User Manual

Original Instructions

EtherNet/IP Network Configuration

EtherNet/IP Communication Modules

1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TP, 1756-EN2TPK, 1756-EN2TPXT, 1756-EN2TR, 1756-EN2TRXT, 1756-EN2TSC, 1756-EN2TXT, 1756-EN3TR, 1756-EWEB, 1768-ENBT

CompactLogix 5370 Controllers

EtherNet/IP Adapters

1734-AENT, 1734-AENTR, 1769-AENTR, 1794-AENT, 20-COMM-E, 22-COMM-E, 20-750-ENETR

Embedded Switches

1783-ETAP, 1783-ETAP1F, 1783-ETAP2

AB QUALITY **Allen-Bradley**

Allen-Bradley · Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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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.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

⚡	**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).

Notes:

Summary of Changes

This manual contains new and updated information as indicated in the following table.

Topic	Page
Added content about how to change a module type but keep the definition.	30
Added Parallel Redundancy Protocol content.	36
Added the 1756-EN2TP PRP communication module to the Diagnostics chapter.	116

Notes:

Purpose

This manual describes how you can use EtherNet/IP communication modules with your Logix5000™ controller and communicate with various devices on the Ethernet network.

Scope

Use this manual if you program applications that use EtherNet/IP networks with these Logix5000 controllers:

- CompactLogix™ controller
- ControlLogix® controller
- SoftLogix™ controller

Conventions

Be sure to understand these concepts and tools:

- Use of networking
- Studio 5000 Logix Designer® application
- RSLinx® Classic software
- RSNetWorx™ for EtherNet/IP software

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
EtherNet/IP Modules Installation Instructions, publication ENET-IN002	Provides information about how to complete these tasks with EtherNet/IP communication modules in a Logix5000 control system: • Install the module • Configure initial application setup • Troubleshoot application anomalies related to EtherNet/IP communication module use
EtherNet/IP Media Planning and Installation Manual This manual is available from the Open DeviceNet Vendor Association (ODVA) at: http://www.odva.org.	Provides details about how to install, configure, and maintain linear and Device Level Ring (DLR) networks by using Rockwell Automation® EtherNet/IP devices equipped with embedded switch technology.
EtherNet/IP Secure Communication User Manual, publication ENET-UM003	Provides information on how to configure authentication, encryption, and firewalls, typical architectures, and diagnostics for modules equipped with secure communication function.
Ethernet Design Considerations Reference Manual, publication ENET-RM002	Provides details about how to use EtherNet/IP communication modules with Logix5000 controllers and communicate with other devices on the EtherNet/IP network.
EtherNet/IP Socket Interface Application Technique, publication ENET-AT002	Describes the socket interface that you can use to program MSG instructions. These instructions communicate between a Logix5000 controller via an EtherNet/IP module and Ethernet devices that do not support the EtherNet/IP application protocol. These include bar code scanners, RFID readers, or other standard Ethernet devices.
EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005	Provides details about how to install, configure, and maintain linear and Device Level Ring (DLR) networks by using Rockwell Automation EtherNet/IP devices equipped with embedded switch technology.
Troubleshoot EtherNet/IP Networks Application Technique, publication ENET-AT003	Provides details about how to assign IP addresses to and how to troubleshoot EtherNet/IP networks and devices.
EtherNet/IP Parallel Redundancy Protocol (PRP) Application Technique, publication ENET-AT006	Provides details about how to install, and configure a Parallel Redundancy Protocol (PRP) networks by using Rockwell Automation EtherNet/IP devices equipped with embedded switch technology.

You can view or download publications at
http:/www.rockwellautomation.com/literature/. To order paper copies of
technical documentation, contact your local Allen-Bradley distributor or
Rockwell Automation sales representative.

EtherNet/IP Overview

EtherNet/IP networks are communication networks that offer a comprehensive suite of messages and services for many automation applications.

The following are examples of applications that use EtherNet/IP networks:

- Real-Time Control
- Time Synchronization
- Motion

This open network standard uses commonly available Ethernet communication products to support real-time I/O messaging, information exchange, and general messaging.

EtherNet/IP networks also support CIP Safety, which makes the simultaneous transmission of safety and standard control data and diagnostics information over a common network possible.

EtherNet/IP Communication Modules in a Control System

Depending on the type, Rockwell Automation® EtherNet/IP communication modules provide some of these functions:

- Support for messaging, produced/consumed tags, and distributed I/O

- Encapsulate messages within standard TCP/UDP/IP protocol

- Share a common application layer with ControlNet and DeviceNet network protocols

- Interface via RJ45, category 5, unshielded, twisted-pair cable connectors

- Fiber connectors

- Support for half/full duplex 10 Mbps or 100 Mbps operation

- No network scheduling or routing table requirements

This graphic shows how Rockwell Automation EtherNet/IP communication modules fit into a control system.

Figure 1 - EtherNet/IP Communication Modules in a Control Systems
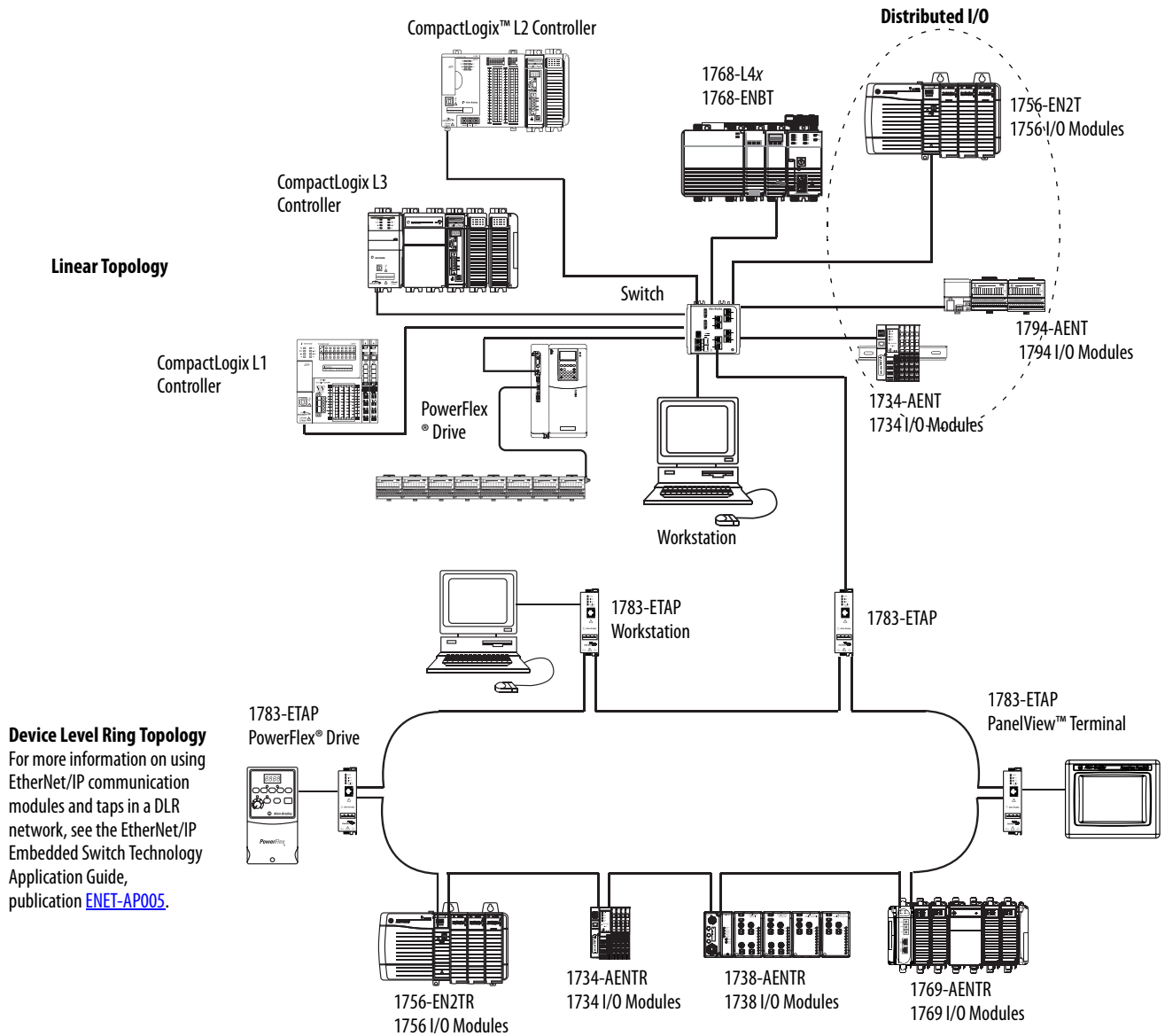
In this example, these actions can occur over the EtherNet/IP network:

- Controllers produce and consume tags.

- Controllers initiate MSG instructions that send and receive data or configure devices.

- Workstations upload or download projects to the controllers

Configure a Workstation to Operate on an EtherNet/IP Network

This chapter describes how to configure a workstation to operate on an EtherNet/IP network.

You must configure an Ethernet communication driver in RSLinx® software for the workstation.

A workstation needs the driver to perform these tasks:

- Upload and download the programming software project information to controllers over an EtherNet/IP network.

- Configure EtherNet/IP network parameters for devices via RSNetWorx™ for EtherNet/IP software.

- Collect controller data for electronic operator interfaces, for example, PanelView™ Plus terminals, and visualization software, for example, FactoryTalk® View software.

You can choose either of these Ethernet drivers:
- AB_ETHIP
- AB_ETH

Before you add a driver, confirm that these conditions exist:

- Workstation is properly connected to the EtherNet/IP network

- IP address and other network parameters are correctly configured for the workstation

Configure the Ethernet Communication Driver in RSLinx Software

To configure the EtherNet/IP driver, follow these steps.

1. From the Communications menu, choose Configure Drivers.
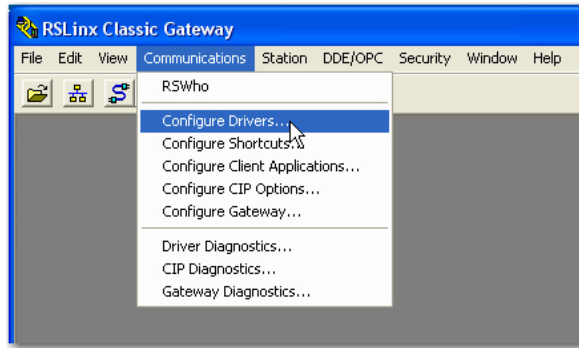
The Configure Drivers dialog box appears.

2. From the Available Driver Types pull-down menu, choose EtherNet/IP Driver or Ethernet devices and click Add New.
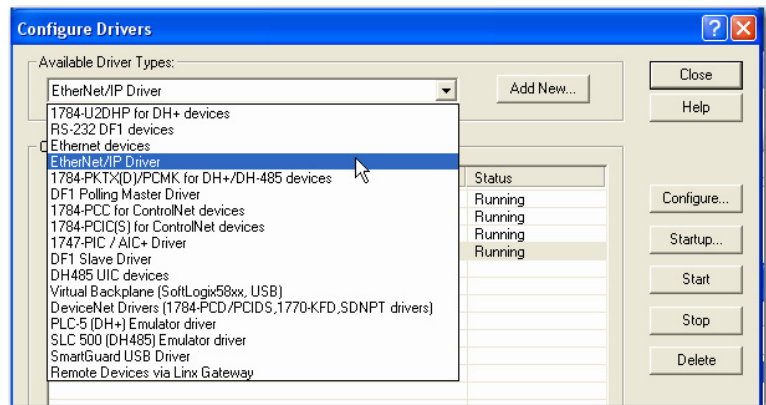
The Add New RSLinx® Driver dialog box appears.

3. Type a name for the new driver and click OK.
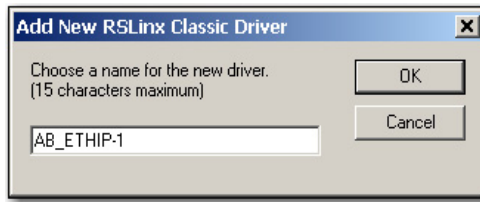
The Configure driver dialog box appears.

4. Click Browse Local Subnet.

> **TIP** To view devices on another subnet or VLAN from the workstation running RSLinx software, click Browse Remote Subnet.

5. Click OK to close the dialog box.
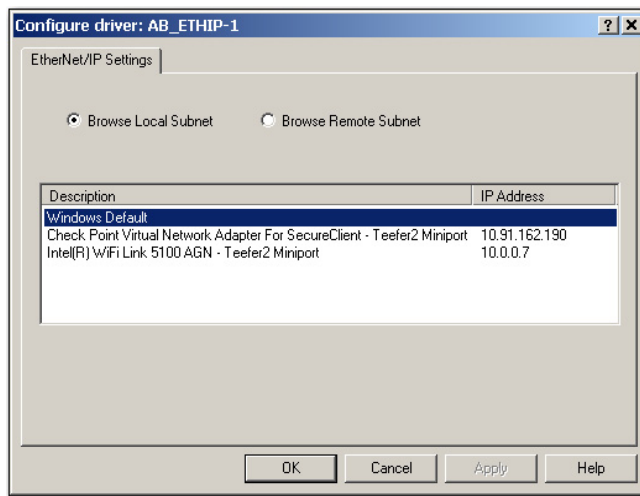
This new driver is available.
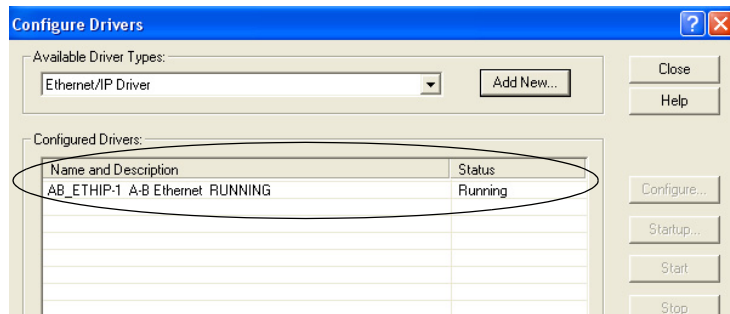
Notes:

Configure an EtherNet/IP Communication Module to Operate on the Network

This chapter describes how to configure an EtherNet/IP communication module to operate on an EtherNet/IP network.

Determine Network Parameters

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

EtherNet/IP Network 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 from 000…254. There are some reserved values that you **cannot use as the first octet** in the address. These numbers are **examples** of values you cannot use: • 001.*xxx.xxx.xxx* • 127.*xxx.xxx.xxx* • 223 to 255.*xxx.xxx.xxx* The specific reserved values that cannot be used vary according to the conditions of each application. The previous values are only examples of reserved values.
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 different subnets into a system of networks. When a node must 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.

Table 1 - EtherNet/IP Network Parameters for DNS Addressing

EtherNet/IP Network 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 type a domain name. Also, if you send email from the module, some mail relay servers require a domain name during the initial handshake of the SMTP session.
Primary DNS server address	This address identifies any DNS servers used in the network. You must have a DNS server that is configured if you specified a domain name or a host name in the configuration of the module. The DNS server converts the domain name or host name to an IP address that the network uses.
Secondary DNS server address	
	For more information on DNS addressing, see page 29.

Check with your Ethernet network administrator to determine if you must specify these parameters.

Set the Network IP Address on a Module

Depending on the EtherNet/IP communication module, you can use some or all of these tools to set the network Internet Protocol (IP) address:

- Rotary switches - Switches are physical parts on the module. Remember the following as you read this chapter:

  – Some EtherNet/IP communication modules use thumbwheel switches that function similarly to rotary switches. This chapter uses the term rotary switches to describe both switch types.

  – Some EtherNet/IP communication modules do not have rotary switches. If your module does not have switches, skip Set the Network IP Address with the Rotary Switches on page 19 and go to Set the Network IP Address with the BOOTP/DHCP Server on page 20.

  – 1783-ETAP*x* EtherNet/IP taps use DIP switches to set the network IP address. For more information on how to use the DIP switches, see the publications for those products.

- Bootstrap Protocol (BOOTP)/Dynamic Host Configuration Protocol (DHCP) server

- RSLinx® Classic software

- Programming software

The module uses these tools sequentially to set the IP address.

EtherNet/IP communication modules are shipped with this configuration:

- BOOTP/DHCP enabled

- Rotary switches set to 999 - when applicable

If you must reset the settings of your module to its factory default settings during normal module operation, see <u>Reset the Module IP Address to Factory Default Value on page 27</u>.

The tools are used in this sequence to set the network IP address:

1. <u>Set the Network IP Address with the Rotary Switches</u>

2. <u>Set the Network IP Address with the BOOTP/DHCP Server</u>

3. <u>Set the Network IP Address with RSLinx Software or the Programming Software</u>

Set the Network IP Address with the Rotary Switches

This graphic shows the rotary switches on a 1756 EtherNet/IP communication module. The location of the switches is dependent on the module.

At powerup, the module reads the rotary switches to determine if they are set to a valid number for the last portion of the IP address. Valid numbers range from 001...254.

If the settings are a valid number, these conditions result:

- IP address = 192.168.1.*xxx* (where *xxx* represents the switch settings)

- Subnet mask = 255.255.255.0

- Gateway address = 0.0.0.0

> **TIP**   Some modules now provide a gateway address of 192.168.1.1 when the network address is set with rotary switches. See the product documentation to determine the correct gateway address the module uses.

- The module does not have a host name that is assigned to it, nor does it use any Domain Name System

We recommend that you set the rotary switches to a valid number before installing the module.

If either of these conditions exist, the module attempts to use the BOOTP/DHCP server to set the IP address:

- Rotary switches are not set to a valid number
- Module does not have rotary switches

For more information on how to use the BOOTP/DHCP server to set the IP address, see .

Set the Network IP Address with the BOOTP/DHCP Server

The BOOTP/DHCP server is a standalone server that you can use to set an IP address. When used, the BOOTP/DHCP server sets an IP address and other Transport Control Protocol (TCP) parameters.

You can use the BOOTP/DHCP server to set the IP address of the module if one of these conditions exists at powerup:

- The rotary switches of the module are not set to a number and the module is BOOTP/DHCP enabled.

- The module does not have rotary switches and the module is BOOTP/DHCP enabled.

Access the BOOTP/DHCP server from one of these locations:

- Programs > Rockwell Software > BOOTP-DHCP Server

  If you have not installed the server, you can download and install it from http://www.ab.com/networks/ethernet/bootp.html.

- Tools directory on the programming software installation CD

> **IMPORTANT** Before you start the BOOTP/DHCP server, make sure that you have the hardware (MAC) address of the module. The hardware address is on a sticker on the side of the communication module and uses an address in a format similar to the following:
>
>   00-00-BC-14-55-35

To set the IP address of the module with a BOOTP/DHCP server, follow these steps.

1. Start the BOOTP/DHCP software.

2. From the Tools menu, choose Network Settings.
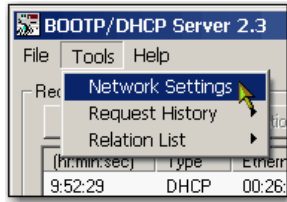
3. Type the Subnet Mask of the network.
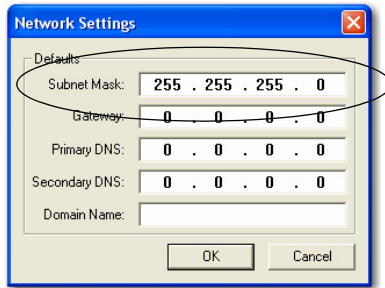
The Gateway address, Primary and/or Secondary DNS address, and Domain Name fields are optional.

4. Click OK.

The Request History panel appears with the hardware addresses of all modules that issue BOOTP requests.

5. Select the appropriate module.
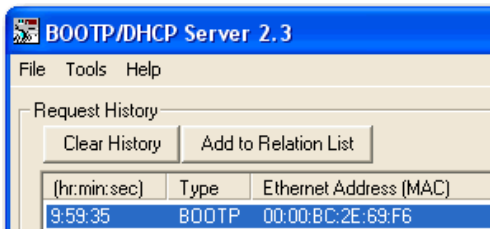
6. Click Add to Relation List.
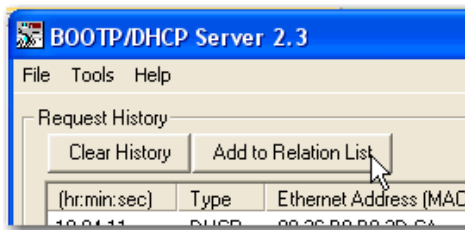
The New Entry dialog box appears.

7. Type an IP Address, Hostname, and Description for the module.
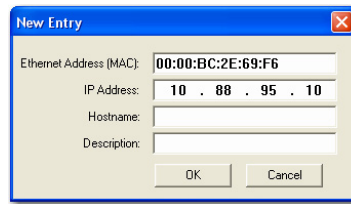
8. Click OK.

9. To assign this configuration to the module, wait for the module to appear in the Relation List panel and select it.

10. Click Disable BOOTP/DHCP.
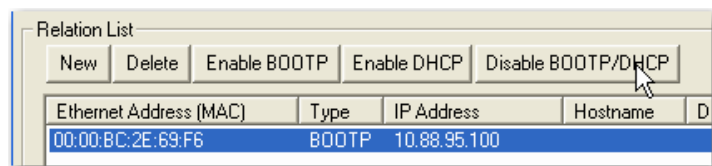
When power is recycled, the module uses the assigned configuration and does not issue a BOOTP request.

> **IMPORTANT**   If you do not click Disable BOOTP/DHCP, on a power cycle, the host controller clears the current IP configuration and begins sending BOOTP requests again.

Use DHCP Software

Dynamic Host Configuration Protocol (DHCP) software automatically assigns IP addresses to client stations logging on to 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 a module. A BOOTP client, such as the EtherNet/IP communication modules, can start from a DHCP server only if the DHCP server is written to handle BOOTP queries. This situation is specific to the DHCP software package used. Consult your system administrator to see if a DHCP package supports BOOTP commands and manual IP allocation.

> ⚠ **ATTENTION:** The EtherNet/IP communication 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.

Set the Network IP Address with RSLinx Software or the Programming Software

This table describes when to set the network IP address with RSLinx software or programming software.

Conditions	Software to Use	Page
• A BOOTP server is not available • The EtherNet/IP communication module is connected to another NetLinx network	RSLinx software	24
The programming software project is online with a controller that communicates to or through the EtherNet/IP communication module	Studio 5000 Logix Designer® application	26

Consider these factors when you determine how to set the network IP address:

- Network isolation from or integration into the plant/enterprise network

- Network size - For large networks, isolated networks, it can be more convenient and safer to use a BOOTP/DHCP server rather than the programming software or RSLinx software. The BOOTP/DHCP server also limits the possibility of assigning duplicate IP addresses.

- Company policies and procedures that deal with plant floor network installation and maintenance

- Level of involvement by IT personnel in plant-floor network installation and maintenance

- Type of training that is offered to control engineers and maintenance personnel

A module can get an address from the enterprise server before the Rockwell Automation® utility even sees the module. This situation can occur when you use the Rockwell Automation BOOTP or DHCP server in an uplinked subnet where an enterprise DHCP server exists. You have to disconnect from the uplink to set the address and configure the module to retain its static address before reconnecting to the uplink. This possibility is not a problem if you have node names that are configured in the module and leave DHCP enabled.

