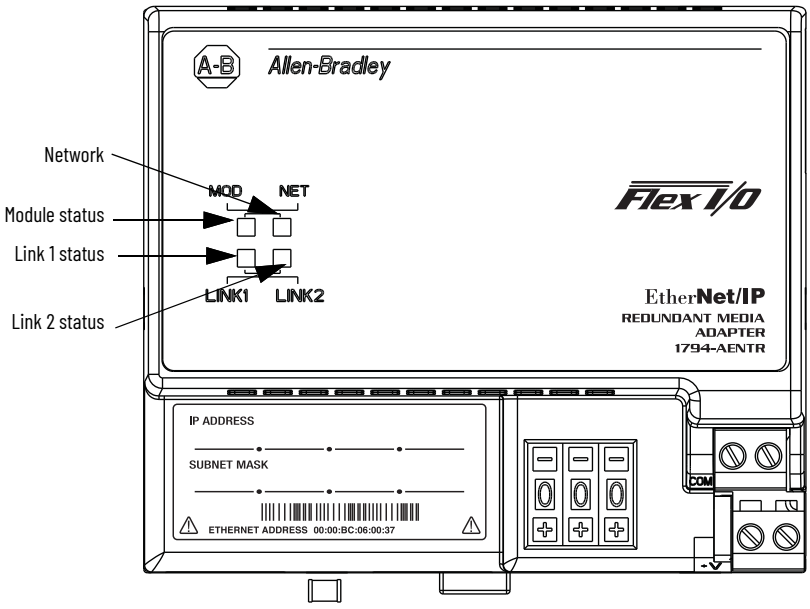
- In the example application, the ControlLogix 5580 controller is in the slot that is shown in Figure 4 in the ControlLogix chassis.
- Verify that the IP addresses for the controller network, the 1794-AENTR adapter, and the programming terminal are correct.
- Verify the position (slot) of the I/O modules on the DIN rail.
- Verify that all wiring and cabling is properly connected.
- Make sure you have your communication driver (for example, AB_ETH-1 or AB_ETHIP-1) configured in RSLinx as described in Appendix B.

Interpret Status Indicators

The faceplates of the 1794-AENT and 1794-AENTRXT adapters are provided with status indicators that display the Module Status, Network Status, and Link Status for both links.

Status Indicators

Figure 5 - 1794-AENTR, 1794-AENTRXT Module



1794-AENTR shown

Use Table 3 to determine the indicator conditions and status.

Table 3 - Status Indicator Identification

Indicator	State	Status
Link 1 or Link 2 (individually)	Off	No link exists. Verify network cabling. Correct as necessary.
	Solid green	Link exists at 100 Mbps.
	Flashing green	I/O is being transmitted or received at 100 Mbps.
	Flashing yellow	I/O is being transmitted or received at 10 Mbps.
	Solid yellow	Link exists at 10 Mbps.
Module Status Indicator	Off	No power. The adapter does not have 24V DC power. Make sure that power is supplied to the adapter.
	Flashing green	Standby. The adapter is not configured. Configure the adapter.
	Green	Operational. The adapter is operating correctly. No action required.
	Flashing red	Minor fault. A recoverable fault has been detected. This could be caused by an incorrect or inconsistent configuration. Check the configuration and reconfigure as needed.
	Solid red	Major fault. An unrecoverable fault has been detected. Cycle power to the adapter. If this does not clear the fault, replace the adapter.
	Flashing red/green	Self-test. The adapter is performing a power-up self-test. Wait until it is completed.

Configure the RSLinx Ethernet Communication Driver

Read this appendix to install and configure the AB_ETH driver.

About the Ethernet Communication Driver

To communicate with your 1794-AENTR or 1794-AENTRXT adapters over your network, you must configure the RSLinx Ethernet communication driver (AB_ETH). You can configure the AB_ETH driver with the IP addresses of all Ethernet devices on your system. You need this driver to download the example application programs in this manual.

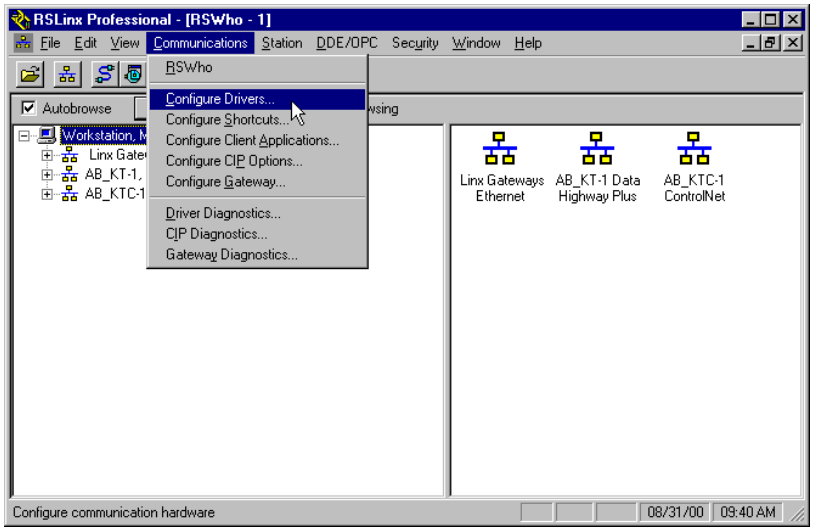
Install the RSLinx Software

You can download and install RSLinx software from the Product Compatibility and Download Center at rok.auto/pcdc.

Configure the AB_ETH Driver

To configure the AB_ETH Ethernet communication driver perform the following steps:

1. Start the RSLinx software.



2. From the Communications menu, select Configure Drivers.
3. From the Available Driver Types drop-down menu, select Ethernet Devices, and then select Add/New.

   The Add New RSLinx Driver dialog box appears.