Set the Network IP Address with RSLinx Software

To use RSLinx software to set the IP address of the communication module, follow these steps.

1. From the Communications menu, choose RSWho.

    The RSWho dialog box appears.

2. Navigate to the Ethernet network.

3. Right-click the EtherNet/IP module and choose Module Configuration.
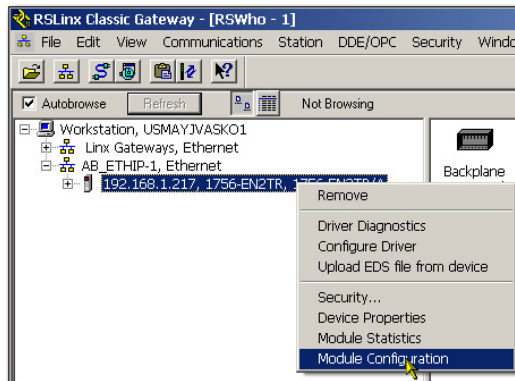
The Module Configuration dialog box appears.

4. Click the Port Configuration tab.
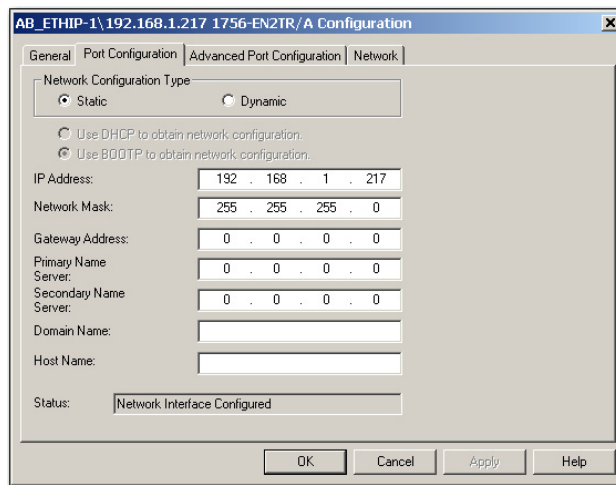
5. For Network Configuration Type, click Static to assign this configuration to the port.

IMPORTANT	If you click Dynamic, on a power cycle, the controller clears the current IP configuration and resumes sending BOOTP requests.

6. Type this information in the appropriate fields:
   - In the IP Address field, type the IP address.
   - In the Network Mask field, type the network mask address.
   - In the Gateway Address field, type the gateway address.
   - In the Primary Name Server field, type the name of the primary server.
   - In the Secondary Name Server field, type the name of the secondary server.
   - In the Domain Name field, type the domain name.
   - In the Host Name field, type the host name.

7. Configure the port settings.

To	Then
Use the default port speed and duplex settings	Leave Auto-negotiate port speed and duplex checked. This setting determines the actual speed and duplex setting.
Manually configure the speed and duplex settings for your port	Follow these steps. 1. Clear the Auto-negotiate port speed and duplex checkbox. 2. From the Current Port Speed pull-down menu, choose a port speed. 3. From the Current Duplex pull-down menu, choose the appropriate Duplex value, that is, Half Duplex or Full Duplex.

> **IMPORTANT** Consider the following when you configure the port settings for the module:
>
> - The speed and duplex settings for the devices on the same Ethernet cable must be the same to avoid transmission errors.
> - Fixed speed and full-duplex settings are more reliable than autonegotiate settings and are recommended for some applications.
> - If the module is connected to an unmanaged switch, leave Autonegotiate port speed and duplex checked or communication can be impaired.
> - If you force the port speed and duplex with a managed switch, the corresponding port of the managed switch must be forced to the same settings or the module fails.
> - If you force the port speed and duplex, and the other device is configured for autonegotiate, a high rate of transmission errors can occur.

8. Click OK.

Set the Network IP Address with the Programming Software

To use programming software to set the IP address of the communication module, follow these steps.

1. In the Controller Organizer, right-click the EtherNet/IP module and choose Properties.
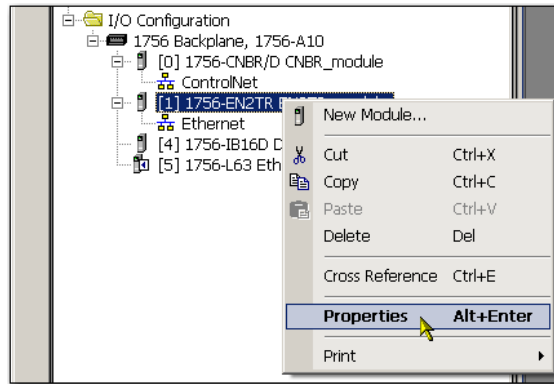
The Module Properties dialog box appears.

2. Click the Port Configuration tab.
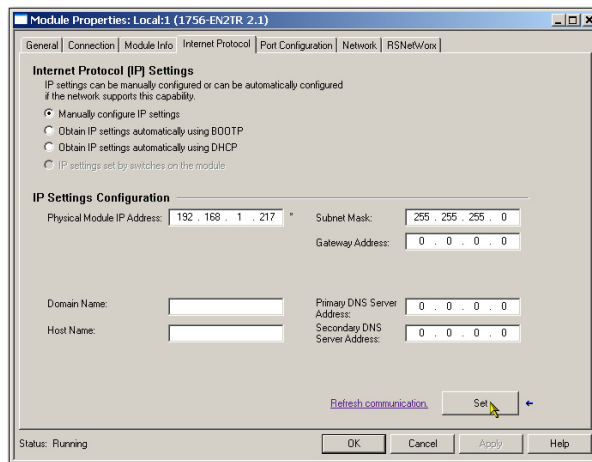
3. In the IP Address field, type the IP address.

4. In the other fields, type the other network parameters, if needed.

IMPORTANT	The fields that appear vary from one EtherNet/IP module to another.

5. Click Set.

6. Click OK.

Reset the Module IP Address to Factory Default Value

You can reset the IP address of the module to its factory default value with the following methods:

- If the module has rotary switches, set the switches to 888 and cycle power.

- If the module does not have rotary switches, use a MSG instruction to the reset the IP address.

Duplicate IP Address Detection

Some EtherNet/IP communication modules support duplicate IP address detection. The module verifies that its IP address does not match the IP address of any other network device when you perform either of these tasks:

- Connect the module to a EtherNet/IP network.

- Change the IP address of the module.

If the IP address of the module matches that of another device on the network, the EtherNet/IP port of the module transitions to Conflict mode. In Conflict mode, these conditions exist:

- OK status indicator is blinking red.

- Network (NET) status indicator is solid red.

- On some EtherNet/IP communication modules, the module status display indicates the conflict.

  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

- On some EtherNet/IP communication modules, the diagnostic webpage for the module displays information about duplicate IP address detection.

  For more information on which EtherNet/IP communication modules support displaying duplicate IP address on their diagnostic webpage, see the Technical Note titled **Logix modules Duplicate IP address detection enhancement**, #118216, in the Technical Support Knowledgebase available at http://www.rockwellautomation.com/knowledgebase/.

Duplicate IP Address Resolution

When two EtherNet/IP communication modules on a network have IP addresses that conflict, the resolution depends on the conditions in which the duplication is detected. This table describes how duplicate IP addresses are resolved.

Duplicate IP Address Detection Conditions	Resolution Process
• Both modules support duplicate IP address detection • Second module is added to the network after the first module is operating on the network	1. The module that began operation first uses the IP address and continues to operate without interruption. 2. The module that begins operation second detects the duplication and enters Conflict mode. To assign a new IP address to the module and leave Conflict mode, see <u>Set the Network IP Address on a Module on page 18</u>.
• Both modules support duplicate IP address detection • Both modules were powered up at approximately the same time	Both EtherNet/IP devices enter Conflict mode. To resolve this conflict, follow these steps: a. Assign a new IP address to one of the modules by using the methods described in <u>Set the Network IP Address on a Module on page 18</u>. b. Cycle power to the other module.
One module supports duplicate IP address detection and a second module does not	1. Regardless of which module obtained the IP address first the module that does not support IP address detection uses the IP address and continues to operate without interruption. 2. The module that supports duplicate IP address detection detects the duplication and enters Conflict mode. To assign a new IP address to the module and leave Conflict mode, see <u>Set the Network IP Address on a Module on page 18</u>.

Devices that experience duplicate IP address conditions behave differently depending on whether connections have been established to either of the modules and whether both modules support duplicate IP address detection.

IP Address Swapping

Some EtherNet/IP communication modules support IP address swapping. This function is used in ControlLogix® enhanced redundancy systems. During a system switchover, partnered EtherNet/IP communication modules swap IP addresses.

For more information about IP address swapping, see the ControlLogix Enhanced Redundancy System User Manual, publication <u>1756-UM535</u>.

DNS Addressing

To qualify the address of a module, use DNS addressing to specify a host name for a module, which also includes specifying a domain name and DNS servers. DNS addressing makes it possible to configure similar network structures and IP address sequences under different domains.

DNS addressing is necessary only if you refer to the module by host name, such as in path descriptions in MSG instructions.

To use DNS addressing, follow these steps.

1. Assign a host name to the module.

   A network administrator can assign a host name. Valid host names must be IEC-1131-3 compliant.

2. Configure the parameters of the module.

3. Configure the IP address, subnet mask, gateway address, a host name for the module, domain name, and primary/secondary DNS server addresses.

   In the DNS server, the host name must match the IP address of the module.

IMPORTANT	Make sure the DNS enable bit is set.
	If you configure your module by using RSLinx software, version 2.41, the enable bit is cleared and DNS addressing does not work. If you configure your module by using the Port Configuration tab in the programming software, the enable bit is set, so DNS addressing works.

4. In the programming software, add the module to the I/O configuration tree.

   See <u>Add an I/O Module on page 43</u>.

IMPORTANT	If a child module resides in the same domain as its parent module, type the host name. If the child domain of the child module differs from the domain of its parent module, type the host name and the domain name (host.domain)

> **IMPORTANT**   You can also use DNS addressing in a module profile in the I/O controller tree or in a message path. If the domain name of the destination module differs from that of the source module, use a fully qualified DNS name (hostname.domainname). For example, to send a message from ENBT1.location1.companyA to ENTB1.location2.companyA, the host names match, but the domains differ. Without the entry of a fully qualified DNS name, the module adds the default domain name to the specified host name.

Use EtherNet/IP Communication Modules in a Logix5000 Controller Application

After installing an EtherNet/IP communication module and setting its IP address, add the module to the Controller Organizer in a programming software project. This addition establishes I/O control.

You must download that project to the host controller before operation can begin. When the controller begins operation, it establishes a connection with the EtherNet/IP communication module. The configuration of the module determines its behavior.

For more information on how to connect a workstation to and configure it for use on an EtherNet/IP network, see .

For more information on controlling I/O, see .

Change Type

Use the Change Type dialog box to change your bridge module type to another bridge module type or revision. For example, you can change a 1756-EN2TR Ethernet Bridge module to a 1756-EN2TP Ethernet Bridge module, keeping the module definitions.

Use the Change Type function on the Module Properties dialog box to change the module type without having to create a new module definition.
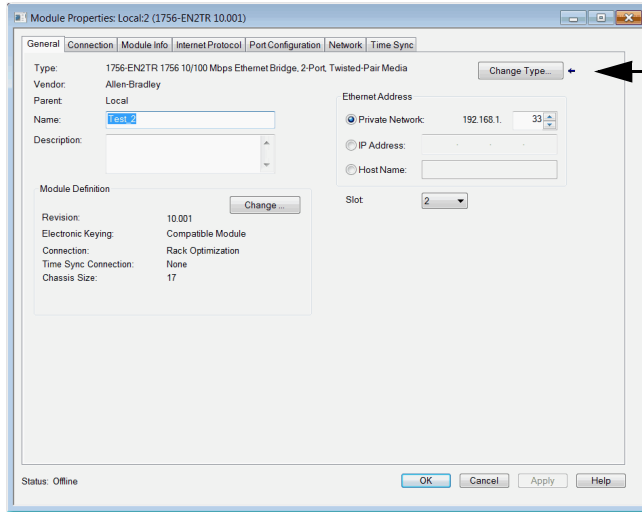
Follow these steps to change one module definition to another module type.

1. Right-click on the module in the Controller Organizer.

2. Click Properties.

3. Click Change Type.
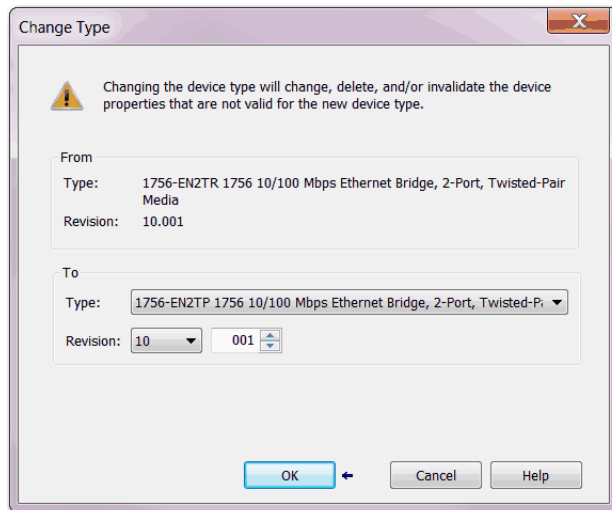
4. Select the Change module to type:

5. Click OK.

The previous module definition properties apply to the new module you selected. Unless you have copied the module in the Controller Organizer, the module you changed from is now gone.

Explicit Protected Mode

When in this mode, the module does not allow any configuration changes.

Enter Explicit Protected Mode

Follow these steps to enter Explicit Protected Mode (Italics are where the entry/exit procedures are different).

1. Remove the module from the chassis and record the positions of the rotary switches.

2. Set the rotary switches to: *900*

3. Insert the module into the chassis.

4. Observe on the display.

   Explicit protected mode *enabled* - Change Switch Settings

   The module is non-operational at this point. You must continue with step 5 to re-establish operation.

5. Remove the module from the chassis

6. Return the rotary switches to the positions they were in before step 2.

7. Insert the module in the chassis.

   The module is operational, and *does not allow* any configuration changes.

Exit Explicit Protected Mode

Follow these steps to exit Explicit Protected Mode.

1. Remove the module from the chassis and record the positions of the rotary switches.

2. Set the rotary switches to: *000*

3. Insert the module into the chassis.

4. Observe on the display.

   Explicit protected mode *disabled* - Change Switch Settings

   The module is non-operational at this point. You must continue with step 5 to re-establish operation.

5. Remove the module from the chassis.

6. Return the rotary switches to the positions they were in before step 2.

7. Insert the module in the chassis.

   The module is operational, and *allows* configuration changes.

   > **TIP** Another option is to do an out of box reset using the rotary switches, as described in <u>Set the Network IP Address with the Rotary Switches on page 19</u>.

Electronic Keying

Electronic Keying reduces the possibility that you use the wrong device in a control system. It compares the device defined in your project to the installed device. If keying fails, a fault occurs. These attributes are compared.

Attribute	Description
Vendor	The device manufacturer.
Device Type	The general type of the product, for example, digital I/O module.
Product Code	The specific type of the product. The Product Code maps to a catalog number.
Major Revision	A number that represents the functional capabilities of a device.
Minor Revision	A number that represents behavior changes in the device.

The following Electronic Keying options are available.

Keying Option	Description
Compatible Module	Lets the installed device accept the key of the device that is defined in the project when the installed device can emulate the defined device. With Compatible Module, you can typically replace a device with another device that has the following characteristics: • Same catalog number • Same or higher Major Revision • Minor Revision as follows: – If the Major Revision is the same, the Minor Revision must be the same or higher. – If the Major Revision is higher, the Minor Revision can be any number.
Disable Keying	Indicates that the keying attributes are not considered when attempting to communicate with a device. With Disable Keying, communication can occur with a device other than the type specified in the project. **ATTENTION**: Be extremely cautious when using Disable Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss. We **strongly recommend** that you **do not use** Disable Keying. If you use Disable Keying, you must take full responsibility for understanding whether the device being used can fulfill the functional requirements of the application.
Exact Match	Indicates that all keying attributes must match to establish communication. If any attribute does not match precisely, communication with the device does not occur.

Carefully consider the implications of each keying option when selecting one.

IMPORTANT	Changing Electronic Keying parameters online interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken. If an I/O connection to a device is interrupted, the result can be a loss of data.

More Information

For more detailed information on Electronic Keying, see Electronic Keying in Logix5000™ Control Systems Application Technique, publication [LOGIX-AT001](#).

Device Level Ring Network

A Device Level Ring (DLR) network is a single-fault-tolerant ring network intended for the interconnection of automation devices without the need for additional switches. The ring topology offers these advantages:

- Media redundancy
- Fast network fault detection and reconfiguration
- Resiliency of a single-fault-tolerant network
- Easy implementation without additional hardware requirements

> **IMPORTANT**   This section summarizes a DLR network. For information on planning, configuring, and monitoring DLR networks, see EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

One DLR network can support as many as 50 nodes. A DLR network supports copper connections (maximum of 100 m), fiber-optic connections (maximum of 2 km), or a mix of copper and fiber.

Figure 2 - Example Device Level Ring Topology
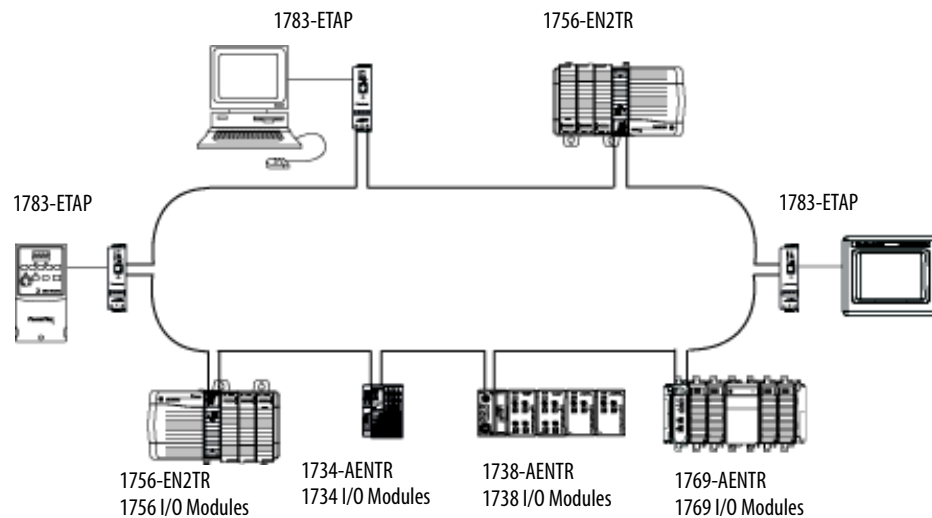
Check your device specifications to determine whether the device supports the DLR network and whether the device can act as a supervisor.

A DLR network consists of the following nodes.

Node	Description
Supervisor Node	A DLR network requires at least one node to be configured as ring supervisor. **Important:** Out-of-the-box, the supervisor function of the supervisor-capable devices is disabled so they are ready to participate in a linear/star network or as a ring node on a DLR network. In a DLR network, you must configure at least one of the supervisor-capable devices as the ring supervisor before physically connecting the ring. If you do not, the DLR network does not work. The ring supervisor provides these main functions: • Manages traffic on the DLR network • Collects diagnostic information for the network We recommend that you do the following: • Configure at least one back-up supervisor. • Configure the desired active ring supervisor with a numerically higher precedence value as compared to the back-up supervisors. • Record the supervisor-precedence values of the DLR network for all supervisor-enabled nodes.
Ring Node	A ring node is any node that operates on the network to process data that is transmitted over the network. A ring node is also any node that passes on the data to the next node on the network. When a fault occurs on the DLR network, the ring nodes reconfigure themselves and relearn the network topology. Additionally, ring nodes can report fault locations to the active ring supervisor.

Parallel Redundancy Protocol Network

A Parallel Redundancy Protocol (PRP) network offers a higher level of redundancy than DLR. PRP is an international standard that is described in [IEC 62439-3](). PRP technology builds network redundancy into the end devices so that network infrastructure can be duplicated using standard components, such as managed and unmanaged switches.

Table 2 describes terms to know when you configure PRP.

Table 2 - PRP Terms

Term	Description
Doubly or Dually Attached Node, which implements PRP (DAN)	End-device with PRP functionality that is connected to each of the two independent LANs.
Single Attached Node (SAN)	Device with one network interface that is connected directly to one of the two LANs.
Redundancy Box (RedBox)	Device that connects one or more SANs to both LANs. The switch implements RedBox functionality.
Virtual DAN (VDAN)	A SAN connected to both LANs through a RedBox. A node behind a RedBox appears to other nodes as a DAN.
Hot Standby Router Protocol (HSRP)	HSRP is one way to achieve near-100 percent network uptime. HSRP provides network redundancy for IP networks, ensuring that user traffic immediately and transparently recovers from first hop failures in network edge devices or access circuits.

Figure 3 illustrates the simplest design of the PRP network topology. This topology is the same as a star network configuration, but adds PRP functionality by adding a separate, second LAN and replacing the end nodes with PRP devices.

Figure 3 - Parallel Redundancy Protocol (PRP) Topology
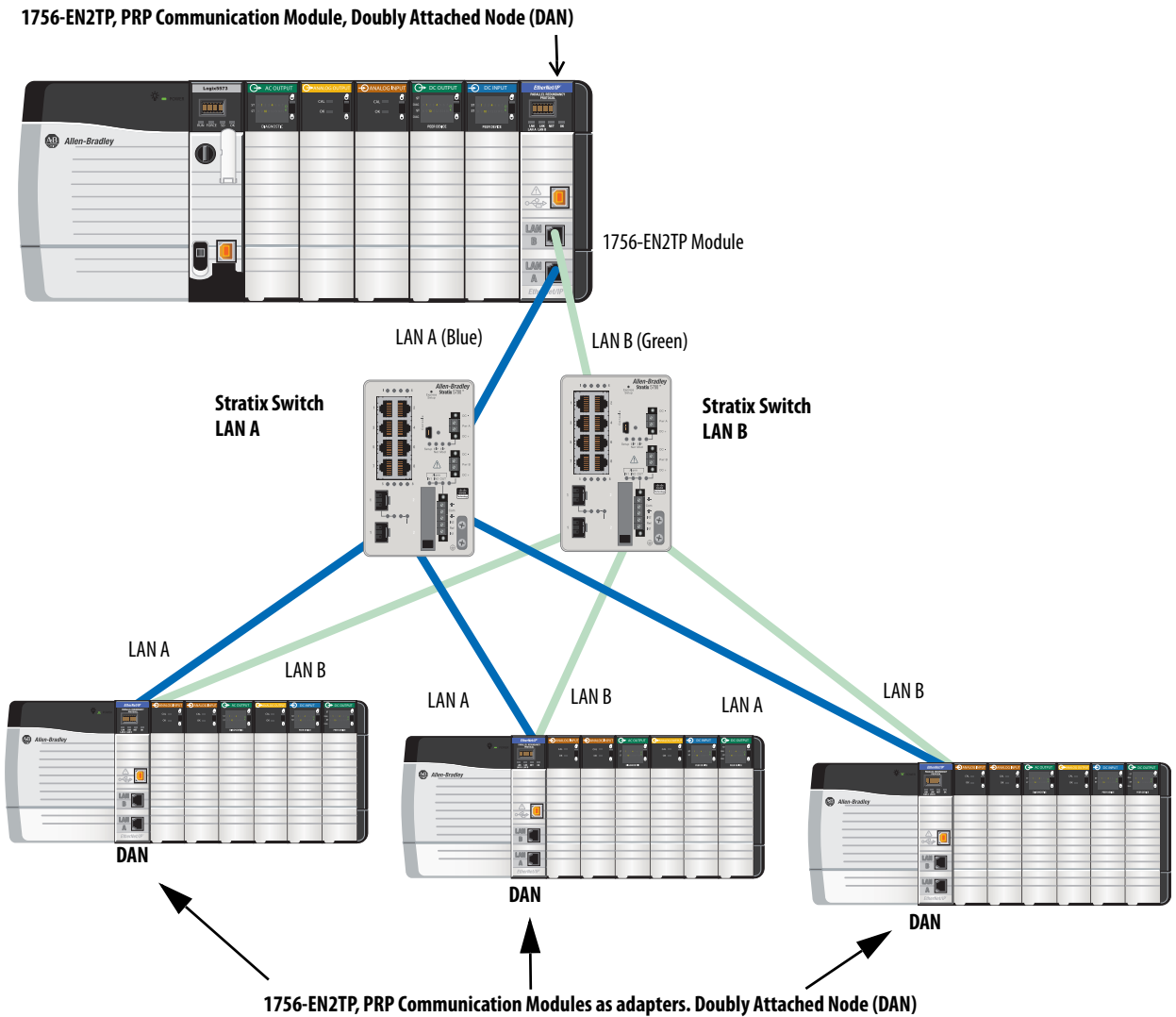
PRP provides a redundant network infrastructure. An important feature of PRP is that the two LANs do not meet, but connect at the PRP end nodes. An end node that is connected to both LANs is called Doubly or Dually Attached Node or DAN. Both terms are fully accepted and used in the IEC standard.

> ⚠️ **WARNING:** Never connect LAN A and LAN B directly to each other. For example, never connect an infrastructure switch in LAN A to an infrastructure switch in LAN B.

Figure 4 illustrates the addition of a Redundancy Box, or RedBox. The RedBox allows non-PRP devices to be added to both LANs. Devices that are connected to both LANs through a RedBox are called Virtual Doubly Attached Nodes, or VDANs.

VDANs do not have media redundancy between the device and the RedBox, however, media redundancy exists on the LAN A/LAN B side of the RedBox. In this example, the Stratix® 5400 switch is configured as a RedBox.

Figure 4 - Parallel Redundancy Protocol (PRP) Topology, with a Stratix 5400 as a RedBox
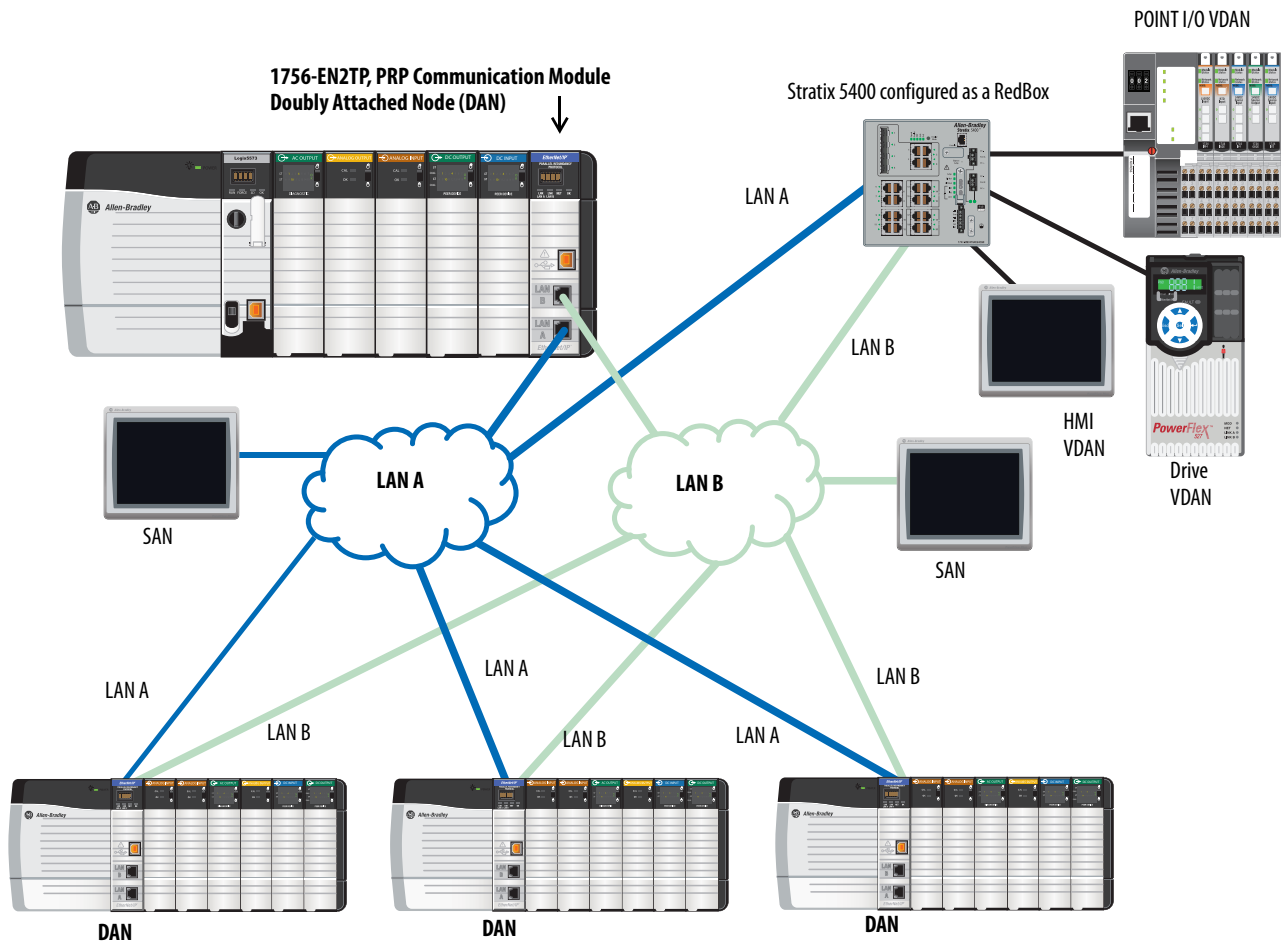
IMPORTANT	Products with PRP technology have two ports. Each port connects to a separate PRP LAN that then connects to two independent sets of network infrastructures.
	You cannot use these ports as two Network Interface Cards (NICs) connected to two different subnets. Each 1756-EN2TP module has only 1 unique MAC and has only one IP address.
	The 1756-EN2TP Ethernet Communication module cannot be used as part of a DLR ring, because the 1756-EN2TP supports PRP but not the DLR protocol.

For more information on PRP topologies and configuration scenarios, see the EtherNet/IP Parallel Redundancy Protocol Application Technique, publication ENET-AT006.

For more information on how to configure the Stratix switches for PRP see the Stratix Managed Switches User Manual 1783-UM007.
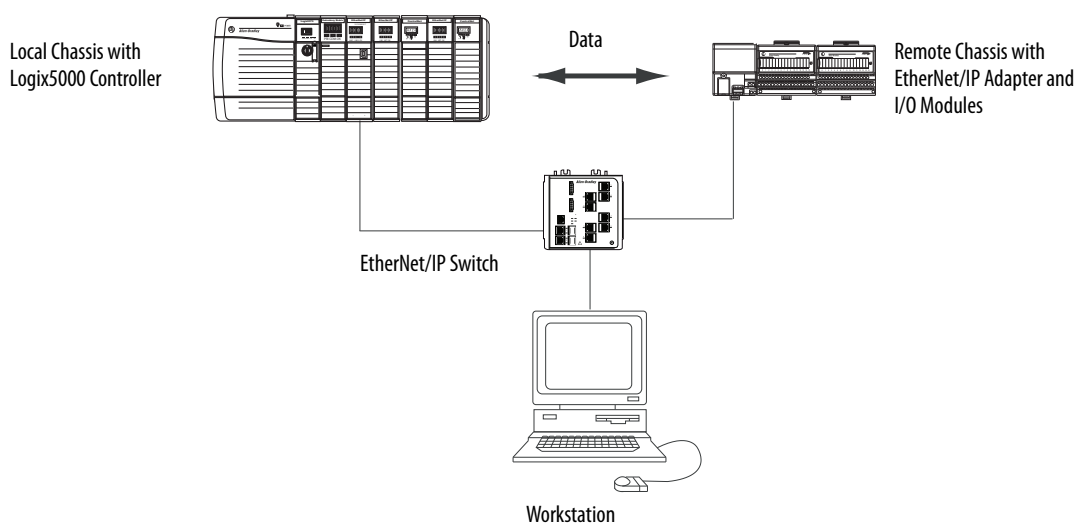
Notes:

Control I/O

This chapter describes how a controller controls distributed I/O over an EtherNet/IP network. An EtherNet/IP communication module connects the controller to the network.

Topic	Page
Set Up the Hardware	41
Add Distributed I/O	42
Select a Communication Format	45
Set the Requested Packet Interval (RPI)	51
Access Distributed I/O	52

Set Up the Hardware

In this example, the Logix5000™ controller uses an EtherNet/IP communication module to connect to the EtherNet/IP network. The distributed (remote) I/O uses an EtherNet/IP adapter to connect to the EtherNet/IP network.

Figure 5 - Distributed I/O over an EtherNet/IP Network

Local Chassis with Logix5000 Controller

Data

Remote Chassis with EtherNet/IP Adapter and I/O Modules

EtherNet/IP Switch

Workstation

A Logix5000 controller establishes direct or rack-optimized connections to communicate with I/O modules. Digital I/O modules support either connection type, but analog I/O modules support only direct connections.

You must complete these tasks before your controller can communicate with distributed I/O modules over an EtherNet/IP network:

- Set the IP addresses for each EtherNet/IP communication module.

- Connect all wiring and cabling.

- Configure a communication driver (such as AB-ETHIP-1) for the programming workstation.
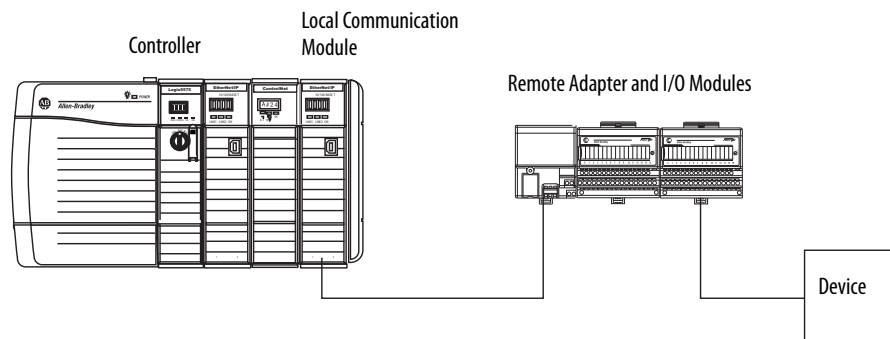
Add Distributed I/O

To communicate with distributed I/O modules, add the following components to the I/O Configuration folder of the controller:

- Local EtherNet/IP communication module
- Remote adapter
- I/O modules in the same chassis as the remote adapter

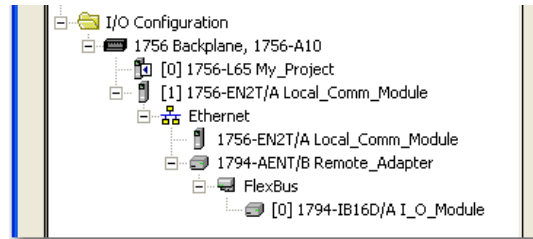Within the folder, organize the modules into a hierarchy (tree/branch, parent/child).

This graphic shows a system that uses a 1756-EN2TR module as the local communication module, a remote 1794-AENT adapter and distributed FLEX™ I/O modules.

To build the I/O configuration for a typical distributed I/O network, follow these steps.

1. Add the local communication module, that is, the bridge.

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

3. Add the I/O module.

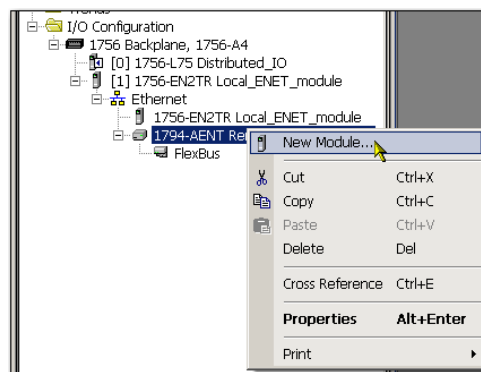This graphic shows the I/O configuration of the consumer controller after distributed I/O modules are added.

```
□─🗀 I/O Configuration
  □─▣ 1756 Backplane, 1756-A10
     ⊡ [0] 1756-L65 My_Project
     □─🗋 [1] 1756-EN2T/A Local_Comm_Module
        □─🗋 Ethernet
           🗋 1756-EN2T/A Local_Comm_Module
           □─🗋 1794-AENT/B Remote_Adapter
              □─🖳 FlexBus
                 🗋 [0] 1794-IB16D/A I_O_Module
```

> **IMPORTANT**   I/O is controlled on the same subnet and cannot be processed via a router.

Add an I/O Module

To add a module to the I/O Configuration folder, follow these steps.

1. In the Controller Organizer, right-click the remote communication module and choose New Module.

```
□─🗀 I/O Configuration
  □─▣ 1756 Backplane, 1756-A4
     ⊡ [0] 1756-L75 Distributed_IO
     □─🗋 [1] 1756-EN2TR Local_ENET_module
        □─🗋 Ethernet
           🗋 1756-EN2TR Local_ENET_module
           □─🗋 1794-AENT Re │ New Module...
              🖳 FlexBus      │ Cut          Ctrl+X
                             │ Copy         Ctrl+C
                             │ Paste        Ctrl+V
                             │ Delete       Del
                             │ Cross Reference  Ctrl+E
                             │ **Properties**   Alt+Enter
                             │ Print        ▶
```

The Select Module dialog box appears.

2. Choose the module that you wish to add and click OK.
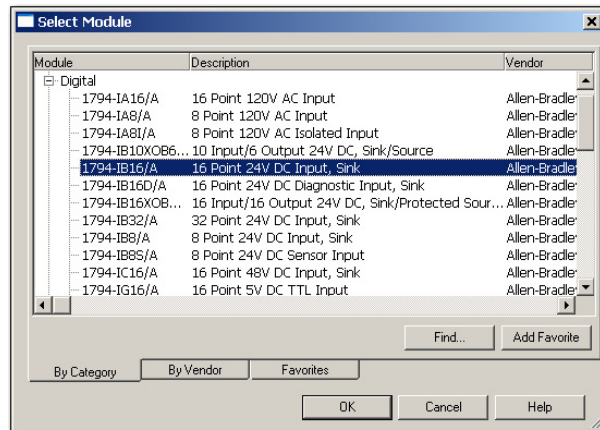
Depending on the I/O module, the Select Major Revision dialog box can appear. If the dialog box appears, choose the major revision of the module and click OK.

The Module Properties dialog box appears.
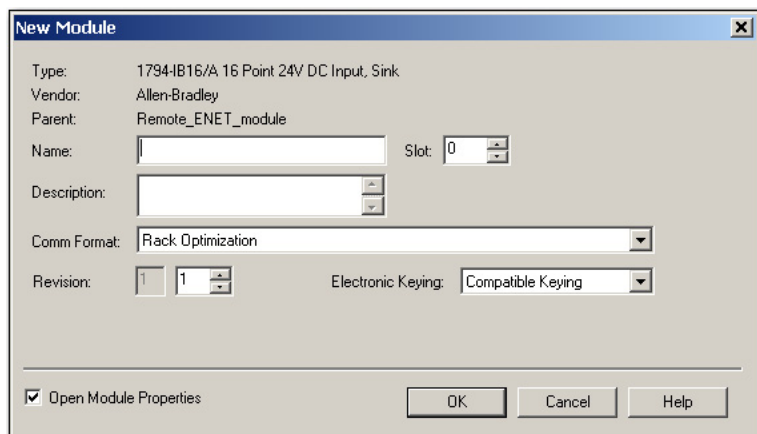
3. In the Name field, type the name of your I/O module.

4. In the Slot field, type the slot number in which your I/O module resides.

5. From the Comm Format pull-down menu, choose a communication format.

    For more information on the selection of communication formats, see .

6. Click OK to see the rest of the Module Properties dialog box.

7. Configure the module as necessary.

    Use the Help button to view module-specific configuration information.

8. Click Finish.

Select a Communication Format

When configuring an I/O module, you must select a communication format. The type of communication format determines the data structure for the tags of the module. Many I/O modules support different formats. Each format uses another data structure.

The communication format determines these parameters:
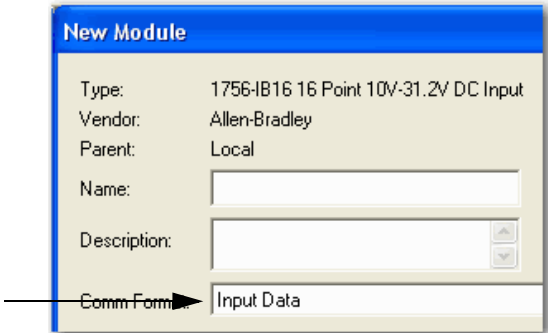- Direct or rack-optimized connection
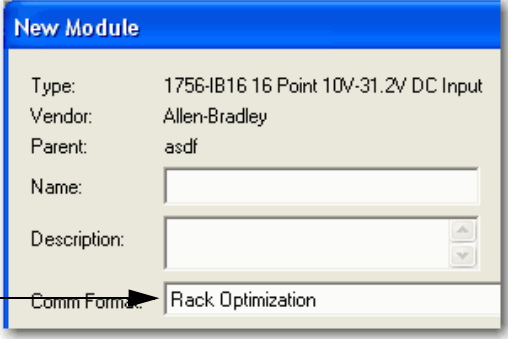- Ownership

Table 3 - Communication Formats

I/O Module Type	Desired Connection Type	Required Communication Format
Digital	A rack-optimized connection	Rack Optimization
	To use specialty features of the module, such as diagnostics, time stamps, or electronic fuses	Full Diagnostics CST Timestamped
Digital	A direct connection	Scheduled Data Input Data Output Data
Analog	A direct connection (only direct connection is supported for analog modules)	Float Data Integer Data CST Timestamped

See the programming software online help for specific communication formats per I/O module.

Choosing a Direct or Rack-optimized Connection

The Logix5000 controller uses connections to transmit I/O data. These connections can be direct connections or rack-optimized connections. The connection types that are available are module-dependant.

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

Term	Definition
Rack-optimized connection	For digital I/O modules, you can choose 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). **New Module** Type: 1756-IB16 16 Point 10V-31.2V DC Input Vendor: Allen-Bradley Parent: asdf Name: Description: Rack-optimized connection ────► Comm Format: Rack Optimization

> **IMPORTANT**   If you must use a rack-optimized communication format with a remote 1756 chassis, you cannot install different 1756 EtherNet/IP communication modules in the same remote chassis. For example, you cannot install a 1756-ENBT module and a 1756-EN2T module in the same remote chassis if you format with a 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.
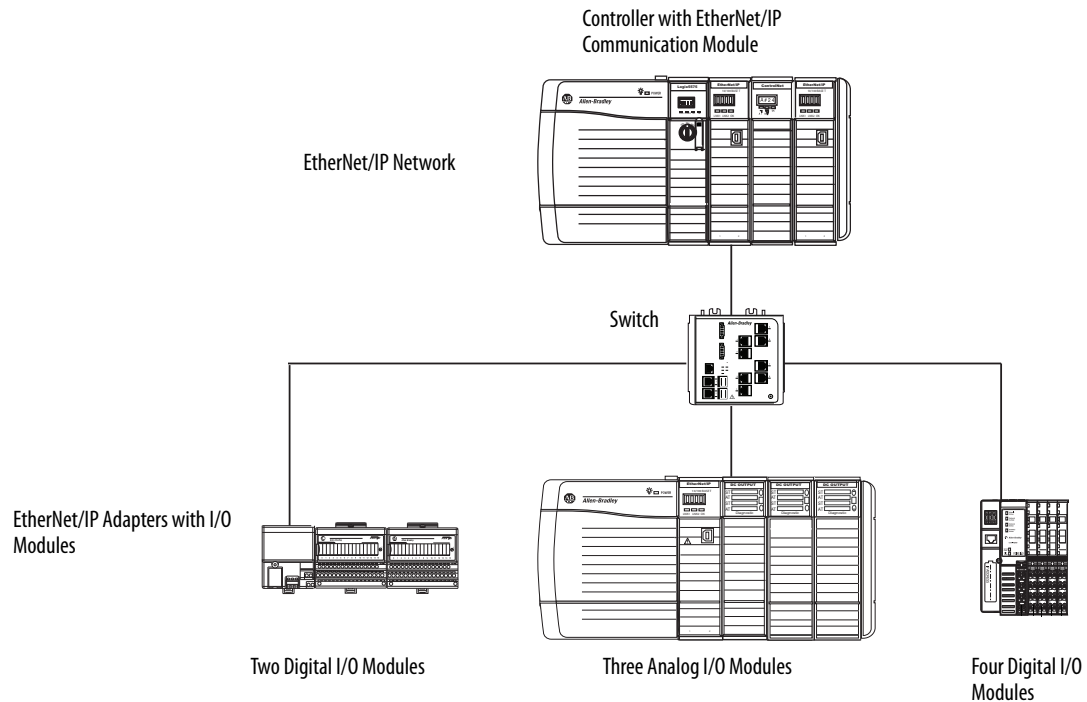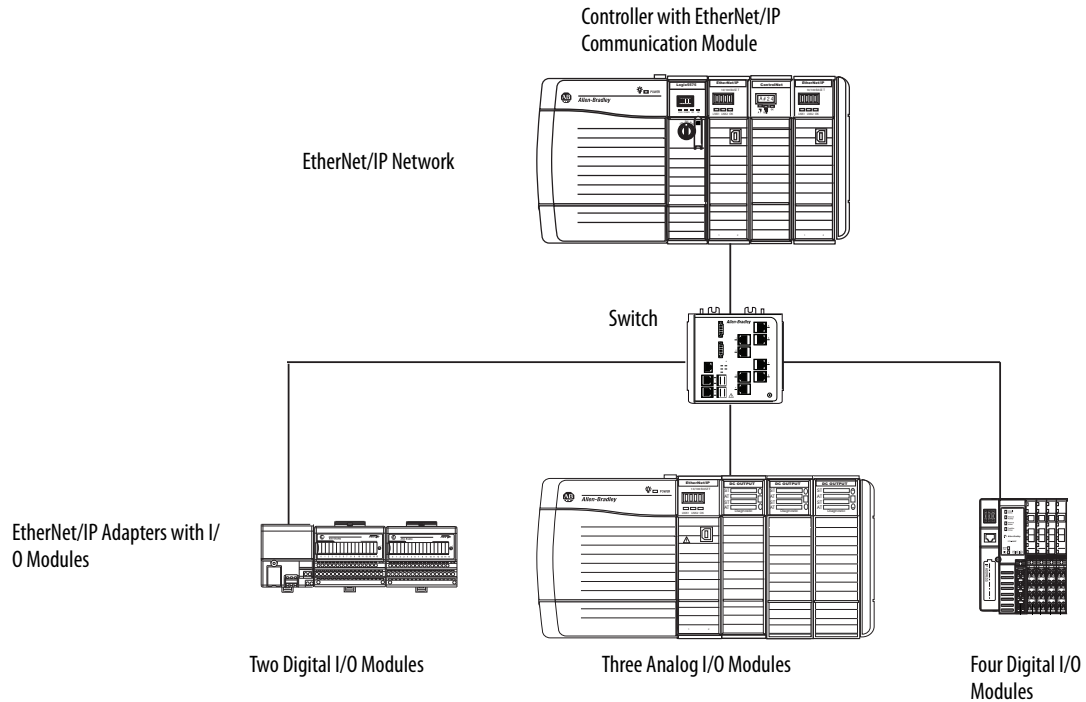

Table 4 - Example - System Connections

System Connections	Amount
Controller to local EtherNet/IP communication module	0

Controller to EtherNet/IP adapter
    Direct connection for digital I/O modules
    Direct connection for analog I/O modules
	
	6
	3

Total connections used	9

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

See 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.

Controller with EtherNet/IP
Communication Module

EtherNet/IP Network

Switch

EtherNet/IP Adapters with I/O Modules

Two Digital I/O Modules

Three Analog I/O Modules

Four Digital I/O Modules

Table 5 - Example - System Connections

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)	3
Total connections used	5
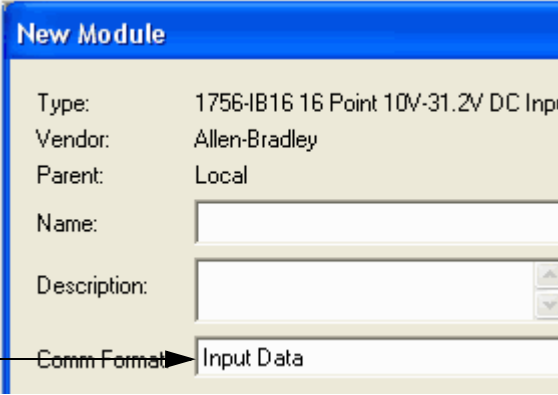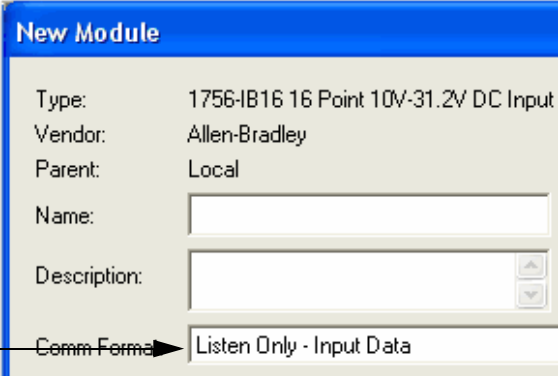
The rack-optimized connection conserves connections, but can limit the status and diagnostic information that is available from the I/O modules.

Use a rack-optimized connection between any digital I/O that allows it and the remote adapter that connects the distributed I/O to the controller via the communication module. This configuration optimizes the number of available connections.

Ownership

In a Logix5000 system, modules multicast data. Therefore, multiple modules can receive the same data simultaneously from one module. When choosing a communication format, decide whether to establish an owner-controller or listen-only relationship with the module.

Ownership Type	Description
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. An owner connection is any connection that excludes Listen-Only in its Comm Format.
Listen-only connection	An I/O connection where another controller owns/provides the configuration data for the I/O module. A controller that uses a listen-only connection monitors only 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. Listen-only connection

Table 6 - Choosing a Type of Module Ownership

Module Type	Another Controller	Desired Conditions	Use This Connection Type
Input module	Does not own the module		Owner
	Owns the module	Maintain communication with the module if it loses communication with the other controller	Owner Use the same configuration as the other owner controller.
		Stop communication with the module if it loses communication with the other controller	Listen-only
Output module	Does not own the module		Owner
	Owns the module		Listen-only

Table 7 - Input and Output Modules - Differences in Ownership

Control	This Ownership	Description
Input modules	Owner	A controller that establishes a connection as an owner configures an input module. This configuring controller is the first controller to establish an owner connection. Once a controller configures and owns an input module, other controllers can establish owner connections to that module. This process allows additional owners to continue to receive multicast data if the original owner controller breaks its connection to the module. Additional owners must have the identical configuration data and communication format as the original owner controller; otherwise, the connection attempt is rejected.
	Listen-only	Once a controller configures and owns an input module, other controllers can establish a listen-only connection to that module. These controllers can receive multicast data while another controller owns the module. If all owner controllers break their connections to the input module, all controllers with listen-only connections no longer receive multicast data.
Output modules	Owner	A controller that establishes a connection as an owner configures an output module. Only one owner connection is allowed for an output module. If another controller attempts to establish an owner connection, the connection attempt is rejected.
	Listen-only	Once one controller configures and owns an output module, other controllers must establish listen-only connections to that module. These controllers can receive multicast data while another controller owns the module. If the owner controller breaks its connection to the output module, all controllers with listen-only connections no longer receive multicast data.

Select a Remote Adapter

The type of distributed I/O modules that you must access determines which adapter to use.

Table 8 - Choice of Remote Adapter

| Type of Distributed I/O	Available Remote Adapters
1756 ControlLogix® I/O	1756-ENBT, 1756-EN2T, 1756-EN2TP, 1756-EN2TPK, 1756-EN2TPXT, 1756-EN2TR, 1756-EN2TRXT, 1756-EN2TXT, 1756-EN2F, or 1756-EN3TR communication module
1794 FLEX™ I/O	1794-AENT
1734 POINT I/O™	1734-AENT
1769 Compact I/O™	1769-AENTR

Set the Requested Packet Interval (RPI)

When you configure an I/O module, you define the requested packet interval (RPI) for the module. Only data-producing modules require an RPI. For example, a local EtherNet/IP communication module requires no RPI because it produces no data for the system. Instead it functions only as a bridge.

To set an RPI, follow these steps.

1. Make sure that the module is installed, started, and connected to the controller via a serial, or other network, connection.

2. In the Controller Organizer, right-click the EtherNet/IP communication module and choose Properties.
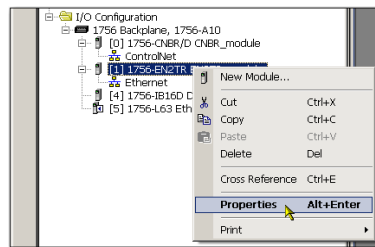
The Module Properties dialog box appears.
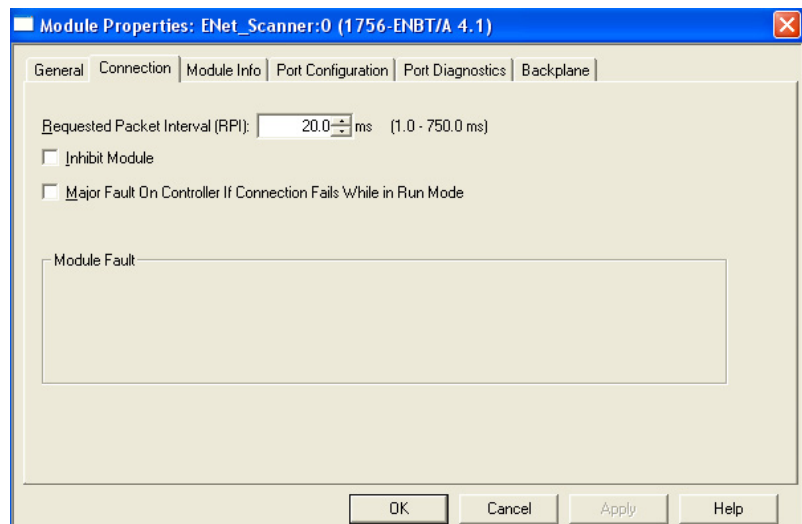
3. Click the Connection tab.

4. From the Requested Packet Interval (RPI) menu, enter the rate at which you want data to be updated over a connection.

Only set the RPI to the rate the application requires.

IMPORTANT	The RPI determines the number of packets per second that the module produces on a connection. Each module can produce only a limited number of packets per second. If you exceed this limit it prevents the module from opening more connections.

5. Click OK.

Unlike EtherNet/IP communication modules, in Logix5000 controllers, I/O values update at an interval set via the I/O configuration folder for 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.

Access Distributed I/O

I/O information is presented as a structure of multiple fields, which depends 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

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, which 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 related to a MemberName
Bit (optional)	Specific point on the I/O module, which depends on the size of the I/O module (0...31 for a 32-point module)

EXAMPLE
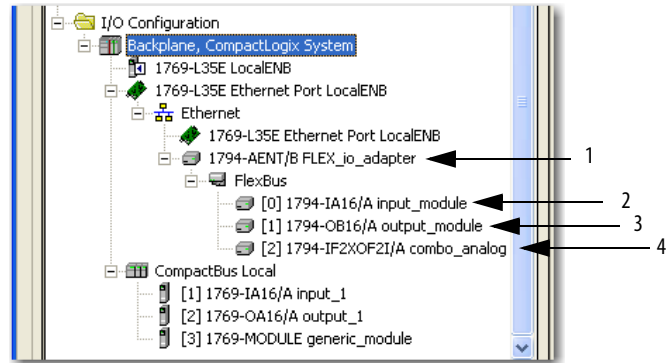
Example	Module	Example Tag Names (automatically created by the software)

1	Remote 1794-AENT adapter "FLEX_io_adapter"	FLEX_io_adapter:I
		    FLEX_io_adapter:I.SlotStatusBits
		    FLEX_io_adapter:I.Data
		FLEX_io_adapter:O
		    FLEX_io_adapter:O.Data

2	Remote 1794-IA16 "input_module" in slot 0
	
	Rack-optimized connection
		FLEX_io_adapter:0:C
		    FLEX_io_adapter:0:C.Config
		    FLEX_io_adapter:0:C.DelayTime_0
		    FLEX_io_adapter:0:C.DelayTime_1
		    FLEX_io_adapter:0:C.DelayTime_2
		    FLEX_io_adapter:0:C.DelayTime_3
		    FLEX_io_adapter:0:C.DelayTime_4
		    FLEX_io_adapter:0:C.DelayTime_5
		FLEX_io_adapter:0:I

3	Remote 1794-OB16 "output_module" in slot 1
	
	Rack-optimized connection
		FLEX_io_adapter:1:C
		    FLEX_io_adapter:1:C.SSData
		FLEX_io_adapter:1:O
		    FLEX_io_adapter:1:O.Data

4	Remote 1794-IF2XOF2I "combo_analog" in slot 2
	
	Direct connection
		FLEX_io_adapter:2:C
		    FLEX_io_adapter:2:C.InputFIlter
		    FLEX_io_adapter:2:C.InputConfiguration
		    FLEX_io_adapter:2:C.OutputConfiguration
		    FLEX_io_adapter:2:C.RTSInterval
		    FLEX_io_adapter:2:C.SSCh0OuputData
		    FLEX_io_adapter:2:C.SSCH1OutputData
		FLEX_io_adapter:2:I

If you use rack optimization for an I/O module, it creates tags as aliases for the tags of the adapter. This logic displays the tag of the device as an alias for the tag of the adapter. In this example, the tag name of the adapter is in angle brackets.

Tag Name of the I/O Device   Tag Name of the Adapter

Conveyor:2:I.0
<Conveyor:I.Data[2].0>
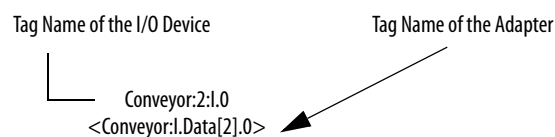
Notes:

Interlocking and Data Transfer between Controllers

This chapter describes how to share data by interlocking controllers (producing and consuming tags) and transferring messages between controllers via an EtherNet/IP network.

Topic	Page
Set Up the Hardware	56
Tag Guidelines for Produced or Consumed Data	57
Connections for Produced and Consumed Tags	57
Produce a Tag	59
Consume Data Produced by Another Controller	61
Guidelines for Message (MSG) Instructions	66
Connections for Messages	67
Enter Message Logic	68
Configure a MSG Instruction	71
Communicate with PLC-5 or SLC Controllers	75

Table 9 - Communication Methods

If you want to	And the Data	Then	Page
Interlock operations	Resides on Logix5000™ controllers	Produce and consume a tag	57
Transfer data	Needs regular delivery at an interval that you specify	Produce and consume a tag	57
	Is sent when a specific condition occurs in your application	Execute a message (MSG) instruction	66

Set Up the Hardware

In this example, the controller in the local chassis produces a tag that the Logix5000 controller in the remote chassis consumes. The local controller can also send a MSG instruction to the remote controller.

Figure 6 - Sharing Data and Transferring Messages
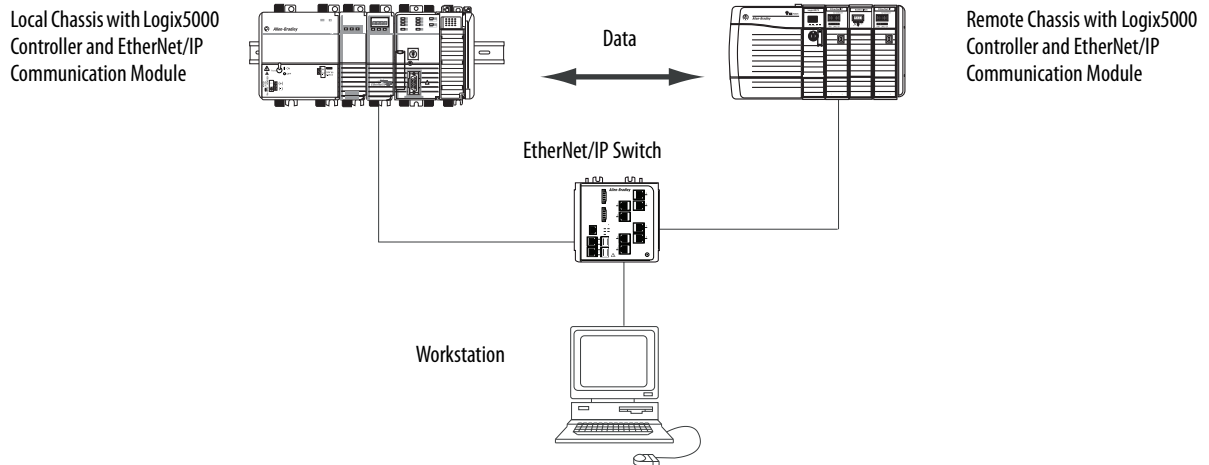
You must complete these tasks before Logix5000 controllers can share tags over an EtherNet/IP network:

- Set the IP addresses and other network parameters for each EtherNet/IP communication module.

- Connect all wiring and cabling.

- Configure a communication driver (such as AB-ETHIP-1) for the programming workstation.

> **IMPORTANT** If you are not using the remote Ethernet communication module to control I/O modules, set the communication format of these modules to none.
> - 1756-ENBT
> - 1756-EN2F
> - 1756-EN2T
> - 1756-EN2TP
> - 1756-EN2TPXT
> - 1756-EN2TR
> - 1756-EN2TXT
> - 1756-EN3TR
> - 1756-EN2TSC
> - 1756-EN2TRXT

Tag Guidelines for Produced or Consumed Data

To organize tags for produced or consumed data (shared data), follow the guidelines in .

Table 10 - Guidelines for the Organization of Tags

Guideline	Details
Create the tags at the controller scope.	You can share only controller-scoped tags.
Use one of these data types: • DINT • REAL • Array of DINTs or REALs • User-defined	• To share other data types, create a user-defined data type that contains the required data. • Use the same data type for the produced tag and corresponding consumed tag or tags.
Limit the size of the tag to ≤ 500 bytes.	If you transfer more than 500 bytes, create logic to transfer the data in packets. A size of < 125 DINT words keeps total bytes within 500. This limit helps reduce the total number of packets for transactions.
Combine data that goes to the same controller.	If you are producing several tags for the same controller: • Group the data into one or more user-defined data types. This method uses fewer connections than does producing each tag separately. • Group the data according to similar update intervals. To conserve network bandwidth, use a greater RPI for less critical data. For example, you could create one tag for data that is critical and another tag for data that is not as critical.

Terminology

A Logix5000 controller can produce (broadcast) and consume (receive) system-shared tags.

Table 11 - Tag Definitions

Term	Definition
Produced tag	A tag that a controller makes available for use by other controllers. Multiple controllers can simultaneously consume (receive) the data. A produced tag sends its data to one or more consumed tags (consumers) without using logic. The produced tag sends its data at the RPI of the consuming tag.
Consumed tag	A tag that receives the data of a produced tag. The data type of the consumed tag must match the data type (including any array dimensions) of the produced tag. The RPI of the consumed tag determines the period at which the data updates.

To share produced or consumed tags, two controllers must be attached to the same EtherNet/IP subnet. Two controllers cannot bridge produced or consumed tags over two subnets.

Connections for Produced and Consumed Tags

Logix controllers can produce (broadcast) and consume (receive) system-shared tags that are sent and received via the EtherNet/IP communication module. Produced and consumed tags each require connections.

Table 12 - Required Connections for Produced and Consumed Tags

Tag Type	Required Connections
Produced	The local controller (producing) must have one connection for the produced tag and the first consumer and one more connection for each additional consumer (heartbeat). The produced tag requires two connections. As you increase the number of controllers that can consume a produced tag, you also reduce the number of connections the controller has available for other operations. Example operations include communication and I/O.
Consumed	Each consumed tag requires one connection for the controller that is consuming the tag. **IMPORTANT**: When you configure a consumed tag, you must add a remote module to the programming software project for the producing controller to configure the consuming controller. The default Comm Format when adding a remote module to the project is Rack Optimized. Change the Comm Format to None when adding the remote communication module.

All EtherNet/IP communication modules support as many as 32 produced multicast connections. Each tag that passes through an EtherNet/IP communication module uses one connection. Due to this feature, the number of available connections limits the total number of tags that can be produced or consumed. If the communication module uses all of its connections for I/O and other communication modules, no connections remain for produced and consumed tags.

> **IMPORTANT**   Depending on whether it is producing or consuming a tag, a Logix5000 controller uses its connections differently.

Table 13 - Number Connections for Produced and Consumed Tags

Type of Tag	Device	Number of Connections Used
Produced tag	Logix5000 controller	Number_of_consumers + 1
	EtherNet/IP communication module	1
Consumed tag	Logix5000 controller EtherNet/IP communication module	1

This graphic shows a Logix5000 controller producing one tag for consumption by another Logix5000 controller. In this example, the producing controller uses two connections and every other Logix module/controller uses only one connection.

Figure 7 - Logix5000 Controller in Local Chassis Producing a Single Tag for a Logix5000 Controller in a Remote Chassis

Local Controller (producer controller)- 1768 CompactLogix™ controller
Connections Used = 2 (1 + Number of consumers)

Remote Controller (consumer controller) - ControlLogix controller
Connections Used = 1

Local Communication Module
1768-ENBT
Connections Used = 1

Remote Communication Module
- 1756-EN2T
Connections Used = 1
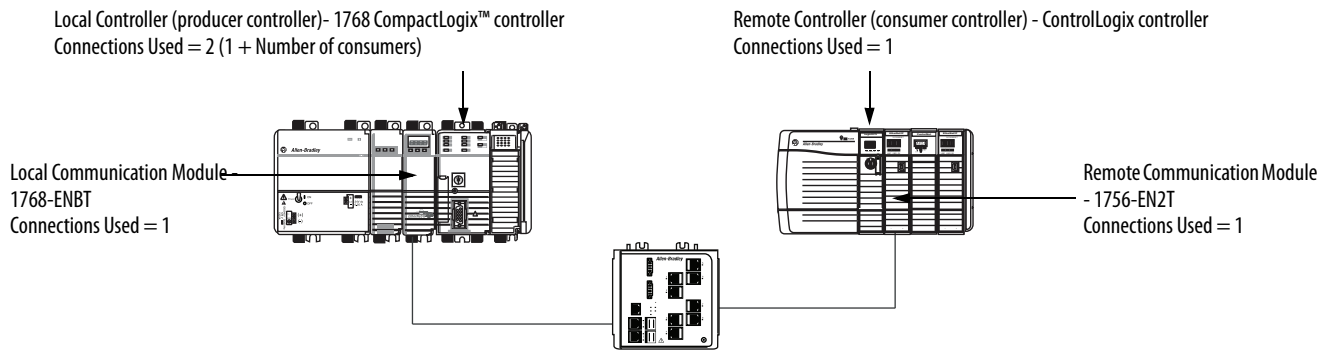
At its limits, a Logix5000 controller that produced 125 tags, each with only 1 consumer, the controller would use all of its available 250 connections. In this example, the Ethernet modules that are used to communicate the tags would use only 125 connections. An example of the different.

For more information on how to use connections over an EtherNet/IP network, see Ethernet Design Considerations Reference Manual, publication ENET-RM002.

Produce a Tag

To produce a tag, configure the produced tag in the programming software project for the local (producer) controller. You do not have to configure the consumer controllers in the I/O Configuration folder of the producer controller.

Configure the Produced Tag

To configure the produced tag, follow these steps.

1. In the Controller Organizer if the producer, right-click the Controller Tags folder and choose Edit Tags.
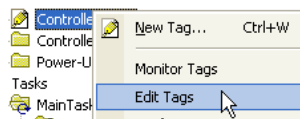
The Controller Tags dialog box appears.
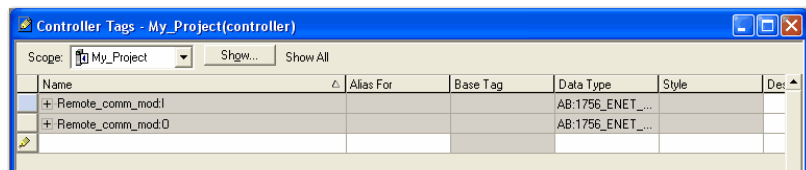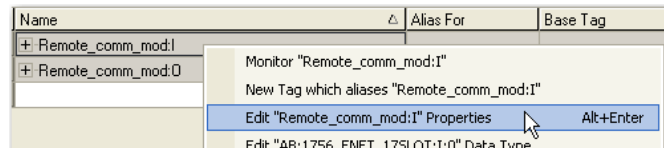
You can produce only controller-scoped tags.

2. In the Controller Tags window, right-click the tag that you want to produce and choose Edit Tag Properties.
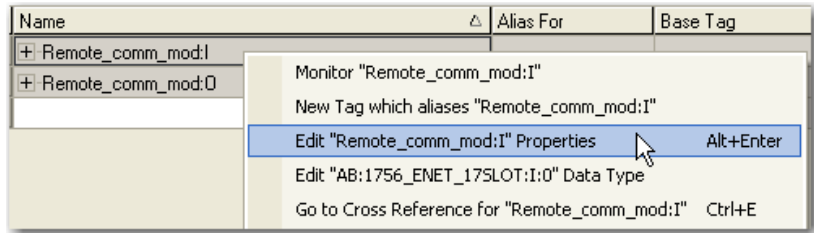
The Tag Properties dialog box appears.
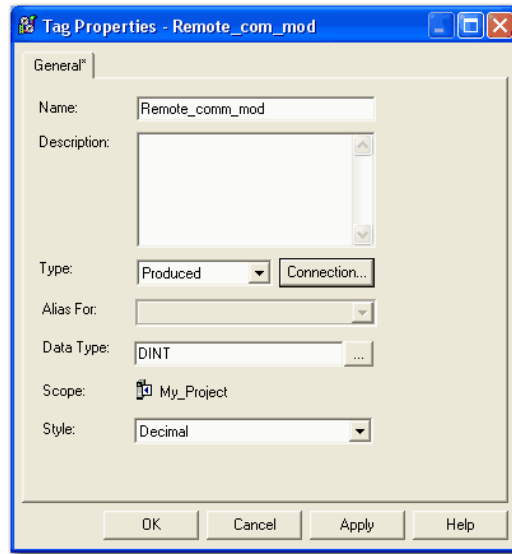
3. From the Type pull-down menu, choose Produced.

4. Click Connection.

The Produced Tag Connection dialog box appears.
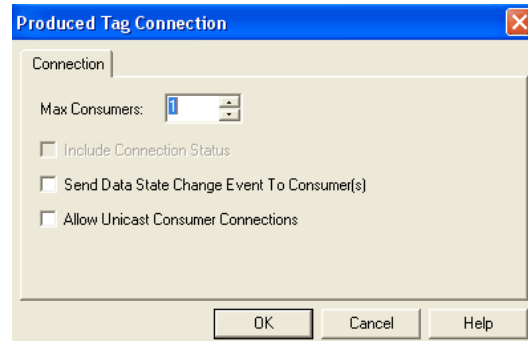
5. In the Max Consumers field, type the maximum number of controllers that consume (receive) the tag.

6. Click OK.

Consume Data Produced by Another Controller

To consume a produced tag, specify both the producer controller and the produced tag in the programming software project for the remote (consumer) Logix5000 controller.

Add the Producer Controller to the I/O Configuration of the Consumer

Add the producer controller to the I/O Configuration folder of the remote controller. In the folder, organize the controllers and communication modules into a hierarchy of tree/branch and parent/child.

Figure 8 - Logix5000 Controller in Local Chassis Consuming a Single Tag for a Logix5000 Controller in a Remote Chassis

Local Controller (consumer controller) - ControlLogix controller
Connections Used = 1

Remote Controller (producer controller)- 1768 CompactLogix™ controller
Connections Used = 2 (1 + Number of consumers)

Local Communication Module
1756-EN2T
Connections Used = 1

Remote Communication Module - 1768-ENBT
Connections Used = 1
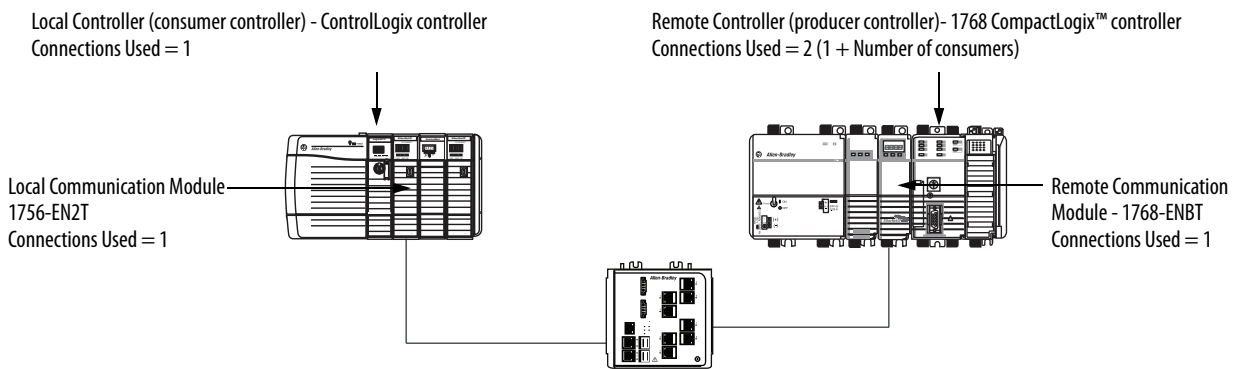
To add a producer controller to the I/O of the consumer controller, follow these steps.

1. Add the local communication module for the consumer controller.

2. Add the remote communication module for the producer controller.

3. Add the producer controller.

This graphic shows the I/O configuration for the consumer controller after the modules are added.
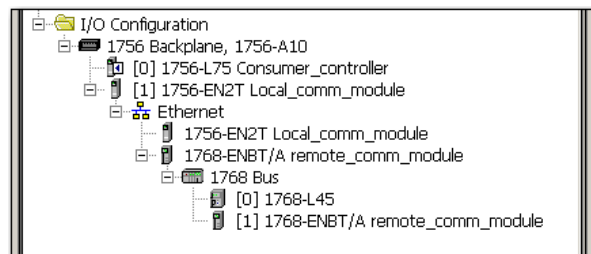
To add a producer controller to the I/O Configuration folder, follow these steps.

1. In the Controller Organizer, right-click the remote backplane and choose New Module.
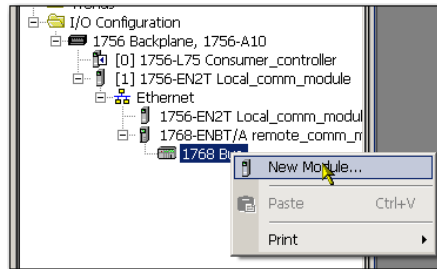
The Select Module Type dialog box appears.

2. Click the By Category tab and choose your producer controller.
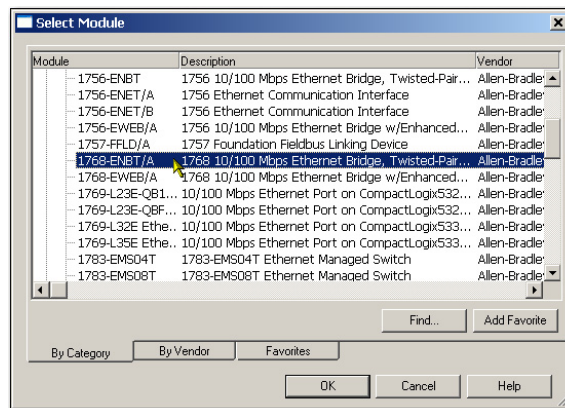
3. Click OK.

Depending on the controller type, the Select Major Revision dialog box can appear. If the dialog box appears, choose the major revision of the module and click OK.
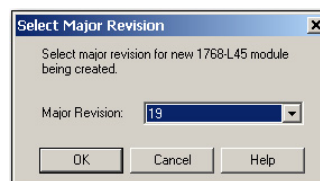
The New Module dialog box appears.

4. Configure your new module.
    - In the Name field, type the name of your module.
    - In the Slot field, type the chassis slot number.
    - From the Electronic Keying pull-down menu, choose the keying level that fits your application.
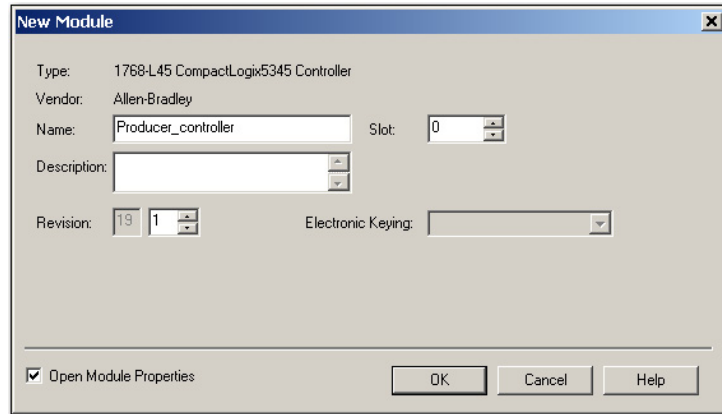
5. Click OK.

IMPORTANT	The number and type of configuration parameters on the New Module dialog box varies according to the controller type.

Create the Consumed Tag

To create the consumed tag, follow these steps.

1. In the programming software of the project of the consumer controller, right-click the Controller Tags folder and choose Edit Tags.
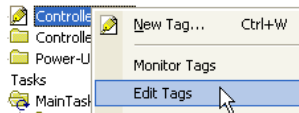
The Controllers Tag dialog box appears.
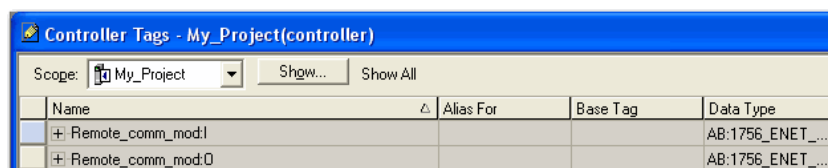
Only controller-scoped tags can consume data.

2. In the Controller Tags window, right-click the tag that consumes the data and choose Edit Tag Properties.

Name	△	Alias For	Base Tag
+ Remote_comm_mod:I			
+ Remote_comm_mod:O			

Monitor "Remote_comm_mod:I"

New Tag which aliases "Remote_comm_mod:I"

Edit "Remote_comm_mod:I" Properties   Alt+Enter

Edit "AB:1756_ENET_17SLOT:I:0" Data Type

The Tag Properties dialog box appears.

3. From the Type pull-down menu, choose Consumed.

4. In the Data Type field, type a data type that matches the type assigned to the produced tag.

5. Click Connection.

Tag Properties - Test1

General*

Name: Test1

Description:

Type: Consumed   Connection...

Alias For:

Data Type: DINT   ...

Scope: PF40_EtherNet_IP

Style: Decimal

OK   Cancel   Apply   Help
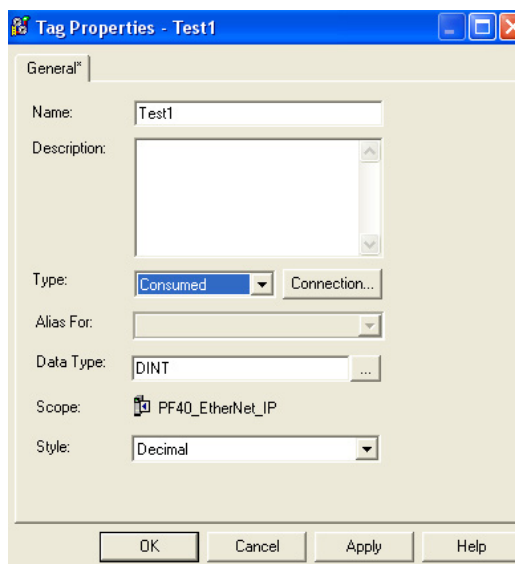
The Consumed Tag Connection dialog box appears.

6. From the Producer pull-down menu, choose the controller that produces the data.

7. In the Remote Data field, type the tag name or instance number of the produced data.

8. In the RPI field, type the requested packet interval (RPI) for the connection.
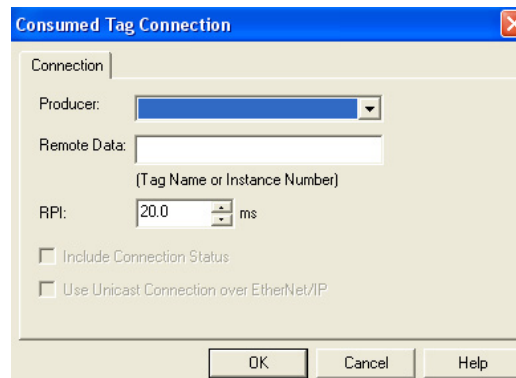
Only set the RPI to the rate the application requires.

IMPORTANT	The RPI determines the number of packets per second that the module produces on a connection. Each module can only produce a limited number of packets per second. If you exceed this limit, it prevents the module from opening more connections.

For information on RPI and how it affects the actual packet interval (API), see the Ethernet Design Considerations Reference Manual, publication ENET-RM002.

9. Click OK.

Guidelines for Message (MSG) Instructions

Follow these guidelines.

Table 14 - MSG Instruction Guidelines

Guideline	Description
For each MSG instruction, create a control tag.	Each MSG instruction requires its own control tag: • Data type = MESSAGE • Scope = controller • The tag cannot be part of an array or a user-defined data type.
Keep the source and destination data at the controller scope.	A MSG instruction can only access tags that are in the Controller Tags folder.
If your MSG is to a module that uses 16-bit integers, use a buffer of INTs in the MSG and DINTs throughout the project.	If your message is to a module that uses 16-bit integers, such as a PLC-5® or SLC™ 500 controller, and it transfers integers (not REALs), use a buffer of INTs in the message and DINTs throughout the project. This process increases the efficiency of your project because Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs).
Cache the connected MSGs that execute most frequently.	Cache the connection for those MSG instructions that execute most frequently, up to the maximum number permissible for your controller revision. This process optimizes execution time because the controller does not have to open a connection each time the message executes.
If you want to enable more than 16 MSGs at one time, use some type of management strategy.	If you enable more than 16 MSGs at one time, some MSG instructions can experience delays when they enter the queue. To make sure that each message executes, perform one of these tasks: • Enable each message in sequence. • Enable the messages in groups. • Program a message to communicate with multiple modules. • Program logic to coordinate the execution of messages.
Keep the number of unconnected and uncached MSGs less than the number of unconnected buffers.	The controller can have 10...40 unconnected buffers. The default number is 10. • If all unconnected buffers are in use when an instruction leaves the message queue, the instruction errors and does not transfer the data. • You can increase the number of unconnected buffers to a maximum of 40.

For more information on programming MSG instruction, see the Logix5000 Controller General Instructions Reference Manual, publication 1756-RM003.

The individual system user manuals for Logix5000 controllers also provide MSG examples unique to specific controller platforms.

Connections for Messages

Messages transfer data to other modules, such as other controllers or operator interfaces. Each message uses one connection, regardless of how many modules are in the message path. To conserve connections, you can configure one message to read from or write to multiple modules.

These connected messages can leave the connection open (cache) or close the connection when the message has finished transmitting.

Table 15 - Message Connections

Type of Message	Communication Method Used	Connection Used
CIP data table read or write	CIP	Yes
PLC-2®, PLC-3®, PLC-5®, or SLC™ (all types)	CIP	No
	CIP with Source ID	No
	DH+™	Yes
CIP generic	CIP	Your choice[1]
Block transfer read or write		Yes

(1) You can connect CIP generic messages, but for most applications we recommend that you leave CIP generic messages unconnected.

Cache Message Connections

Use the execution rate of the message to determine whether to cache a connection or not.

Table 16 - Guidelines for Caching Message Connections

Message Execution	Instruction Configuration
Repeated	Cache the connection. **Important:** Caching keeps the connection open and optimizes execution time. If you open a connection each time the message executes, it increases execution time.
Infrequent	Do not cache the connection. **Important:** Not caching closes the connection upon completion of the message, which frees up the connection for other uses.

Communicate with the Socket Object Via a MSG Instruction

Some EtherNet/IP devices support the use of a CIP Generic MSG instruction to request socket services. For more information, see EtherNet/IP Socket Interface Application Technique, ENET-AT002.

Enter Message Logic

To send or receive data from an EtherNet/IP communication module via a message, you must program a MSG instruction in the logic of the local controller. If the target module is configured in the I/O Configuration folder of the controller, browse to select the module or manually type the message path in the MSG instruction.

Add the EtherNet/IP Communication Module to the I/O Configuration of the Local Controller

To use the Browse button to select the target device of a MSG instruction, add that remote device to the I/O Configuration folder of the local controller. Within the I/O Configuration folder, organize the local and remote devices into a hierarchy of tree/branch, parent/child.

Figure 9 - Logix5000 Controller in Local Chassis Sending a Message to a Logix5000 Controller in a Remote Chassis
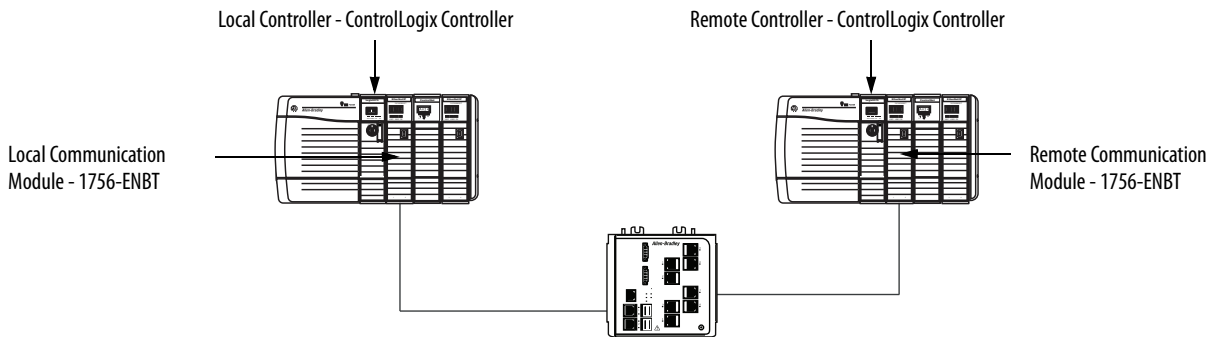
For a typical local/remote MSG structure, following the steps.

1. Add the local communication module for the local controller.

2. Add the remote communication module for the remote controller.

3. Add the remote controller.

This graphic shows the I/O configuration of the local controller after a local EtherNet/IP communication module is added.
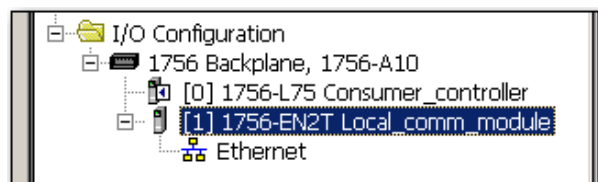
Select a communication format for a communication module based on the modules in its remote chassis.

Table 17 - Module Communication Formats

Conditions	Use This Communication Format
The remote chassis contains only analog modules, diagnostic digital modules, fused output modules, or communication modules	None
The remote chassis contains only standard, digital input and output modules (no diagnostic modules or fused output modules)	Rack Optimization
You want to receive I/O module and chassis slot information from a rack-optimized remote chassis owned by another controller	Listen-Only Rack Optimization

To add a module to the I/O Configuration folder, follow these steps.

1. In the programming software, right-click the level to which you want to add the new module and choose New Module.
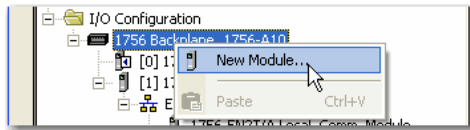
   The Select Module Type dialog box appears.

2. Click the By Category tab and choose your EtherNet/IP communication module.

3. Click OK.

   Depending on the EtherNet/IP communication module, the Select Major Revision dialog box can appear. If the dialog box appears, choose the major revision of the module and click OK.

   The New Module dialog box appears.

4. Configure your new module.

- In the Name field, type the name of your module.
- In the IP Address field, type the module IP address.
- In the Slot field, type the chassis slot number.
- Click Change to configure these parameters:
– Module Revision
– Electronic Keying
– Communication Format

5. Click OK.

IMPORTANT	The number and type of configuration parameters on the New Module dialog box varies according to the EtherNet/IP communication module type.

Enter a Message

To enter a message, follow these steps.

1. Use relay ladder logic to enter a MSG instruction.

2. To configure the MSG instruction, Click ... .

EXAMPLE   Enter a MSG instruction

If *count_send* = 1 and *count_msg.EN* = 0 (MSG instruction is not already enabled), then execute a MSG instruction that sends data to another controller.

Configure a MSG Instruction

To configure a MSG instruction, follow these steps.

1. Click ⬚ in the MSG box.

   The Message Configuration dialog box appears.

2. Click the Configuration tab and specify the type of MSG instruction.
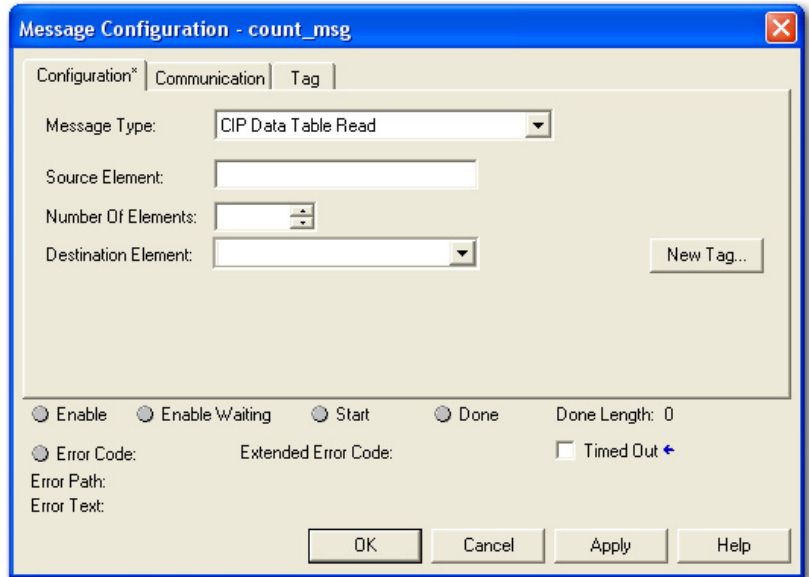
Configure a MSG to a Logix5000 Controller

If you want to	For this item	Type or choose
Read (receive) the data	Message Type	CIP Data Table Read
	Source Element	First element of the tag that contains data in the other controller
	Number of Elements	Number of elements to transfer
	Destination Tag	First element of the tag (controller-scoped) in this controller for the data
Write (send) the data	Message Type	CIP Data Table Write
	Source Tag	First element of the tag (controller-scoped) in this controller that contains the data
	Number of Elements	Number of elements to transfer
	Destination Element	First element of the tag for the data in the other controller

Configure a MSG to an SLC 500 Controller

If the data is	And you want to	For this item	Type or choose
Integer	Read (receive) data	Message Type	SLC Typed Read
		Source Element	Data table address in the SLC 500 controller (for example, N7:10)
		Number of Elements	Number of integers to transfer
		Destination Tag	First element of int_buffer
	Write (send) data	Message Type	SLC Typed Write
		Source Tag	First Element of int_buffer
		Number of Elements	Number of integers to transfer
		Destination Element	Data table address in the SLC 500 controller (for example, N7:10)
Floating point (REAL)	Read (receive) data	Message Type	SLC Typed Read
		Source Element	Data table address in the SLC 500 controller (for example, F8:0)
		Number of Elements	Number of values to transfer
		Destination Tag	First element of the tag (controller-scoped) in this controller for the data
	Write (send) data	Message Type	SLC Typed Write
		Source Tag	First element of the tag (controller-scoped) in this controller that contains the data
		Number of Elements	Number of values to transfer
		Destination Element	Data table address in the SLC 500 controller (for example, F8:0)

Configure a MSG to a PLC-5 Controller

If the data is	And you want to	For this item	Type or choose
Integer	Read (receive) data	Message Type	PLC5 Typed Read
		Source Element	Data table address in the PLC-5 controller (for example, N7:10)
		Number of Elements	Number of integers to transfer
		Destination Tag	First element of int_buffer
	Write (send) data	Message Type	PLC5 Typed Write
		Source Tag	First element of int_buffer
		Number of Elements	Number of integers to transfer
		Destination Element	Data Table address in the PLC-5 controller (for example, N7:10)
Floating point (REAL)	Read (receive) data	Message Type	PLC5 Typed Read
		Source Element	Data table address in the PLC-5 controller (for example, F8:0)
		Number of Elements	Number of values to transfer
		Destination Tag	First element of the tag (controller-scoped) in this controller for the data
	Write (send) data	Message Type	PLC5 Typed Write
		Source Tag	First element of the tag (controller-scoped) in this controller that contains the data
		Number of Elements	Number of values to transfer
		Destination Element	Data table address in the PLC-5 controller (for example, F8:0)

3. Click the Communication tab.

4. In the Path field, type the communication path.

    For a message to a ControlLogix® controller, this Message Configuration dialog box appears.
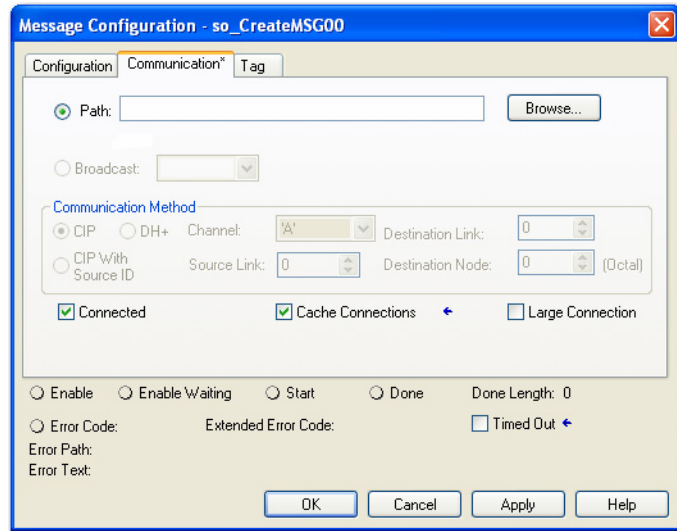
    Select the Large Connection checkbox to use a large 4000 byte connection size, or clear the checkbox to use a standard 500 byte connection size.

    A large connection is only available with connected MSG instructions. For information about how to use the Connected or Cache Connections options, refer to the Logix5000 Controllers Messages Programming Manual, publication 1756-PM012.

    For a message to a SLC 500 or PLC-5 processor, this RSLogix™ Message Configuration dialog box appears.
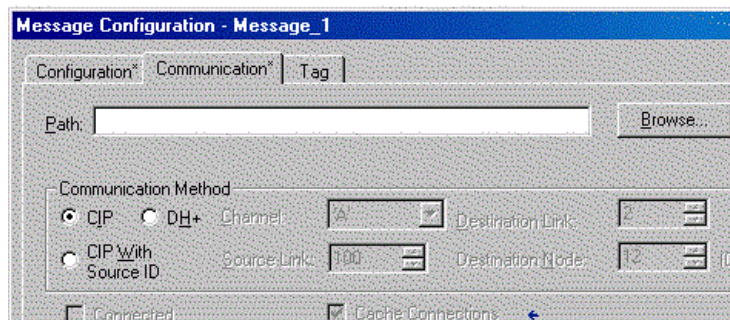
5. If the target module is configured in the I/O Configuration folder of the originating controller, click Browse to select the module or manually type the path to the target module.

A manually typed path includes the following:

- Name of the local EtherNet/IP communication module
- The port the message exits (2 for EtherNet/IP)
- The IP address of the next module in the path, which could be the target module

EXAMPLE   Communication path from a Logix5000 controller to a Logix5000 controller over an EtherNet/IP network
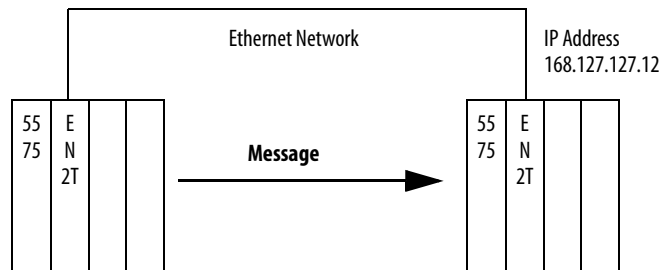
washer, 2, 168.127.127.12, 1, 0

Where	Indicates
Washer	Name of the 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN3TR module
2	Ethernet port of the 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN3TR module
168.127.127.12	IP address of the 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN3TR Module in the destination chassis
1	Backplane port of the 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN3TR Module in the destination chassis
0	Slot number of the destination controller

Communicate with PLC-5 or SLC Controllers

If the message is to a PLC-5 or SLC 500 processor and it reads or writes integers (not REALs), use a buffer of INTs in the message. Remember these considerations:

- Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs).

- PLC-5 and SLC 500 processors require 16-bit integers.

- Messages require an INT buffer.

- Data can be moved into or out of the buffer as needed.

Converting between INTs and DINTs

If the message is to a device that uses 16-bit integers, such as a PLC-5 or SLC 500 controller, and it transfers integers (not REALs), use a buffer of INTs in the message and DINTs throughout the project. This configuration increases the efficiency of your project.

	Data From the Device	Buffer of INTs	DINTs For Use In the Project
Read 16-Bit Integers	Word 1	INT_Buffer[0]	DINT_Array[0]
	Word 2	INT_Buffer[1]	DINT_Array[1]
	Word 3	INT_Buffer[2]	DINT_Array[2]
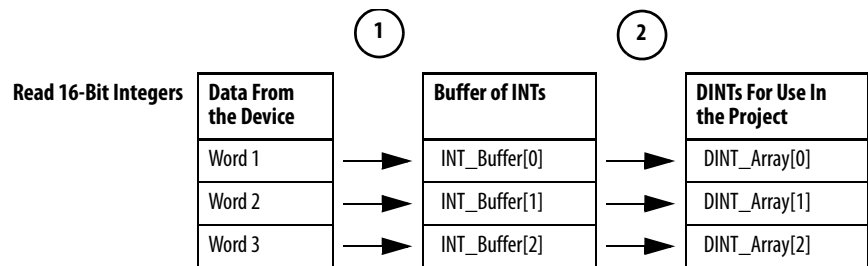
1. The Message (MSG) instruction reads 16-bit integers (INTs) from the device and stores them in a temporary array of INTs.

2. A File Arith/Logical (FAL) instruction converts the INTs to DINTs for use by other instructions in your project.

	DINTs From the Project	Buffer of INTs	Data For the Device
Write 16-Bit Integers	DINT_Array[0]	INT_Buffer[0]	Word 1
	DINT_Array[1]	INT_Buffer[1]	Word 2
	DINT_Array[2]	INT_Buffer[2]	Word 3
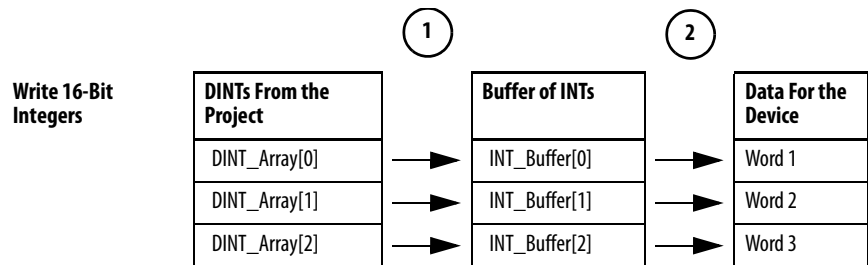
1. An FAL instruction converts the DINTs from the Logix5000 controller to INTs.

2. The MSG instruction writes the INTs from the temporary array to the device.

Mapping Tags

A Logix5000 controller stores tag names on the controller so that other devices can read or write data without having to know physical memory locations. Many products only understand PLC/SLC data tables, so the Logix5000 controller offers a PLC/SLC mapping function that enables you to map Logix tag names to memory locations.

- You have to map only the file numbers that are used in messages; the other file numbers do not need to be mapped.
- The mapping table is loaded into the controller and is used whenever a logical address accesses data.
- You can access only controller-scoped tags (global data).
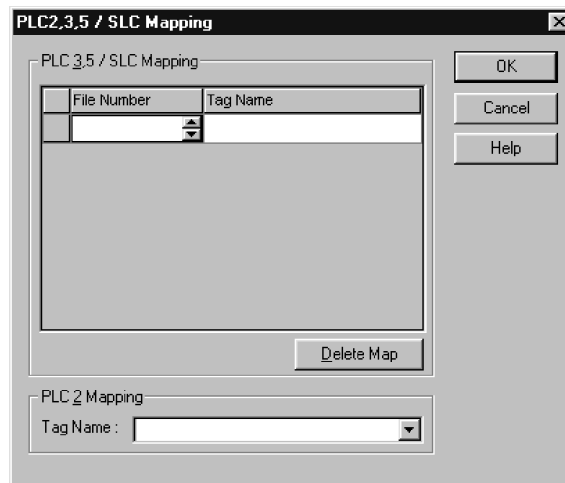
- For each file that is referenced in a PLC-5 or SLC command, make a map entry with one of these methods:
  - Type the PLC/SLC file number of the logical address
  - Type or select the Logix5000 controller-scoped (global) tag that supplies or receives data for the file number (You can map multiple files to the same tag.)
- For PLC-2 commands, specify the tag that supplies or receives the data.

When you map tags, remember these guidelines:

- Do not use file numbers 0, 1, and 2. These files are reserved for Output, Input, and Status files in a PLC-5 processor.
- Use PLC-5 mapping only for tag arrays of data type INT, DINT, or REAL. If you attempt to map elements of system structures, it can produce undesirable effects.
- Use the PLC file identifier of N or B when you access elements in an INT tag array.

This example shows how to use a buffer of INTs.

EXAMPLE   Read integers from a PLC-5 controller.

ATTENTION: When condition turns on, reads 16-bit integer values (INTs) and stores them in int_buffer. Then the FAL instruction moves the values to dint_array. This process converts the values to 32-bit integers (DINTs), for use by other instructions in the ControlLogix controller.

```
condition      message.EN                                    ┌──────MSG──────┐
  ─┤ ├──────────┤/├──────────────────────────────────────────┤ Type - Unconfigured          ⟨EN⟩
                                                              │ Message Control      message  [...] ⟨DN⟩
                                                              │                                    ⟨ER⟩
                                                              └────────────────────────────────────┘

message.DN                              fal_control           ┌──────FAL──────┐
  ─┤ ├──────────────────────────────────⟨RES⟩─────────────────┤ File Arith/Logical            ⟨EN⟩
                                                              │ Control              fal_control
                                                              │ Length                        ?  ⟨DN⟩
                                                              │ Position                      0
                                                              │ Mode                         all  ⟨ER⟩
                                                              │ Dest        dint_array[fal_control.pos]
                                                              │
                                                              │ Expression    int_buffer[fal_control.pos]
                                                              └────────────────────────────────────┘
```
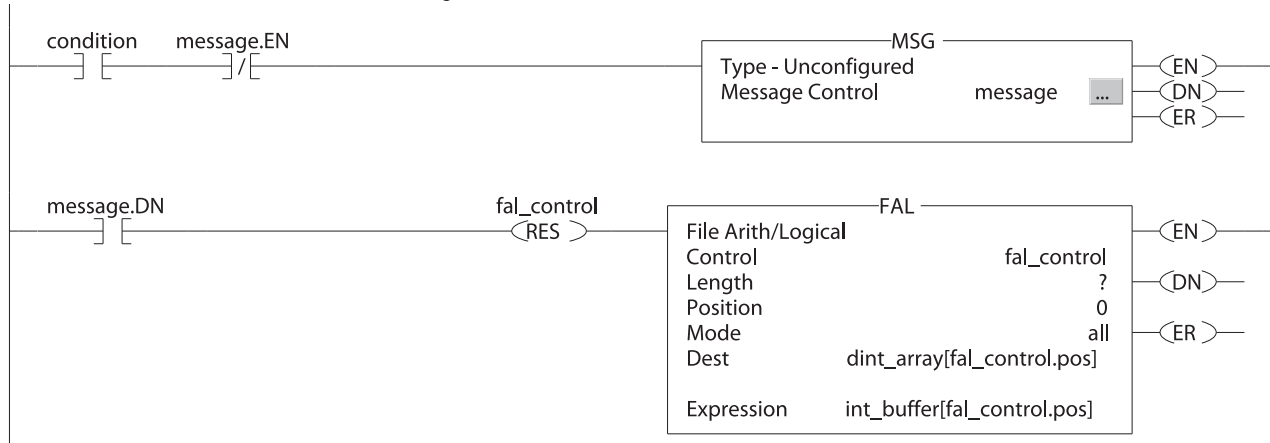
EXAMPLE   Write integers to a PLC-5 controller.

ATTENTION: When condition turns on, it moves the values in dint_array to int_buffer. This process converts the values to 16-bit integers (INTs). Then the message instruction sends int_buffer to the other controller.

```
condition                               fal_control           ┌──────FAL──────┐
  ─┤ ├──────────────────────────────────⟨RES⟩─────────────────┤ File Arith/Logical            ⟨EN⟩
                                                              │ Control              fal_control
                                                              │ Length                        ?  ⟨DN⟩
                                                              │ Position                      0
                                                              │ Mode                         all  ⟨ER⟩
                                                              │ Dest        int_buffer[fal_control.pos]
                                                              │
                                                              │ Expression    dint_array[fal_control.pos]
                                                              └────────────────────────────────────┘

fal_control.DN    message.EN                                  ┌──────MSG──────┐
  ─┤ ├──────────────┤/├──────────────────────────────────────┤ Type - Unconfigured          ⟨EN⟩
                                                              │ Message Control      message  [...] ⟨DN⟩
                                                              │                                    ⟨ER⟩
                                                              └────────────────────────────────────┘
```
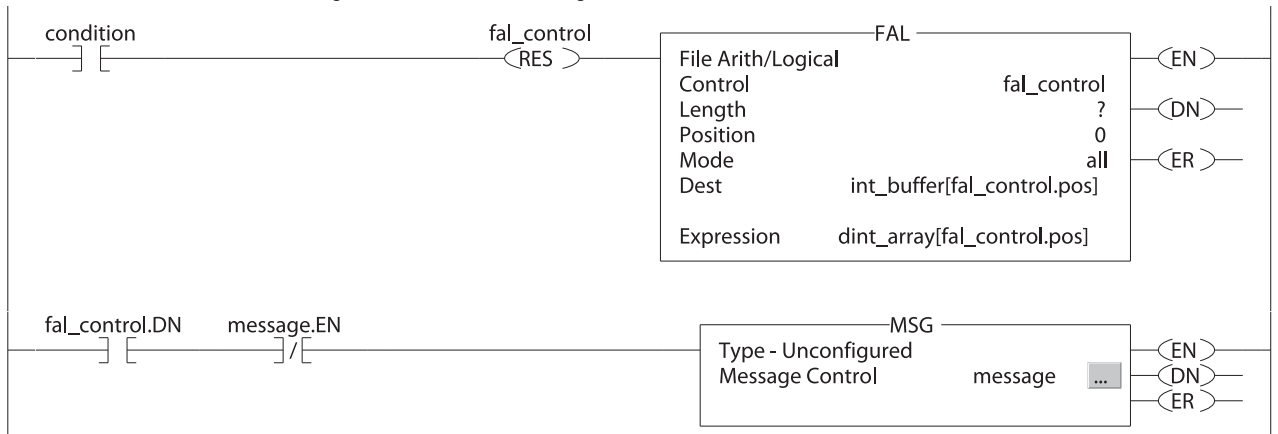
42424

Where	Is an
dint_array	Array of DINTs that are used in the ControlLogix controller
int_buffer	Array of INTs with the same number of elements as dint_array

Receive MSGs from PLC-5 or SLC 500 Controllers

To receive MSGs from PLC-5 or SLC 500 processors, follow these steps.

1. If the originating controller is a PLC-5 or SLC 500 processor, in the MSG instruction, select PLC5.

```
            ┌── MSG ──────────────────────┐
            │  Read/Write Message          │──< EN >──
            │  Type            Peer-To-Peer │
            │  Read/Write             Read  │──< DN >──
            │  Target Device          PLC5  │
            │  Local/Remote          Local  │──< ER >──
            │  Control Block          N7:0   │
            │  Control Block Length     93   │
            │            Setup Screen       │
            └──────────────────────────────┘
```
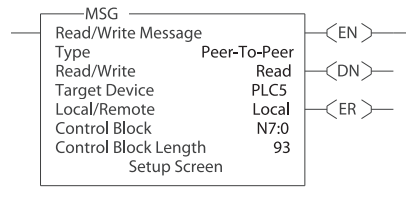
If the controller is a	For this section	And this item	Specify
PLC-5	This PLC-5	Communication Command	PLC-5 Typed Read or PLC-5 Typed Write
		Data Table Address	Starting address of the data in the PLC-5 controller
		Size in Elements	Number of elements to read or write
		Port Number	2
	Target Device	Data Table Address	Type, in quotation marks [" "], the name of the tag in the ControlLogix controller (for example, "count").
		MultiHop	Select Yes.
SLC 500	This Controller	Communication Command	PLC5 Read or PLC5 Write
		Data Table Address	Starting address of the data in the SLC 500 controller
		Size in Elements	Number of elements to read or write
		Channel	1
	Target Device	Data Table Address	Type, in quotation marks [" "], the name of the tag in the ControlLogix controller (for example, "count").
		MultiHop	Select Yes

2. On the MultiHop tab, specify the following:
   - IP address of the EtherNet/IP communication module that is local to the Logix5000 controller
   - Slot number of the Logix5000 controller

Send Email

This chapter describes how to send an email through an EtherNet/IP communication module.

| IMPORTANT | The 1756-EN2TSC module does not support this capability. |

Topic	Page

For email, the EtherNet/IP communication module can be remote or local to the controller.

EtherNet/IP Communication Module as an Email Client

The EtherNet/IP communication module is an email client that uses a mail relay server to send email.

| IMPORTANT | The EtherNet/IP communication module can send an email to only one recipient at a time. The module cannot mail to a distribution list. |

Table 18 - Ethernet Email

Desired Action	Required Tasks
Send an email to specific personnel when a controller application generates an alarm or reaches a certain condition	Program the controller to send a MSG instruction to the EtherNet/IP communication module
	The MSG instruction then instructs the EtherNet/IP communication module to send the email text (contained within the MSG instruction) to the mail relay server.
Send controller or application status information regularly to a project manager	
	Multiple controllers can use the same EtherNet/IP communication module to initiate email.

The EtherNet/IP communication module sends only the content of a MSG instruction as an email to a mail relay server. Delivery of the email depends on the mail relay server. The EtherNet/IP communication module does not receive email.

Figure 10 - Sample System

ControlLogix® Controller With 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN3TR Module

Firewall/Router

Ethernet Switch

Mail Relay Server

Ethernet Switch

1769-L35E CompactLogix™ Controller
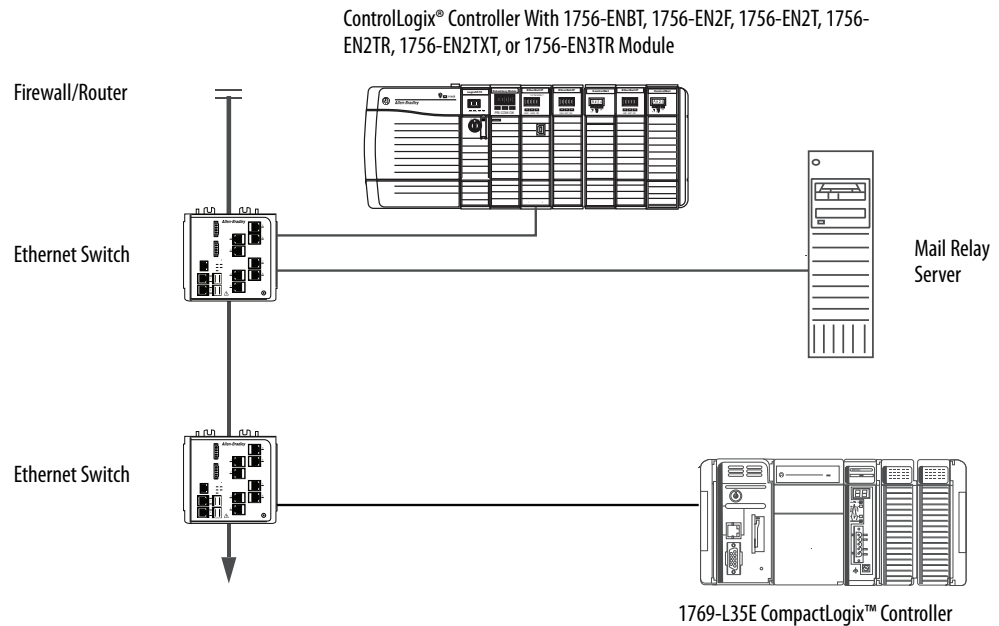
Table 19 - Sample System Capabilities

Device	Capability
ControlLogix controller	Send a MSG instruction to the 1756-ENBT module to initiate sending an email to the mail relay server.
CompactLogix controller	Use the path of the MSG instruction to identify the 1756-ENBT module as the target of the MSG instruction.
1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, EN2TRXT, or 1756-EN3TR module	Send an email to the mail relay server from the email interface on the Send an Email link. This interface requires that you enter all email information.
Mail relay server	Send email to specified recipients. The mail relay server determines the delivery of any email sent through an EtherNet/IP communication module, whether via a MSG instruction or from its built-in interface.

Send Email Via a Controller-initiated Message Instruction

A Logix controller can send a generic CIP message instruction to the EtherNet/IP communication module that instructs the module to send an email message to a SMTP mail relay server that uses the standard SMTP protocol. This process automatically communicates controller data and application conditions to appropriate personnel.

IMPORTANT	Be careful to write the ladder logic to be sure the MSG instructions are not continuously triggered to send email messages.

Some mail relay servers require a domain name be provided during the initial handshake of the SMTP session. For these mail relay servers, specify a domain name when configuring the network settings of the EtherNet/IP communication module.

For additional information, see <u>Configure an EtherNet/IP Communication Module to Operate on the Network on page 17</u>.

Create String Tags

You need three controller-scoped string tags. Each tag performs one of these functions:

- Identifies the mail server
- Contains the email text
- Contains the status of the email transmission

The default STRING data type supports up to 82 characters. In most cases, this limit is sufficient to contain the address of the mail server. For example, to create tag EmailConfigstring of type STRING, follow these steps.

1. Click ⋯ in the Value column of the Controller Tags dialog box.
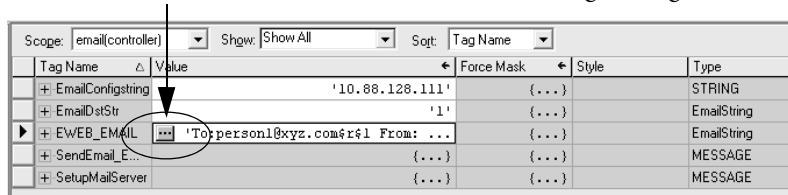
The String Browser dialog box appears.
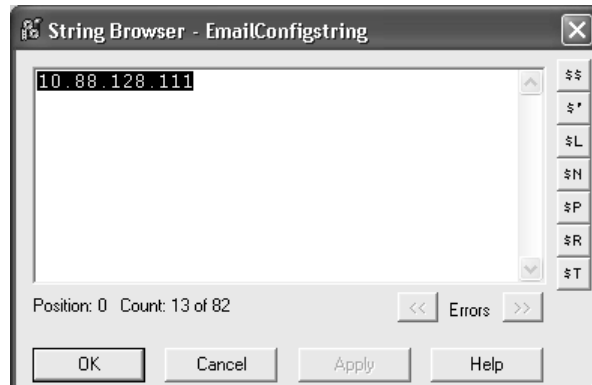
2. Type the IP address or host name of the mail server.

3. Click OK.
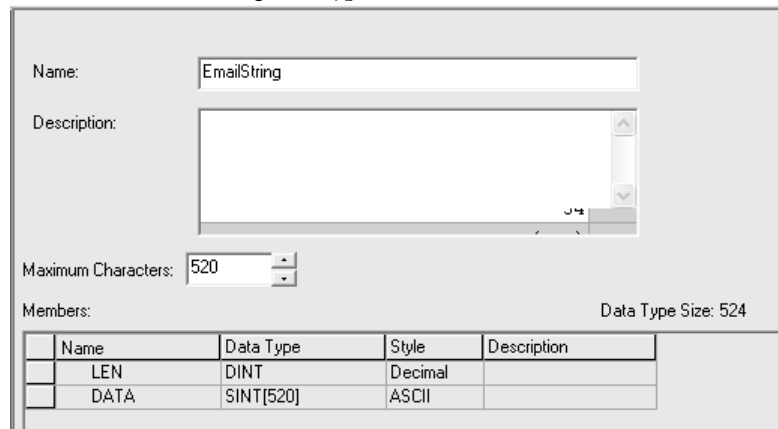
The tags for the email text and transmission status can contain up to 474 characters. For these tags, you must create a user-defined STRING data type. The default STRING data type in the programming software is not large enough for most email text.

To create a user-defined STRING data type, follow these steps.

1. In the Data Types folder in the programming software, navigate to and right-click the Strings folder, and choose New String Type.
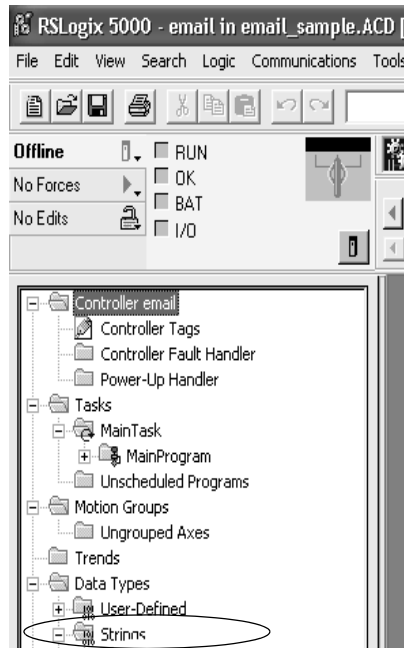
2. Create the EmailString data type.

3. Create one controller-scoped tag, such as EWEB_EMAIL, of this new data type to contain the email text.

4. Create a second controller-scoped tag, such as EmailDstStr, of this new data type to contain the transmission status.

   Both of these tags are of type EmailString.

5. Click ⬚ in the Value column of the Controller Tags dialog box.
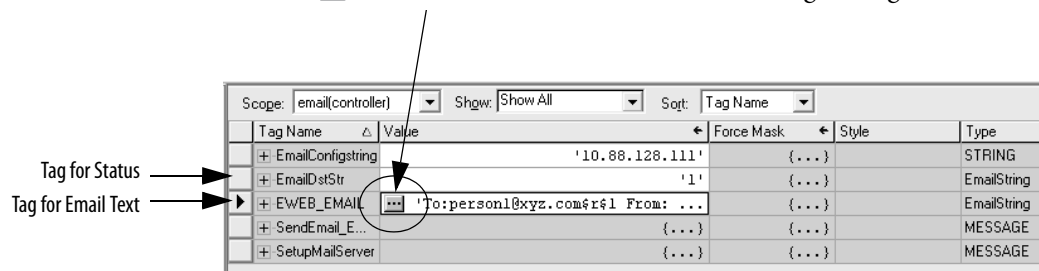
   The String Browser dialog box appears.

6. Type your email.

   The text of the email does not have to be static. You can program a controller project to collect specific data to be sent in an email.

7. Click OK.
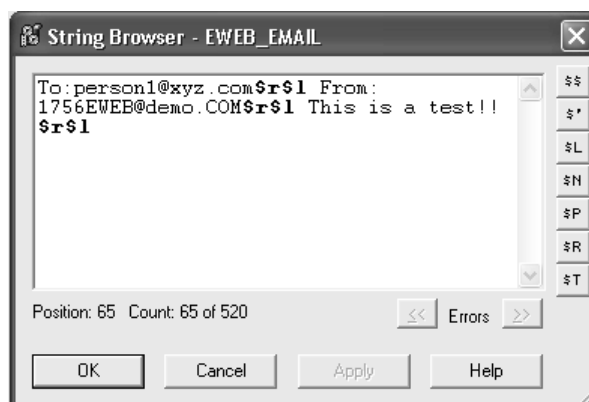
For more information on how to use ladder logic to manipulate string data, see the Logix5000™ Controllers Common Procedures Programming Manual, publication 1756-PM001.

Enter the Ladder Logic

Ladder logic requires two MSG instructions. One MSG instruction configures the mail server and must be executed only once. The second MSG instruction triggers the email. Execute this email MSG instruction as often as needed.
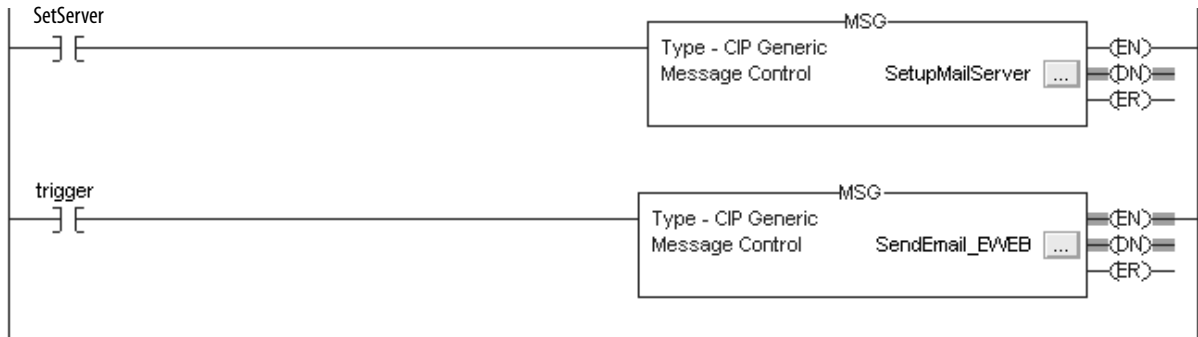
The first rung configures the mail server. The second rung sends the email text.

Configure the MSG Instruction that Identifies the Mail Relay Server

To configure the MSG instruction that identifies the mail relay server, follow these steps.

1. In the MSG instruction, click the Communication tab.
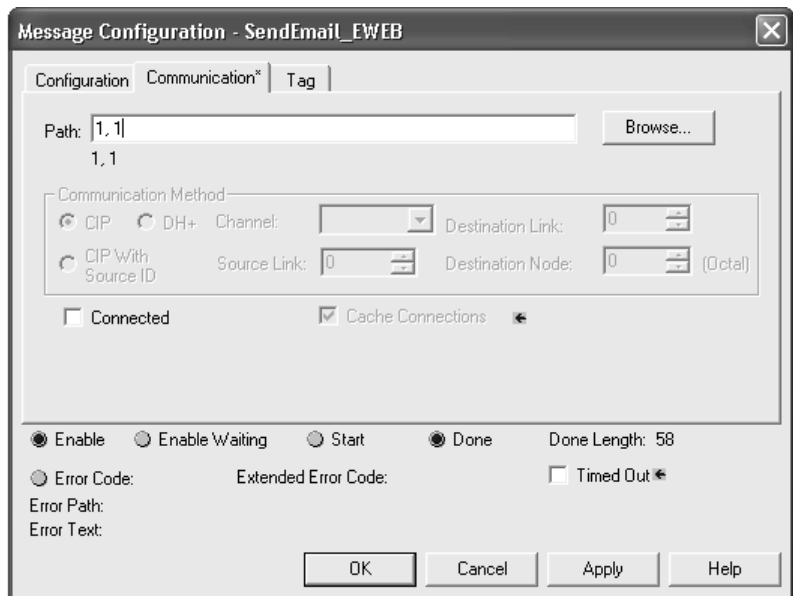
2. In the Path field, type the path for the MSG instruction. The path starts with the controller initiating the MSG instruction.

    Type the number of the port from which the message exits and the address of the next module in the path.

    For example, if the EtherNet/IP communication module is in the same chassis as the controller and is in slot 2, the path is: 1, 2.

    For more information on how to configure the path of a MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

3. Click the Configuration tab.

4. Configure the MSG parameters for sending an email.
    - From the Service Type pull-down menu, choose Attribute Single
    - In the Instance field, type 1.
    - In the Class field, type 32f.
    - In the Attribute field, type 5.
    - From the Source Element pull-down menu, choose the tag that contains your email text.
    - In the Source Length field, type the number of characters in the email plus four.

    In this example, you would enter 13 for the number of characters plus 4 for a total of 17.

The Source Length is the number of characters in the STRING tag that identifies the mail relay server plus 4 characters. In this example, the tag contains 13 characters.

After the MSG instruction that configures the mail relay server executes successfully, the controller stores the mail relay server information in nonvolatile memory. The controller retains this information, even through power cycles, until another MSG instruction changes the information.

Configure the MSG Instruction that Contains the Email Text

To configure the MSG instruction that contains the email text, perform this procedure.

1. Click the Configuration tab.

   The Source Length is the number of characters in the email tag plus 4 characters.

   In this example, the email text contains 65 characters.

2. Configure the MSG parameters for sending an email.
   - From the Service Type pull-down menu, choose Custom.
   - In the Service Code field, type 4b.
   - In the Instance field, type 1.
   - In the Class field, type 32f.
   - In the Attribute field, type 0.
   - From the Source Element pull-down menu, choose the tag that contains your email text.
   - In the Source Length field, type the number of characters in the email plus four.

     In this example, you would enter 65 for the number of characters plus 4 for a total of 69.

   - From the Destination pull-down menu, choose a tag to contain the status of your email transmission.

The Source Length is the number of characters in the STRING tag that identifies the mail relay server plus 4 characters.
In this example, the tag contains 65 characters.

3. Click the Communication tab.

```
Message Configuration - SendEmail_EWEB                              [X]
 Configuration  Communication*  Tag

  Path: 1, 1                                              Browse...
        1, 1
 ─Communication Method─────────────────────────────────────────
   (•) CIP   ( ) DH+   Channel:  [        ▼] Destination Link:  [0  ↕]
   ( ) CIP With        Source Link: [0  ↕]   Destination Node:  [0  ↕] (Octal)
       Source ID

     ☐ Connected            ☑ Cache Connections   ⇐



 (•) Enable   ( ) Enable Waiting   ( ) Start   (•) Done   Done Length: 58
 ( ) Error Code:          Extended Error Code:            ☐ Timed Out ⇐
 Error Path:
 Error Text:
                              OK      Cancel    Apply     Help
```
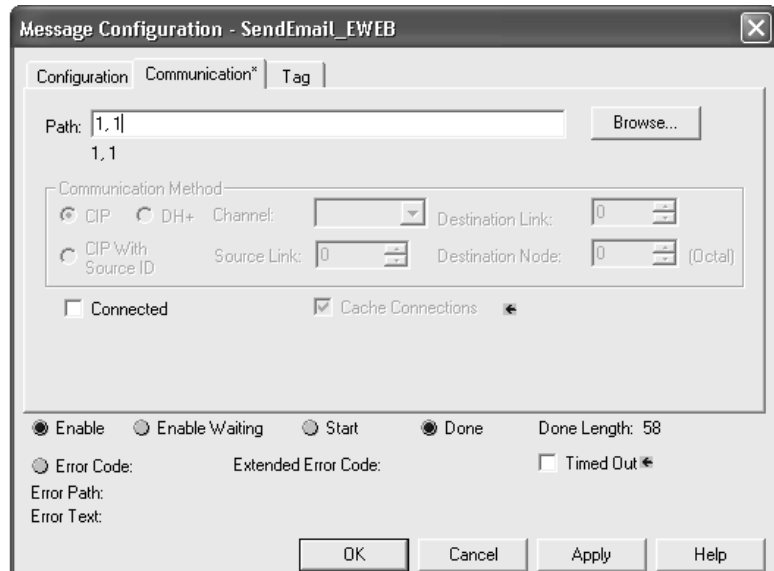
4. In the Path field, type the path from the controller to the EtherNet/IP communication module.

   The path starts with the controller initiating the MSG instruction. The second number in the path represents the port from which the message exits and the address of the next module in the path.

   For example, if the EtherNet/IP communication module is in the same chassis as the controller and is in slot 2, the path is: 1, 2.

5. If all devices in the path are configured in the I/O Configuration tree of the initiating controller, click Browse to select the target module.

   The software automatically completes the path.

6. Click OK.

For more information on how to configure the path of an MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

7. Configure the MSG parameters for disabling the Email Object.
   - From the Service Type pull-down menu, choose Set Attribute Single
   - In the Instance field, type 0.
   - In the Class field, type 32f.
   - In the Attribute field, type 8.
   - From the Source Element pull-down menu, choose the tag that contains your email text.
   - This example uses DisableEmailObject.
   - In the Source Length field, type 1.

Configure the Email Object

Ladder logic requires two MSG instructions. One MSG instruction disables the mail server and must be executed only once. The second MSG instruction enables the email. Execute this email MSG instruction as often as needed.
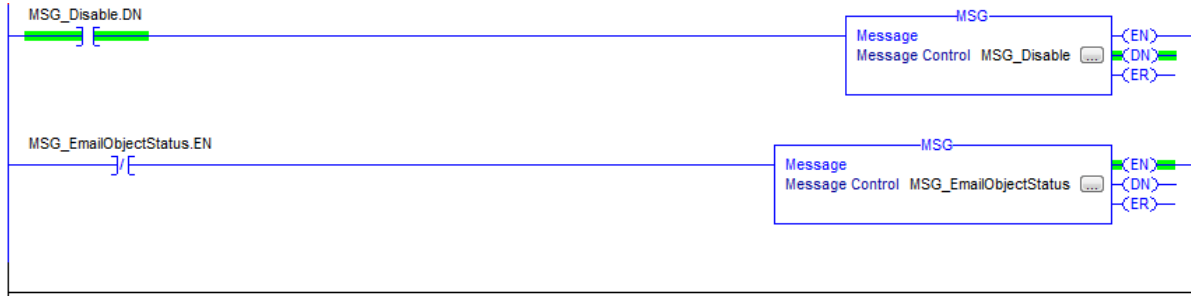
Disable the Email Object

IMPORTANT	If you disable the Email Object, it is permanently disabled and a factory reset is required to enable it again.

You can disable the Email Object by setting the class attribute 0x08 to 0. After that operation, all object-specific services and all instance attributes are unavailable for writing and reading. Furthermore, the Object Enable attribute is read only. The Email Object is permanently disabled and a factory reset is required to enable it again. By default, the Email Object is enabled. Table 20 lists the MSG block parameters to disable an Email Object.

Table 20 - Email Object Parameters

Service	0x10
Class	0x32F
Instance	0x00
Attribute	0x08
Data	0x00

To disable the Email Object, perform this procedure.

1. Create a tag, DisableEmailObject.
2. Select SINT for the data type.
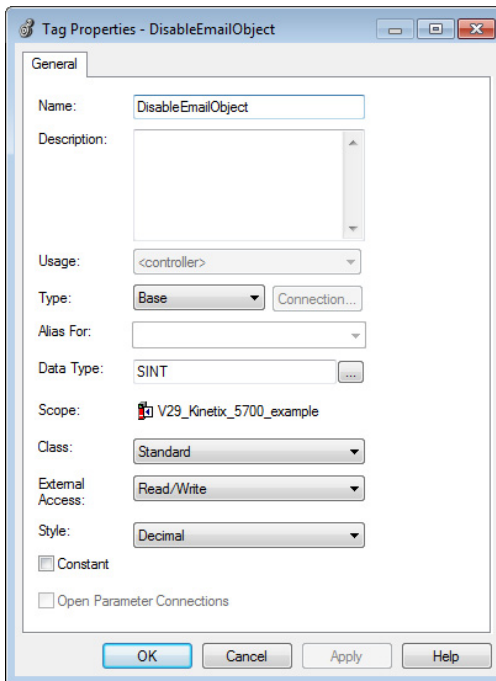
3. Create a message object.

    This example names the message object MSG_Disable.

4. In the Data Type category of the Edit Tags window, change the data type to MESSAGE.

5. In the MSG_Disable tag, click the Communication tab.
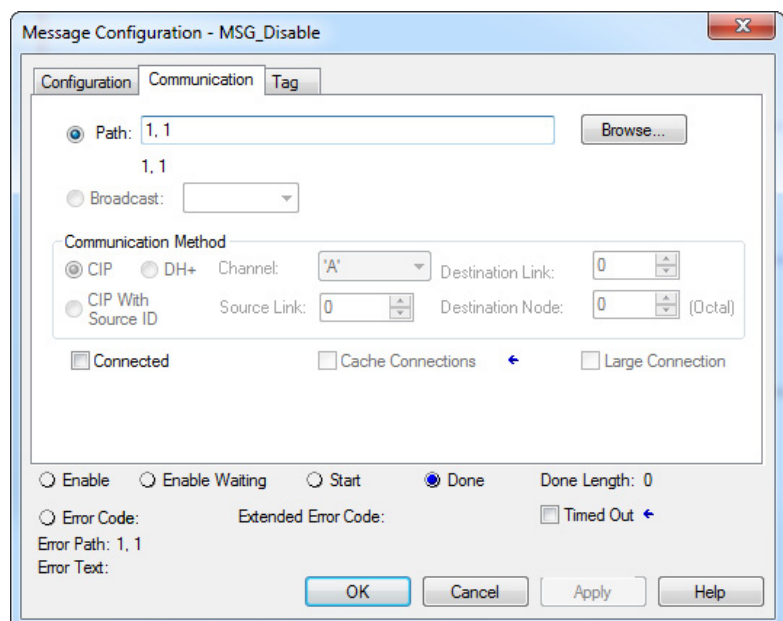
6. In the Path field, type the path for the MSG instruction. The path starts
    with the controller initiating the MSG instruction.

    Type the number of the port from which the message exits and the
    address of the next module in the path.

> **IMPORTANT**   Currently, the only module that supports this application is the 1756-EN2T
> series D module with firmware revision 10.010.

For example, if the EtherNet/IP communication module is in the same
chassis as the controller and is in slot 2, the path is: 1, 2. The path in this
example is 1, 1. For this use case, the path is always 1, <1756-EN2T
module slot number>.

For more information on how to configure the path of a MSG
instruction, see the Logix5000 Controllers General Instructions
Reference Manual, publication 1756-RM003.

7. Click the Configuration tab.
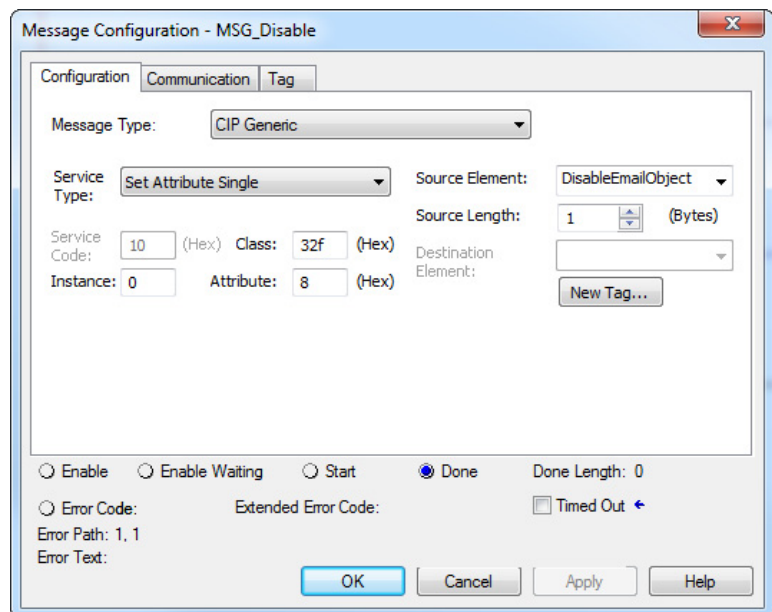
8. Configure the MSG parameters for sending an email.
    - From the Service Type pull-down menu, choose Set Attribute Single
    - In the Instance field, type 0.
    - In the Class field, type 32f.
    - In the Attribute field, type 8.
    - Create a tag that is type SINT and set the tag value to 0. This example
      uses DisableEmailObject.
    - In the Source Length field, type 1.

9. Click Apply.

10. In the ladder logic, toggle message to execute.

The value is returned in the second message. Since there is no destination element, you do not get a response. However, you receive the DN bit set.

Get Email Object Status

To determine if the email object is disabled, perform this procedure.

1. Create a tag, EmailObjectStatus.

2. Select SINT for the data type.
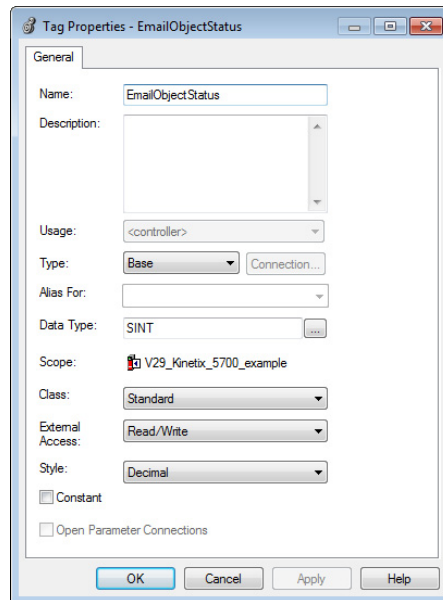
3. Create a message object.

   This example names the message object MSG_EmailObjectStatus.

4. In the Data Type category of the Edit Tags window, change the data type to MESSAGE.

5. In the MSG_EmailObjectStatus instruction, click the Communication tab.
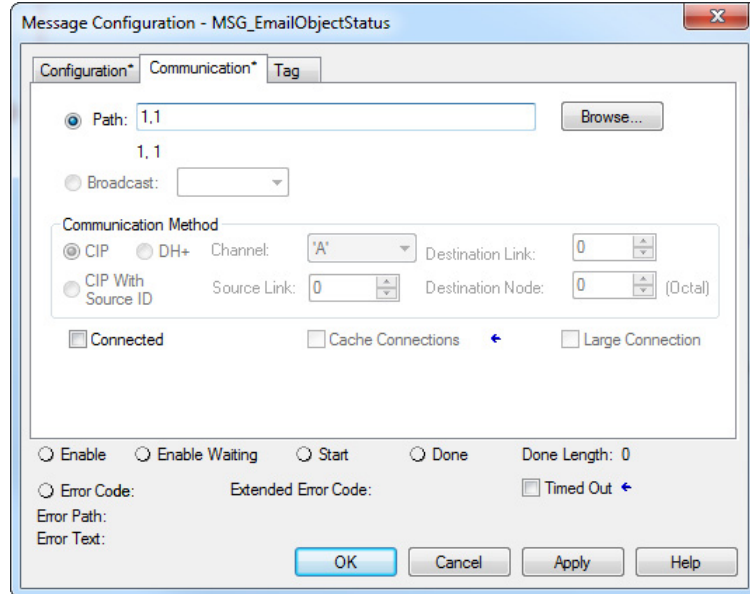
6. In the Path field, type the path for the MSG instruction. The path starts with the controller initiating the MSG instruction.

Type the number of the port from which the message exits and the address of the next module in the path.

For example, if the EtherNet/IP communication module is in the same chassis as the controller and is in slot 2, the path is: 1, 2. The path in this example is 1, 1.

For more information on how to configure the path of a MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

7. Click the Configuration tab.
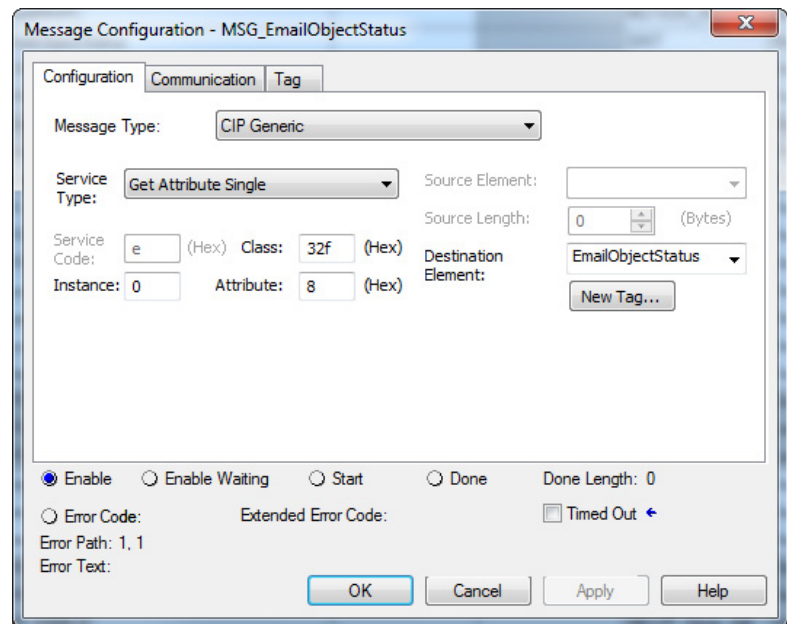
8. Configure the MSG parameters for sending an email.

   - From the Service Type pull-down menu, choose Get Attribute Single.

   - In the Instance field, type 0.

   - In the Class field, type 32f.

   - In the Attribute field, type 8.

   - From the Destination Element pull-down menu, choose the tag that contains your email text. This example uses EmailObjectStatus.

9. Click Apply.

10. In the ladder logic, toggle message to execute.

   If the MSG_EmailObjectStatus.DN bit is set and the value of the EnableObjectStatus is 0, then the Email Object is disabled. If the value of the EnableObjectStatus is 1, then the Email Object is enabled.

Enter Email Text

Use the string browser to type the text of the email. To include To:, From:, and Subject: fields in the email, use <CR><LF> symbols to separate each of these fields. The To: and From fields are required; the Subject: field is optional. For example:

> To: email address of recipient <CR><LF>
> From: email address of sender <CR><LF>
> Subject: subject of message <CR><LF>
> body of email message

An email message must not exceed 474 characters in length. An additional 4-byte string-length value is added to the tag. As a result, the maximum source length is 478 characters.

Possible Email Status Codes

Examine the destination element of the email MSG to see whether the email was successfully delivered to the mail relay server. A successful delivery indicates that the mail relay server placed the email message in a queue for delivery. This notification does not mean that the intended recipient received the email message. Table 21 lists the possible codes that a destination element could contain.

Table 21 - Email Status Code Descriptions

Error Code (Hex)	Extended-error Code (Hex)	Description
0x00	None	Delivery successful to the mail relay server.
0x02	None	Resource unavailable. The email object was unable to obtain memory resources to initiate the SMTP session.
0x08	None	Unsupported Service Request. Make sure that the service code is 0x4B and the Class is 0x32F.
0x11	None	Reply data too large. The Destination string must reserve space for the SMTP server reply message. The maximum reply can be 470 bytes.
0x13	None	Configuration data size too short. The Source Length is less than the Source Element string size plus the 4-byte length. The Source Length must equal the Source Element string size + 4.
0x15	None	Configuration data size too large. The Source Length is greater than the Source Element string size plus the 4-byte length. The Source Length must equal the Source Element string size + 4.
0x19	None	Data write failure. An error has occurred when attempting to write the SMTP server address (attribute 4) to nonvolatile memory.
0xFF	0x0100	Error that an email server returns; check the Destination string for reason. The email message was not queued for delivery.
	0x0101	SMTP mail server not configured. Attribute 5 was not set with a SMTP server address.
	0x0102	'To:' address not specified. Attribute 1 was not set with a 'To:' address AND there is not a 'To:' field header in the email body.
	0x0103	'From:' address not specified. Attribute 2 was not set with a 'From:' address AND there is not a 'From:' field header in the email body.

Table 21 - Email Status Code Descriptions

Error Code (Hex)	Extended-error Code (Hex)	Description
0xFF	0x0104	Unable to connect to SMTP mail server set in Attribute 5. If the mail server address is a host name, make sure that the device supports DNS, and that a Name Server is configured. If the host name is not fully qualified, for example, 'mailhost' and not 'mailhost.xx.yy.com' then the domain must be configured as 'xx.yy.com'. Try 'ping <mail server address>' to make sure that the mail server is reachable from your network. Also try 'telnet <mail server address> 25', which attempts to initiate a SMTP session with the mail server via telnet over port 25. (If you connect then type 'QUIT').
	0x0105	Communication error with SMTP mail server. An error occurred after the initial connection with the SMTP mail server.
		See the ASCII text following the error code for more details as to the type of error.
	0x0106	SMTP mail server host name DNS query did not complete. A previous send service request with a host name as the SMTP mail server address did not yet complete. A timeout for a DNS lookup with an invalid host name can take up to 3 minutes. Long timeouts can also occur if a domain name or name server is not configured correctly.

Notes:

Communicate with PanelView Terminals

This chapter describes how a controller uses an EtherNet/IP communication module to communicate with PanelView™ and PanelView Plus terminals over an EtherNet/IP network.

Set Up the Hardware

In this example, the controller in the local chassis shares data with an HMI application on the EtherNet/IP network. This application could be running these components:

- PanelView terminal

- PanelView Plus terminal

- Workstation running Factory Talk View software

- Workstation running a FactoryTalk® Enterprise application, such as FactoryTalk View Machine Edition or FactoryTalk View Supervisory Edition

Figure 11 - Ethernet Communication with PanelView Terminal

Local Chassis Containing a Logix5000™ Controller with an EtherNet/IP Connection

Data

HMI with EtherNet/IP Connectivity

EtherNet/IP Switch
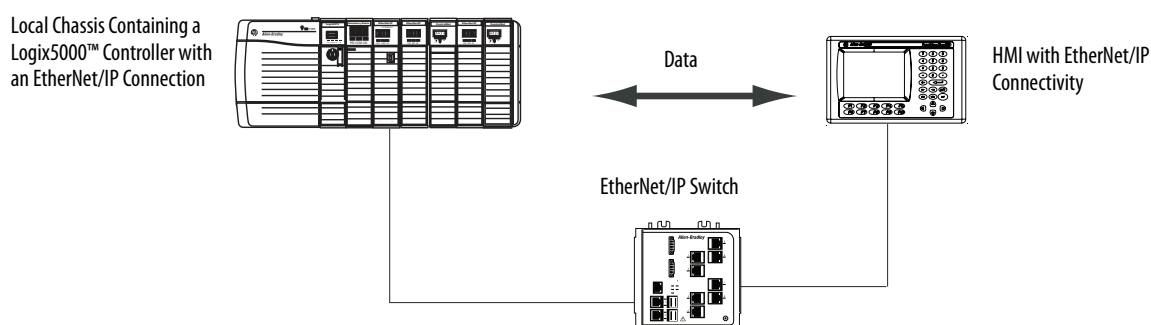
Logix5000 Controller Combinations

Your controller type determines which communication module to use.

Table 22 - Choosing a Communication Module

Controllers	Communication Modules
ControlLogix	1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, 1756-EN3TR, 1756-EWEB, or 1756-EN2TSC communication modules
1769 CompactLogix™	A built-in EtherNet/IP port on the controller.
1768 CompactLogix	1768-ENBT, 1768-EWEB EtherNet/IP communication modules
PowerFlex® 700S with DriveLogix™	1788-ENBT EtherNet/IP communication module.

You must complete these tasks before your controller can communicate with PanelView terminals over an EtherNet/IP network:

- Set the IP addresses for the EtherNet/IP communication module for the controller and the HMI terminal.

- Connect all wiring and cabling.

Connections to PanelView Terminals

To establish communication between a PanelView or PanelView Plus terminal, specify controller connections.

Table 23 - PanelView Terminal Connections

	Terminal Type	
Type of Communication	**PanelView**	**PanelView Plus**
Implicit (connected) • Logix controller communicates to the PanelView terminal like an I/O module. • You must add the PanelView terminal to the I/O configuration tree for the controller project.	Supported	Not supported
Explicit (unconnected) • PanelBuilder® or RSView® ME software configures communication. • The PanelView or PanelView Plus terminal initiates all communication.	Supported	Supported

When communicating implicitly (PanelView terminals only), the controller uses one connection for each terminal. Account for these connections when designing the system. Logix5000 controllers support these numbers of connections:

- Firmware revisions 11 and earlier support up to 16 bidirectional implicit buffers (connections).

- Firmware revisions 12 or later support up to 32 bidirectional implicit buffers (connections).

The larger number of implicit buffers enables more PanelView terminals to request data simultaneously from the controller via implicit communication.

When communicating explicitly, the controller supports 40 outgoing and 3 incoming buffers. This number of incoming buffers limits how many terminals can simultaneously request data from a controller via explicit communication. In other words, while a system can have multiple terminals, only three terminals can explicitly request data from a Logix controller simultaneously.

Add a PanelView Terminal

To add a PanelView terminal, follow these steps.

1. In the Controller Organizer, right-click I/O Configuration and choose New Module.
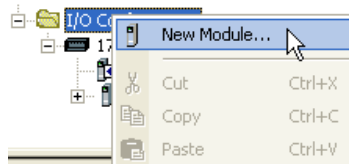
The Select Module dialog box appears.

2. Click the By Category tab.

3. Choose your EtherNet/IP communication module and click OK.

Depending on the EtherNet/IP communication module, the Select Major Revision dialog box can appear. If the dialog box appears, choose the major revision of the module and click OK.

The New Module dialog box appears.

4. Configure your new module.
   - In the Name field, type the name of your module.
   - In the IP Address field, type the module IP address.
   - In the Slot field, type the chassis slot number.
   - Click Change to configure these parameters:
   – Module Revision
   – Electronic Keying
   – Communication Format

5. Click OK.

IMPORTANT	The number and type of configuration parameters on the New Module dialog box varies according to the EtherNet/IP communication module type.

6. In the Controller Organizer, right-click the local EtherNet/IP communication module that you just added and choose New Module.
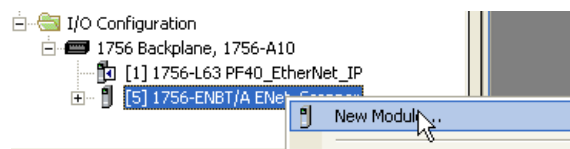
The Select Module Type dialog box appears.

7. Click the By Category tab.

8. Choose the EtherNet/IP PanelView terminal and click OK.
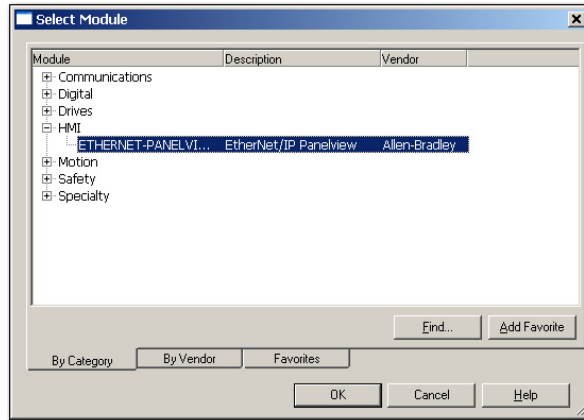
The Module Properties dialog box appears.

9. Configure the PanelView terminal.

   • In the Name field, type the name of your new module.

   • From the Comm Format pull-down menu, choose Data-DINT.

   • From the Electronic Keying pull-down menu, choose Disable Keying.

   • In the IP Address field, type the IP address.

   • In the Input and Output fields, type the connection parameters.
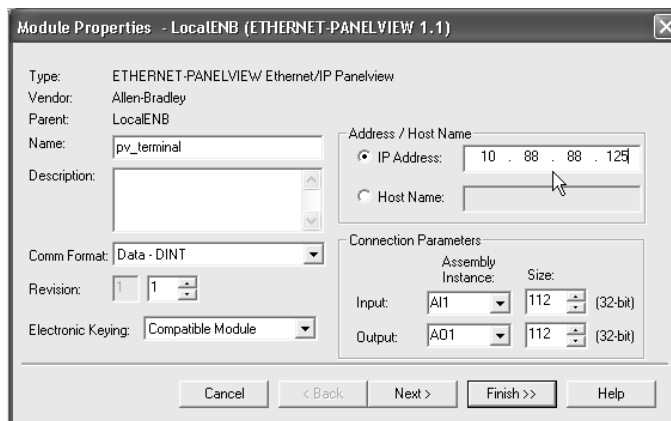
IMPORTANT	You can establish up to eight different instances with each terminal. For example, one controller can use all eight instances or eight controllers can each use one instance.

10. Click Finish.

Organize Controller Data for a PanelView Terminal

Organize data for a PanelView terminal based on how the data is used.

Table 24 - Controller Data Organization

For data that is	Do this
Time critical (for example, data that controls a machine)	Use the I/O tags of the terminal. The tags for this data were created when you added the terminal to the I/O configuration of the controller. They resemble the tags of the I/O modules.

Not time critical	Create arrays to store the data.
	 1. For each screen, create a BOOL array with enough elements for the bit-level objects on the screen.
	    For example, the BOOL[32] array gives you 32 bits for push buttons or indicators.
	 2. For each screen, create a DINT array with enough elements for the word-level objects on the screen.
	    For example, the DINT[28] array provides 28 values for numeric entry controls or numeric displays.

To access the I/O tags of the PanelView or PanelView Plus terminal, use the following address format.

Terminal Function	Requirement
Writes the data	name_of_terminal:I.Data[x].y
Reads the data	name_of_terminal:O.Data[x].y

This address variable	Is
name_of_terminal	Name of the instance in the I/O configuration of the controller.
x	Element of the input (I) or output (O) structure.
y	Bit number within the input or output element.

Connections to FactoryTalk View Applications

To establish communication to a FactoryTalk View application, configure RSLinx® software to collect tags from the controller. A FactoryTalk View or FactoryTalk View Enterprise application uses RSLinx software as a data server.

RSLinx Enterprise software defaults to four read connections and one write connection per configured controller. Modify the RSLinx software configuration as needed.

Notes:

Diagnostic Web Pages

This chapter describes the diagnostic web pages of a few representative modules.

Topic	Page
Access Web Browser Support	106
1756-EN2TR Module	107
1756-ENBT Module	112
1756-EN2TP Module	116
1769-AENTR Adapter	121

The number and type of diagnostic fields vary by module catalog number. This chapter describes the diagnostic web pages on these modules:

- 1756-EN2TR EtherNet/IP communication module

- 1756-ENBT EtherNet/IP communication module

- 1756-EN2TP EtherNet/IP communication module

IMPORTANT	The diagnostic web pages have many fields that you can use to monitor the operating state of your EtherNet/IP module. This section describes only the fields that are most commonly used during monitoring.
	To troubleshoot problems, you diagnose as a result of monitoring the diagnostic web pages of the EtherNet/IP modules, refer to publication ENET-AT003, Troubleshoot EtherNet/IP Networks.

Access Web Browser Support

To troubleshoot most possible problems with your EtherNet/IP communication module, you must access the diagnostic web pages for the module.

> **TIP** The number and type of diagnostic fields vary by module catalog number, the programming software version, and module firmware revision.
>
> For example, this chapter describes the diagnostic web pages for these modules:
>
> • 1756-EN2TR EtherNet/IP communication module
> • 1756-ENBT EtherNet/IP communication module
> • 1756-EN2TP EtherNet/IP Parallel Redundancy Protocol module

To access the EtherNet/IP communication module diagnostic web pages, follow these steps.

1. Open your web browser.

2. In the Address field, type your EtherNet/IP communication module Internet Protocol (IP) address and press Enter.

    The diagnostic web home page appears.

EtherNet/IP Module Internet Protocol (IP) Address
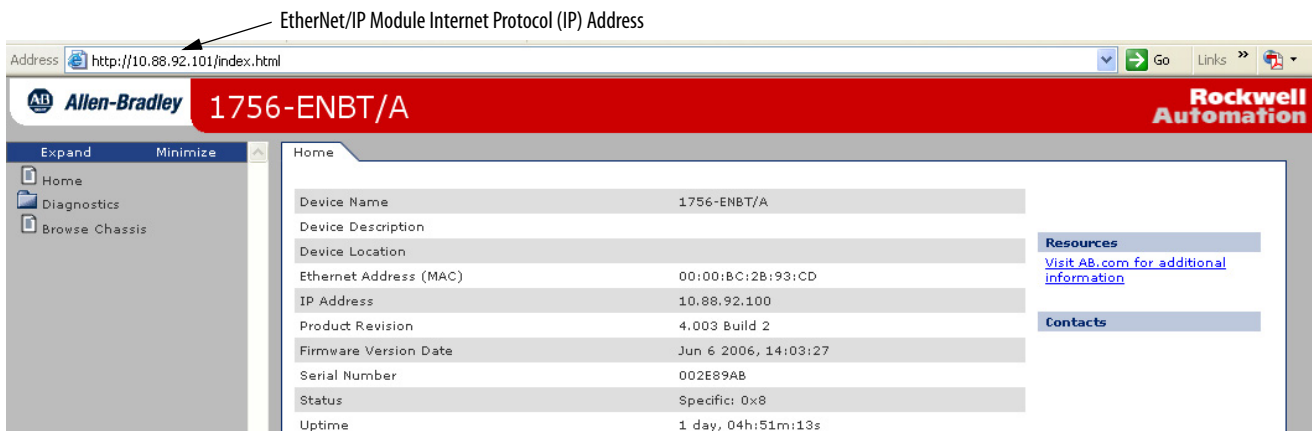
3. Open the Diagnostics folder in the left-most navigation bar and click the link for each diagnostic web page you must monitor.
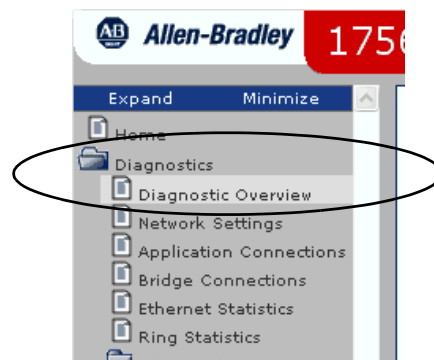
1756-EN2TR Module

These pages are the most commonly used diagnostic web pages for the 1756-EN2TR module:

- Diagnostic Overview Page
- Ethernet Statistics Web Page
- Ring Statistics Web Page

> **TIP**   The 1756-EN2TR module also offers these diagnostic web pages for monitoring the module:
> - Network Settings
> - Application Connections
> - Bridge Connections
>
> These web pages are not as commonly used as the three described in this section and are not described here.

Diagnostic Overview Page

The Diagnostic Overview web page presents a summary of the current configuration and overall status of the module.

The most commonly monitored fields are circled in the graphic and described in the table that follows.

Table 25 describes the fields that are most commonly used on the Diagnostics Overview web page.

Table 25 - Diagnostic Overview Web Page

Field	Specifies
Module Resource Utilization (All Ports)	
CPU	Current percent CPU utilization for the module
CIP Connection Statistics (All Ports)	
Active Total	Total number of active CIP connections used for both messaging and I/O
TCP Connections (EtherNet/IP Port)	
Active	Number of active TCP connections for CIP messaging
HMI/MSG (EtherNet/IP Port)	
Sent packets per second	Number of CIP messages sent in the last one-second snapshot
Received packets per second	Number of CIP packets received in the last one-second snapshot
I/O and Prod/Cons Packets Per Second (EtherNet/IP Port)	
Total	Total number CIP I/O packets that are sent and received
I/O and Prod/Cons Packets Count (EtherNet/IP Port)	
Missed	Number of CIP I/O packets missed

Ethernet Statistics Web Page

The Ethernet Statistics web page provides a summary of the status of communication activity on the Ethernet network.

The most commonly monitored fields are circled in the graphic and described in Table 26.

Table 26 describes the field that is most commonly used on the Ethernet Statistics web page.

Table 26 - Ethernet Statistics Web Page

Field	Specifies
Ethernet Port 1 (These definitions apply to the same fields in the Ethernet Port 2 section.)	
Interface State	Whether the port is turned off or on. Active or inactive indicates whether there is a cable connected.
Link Status	Whether the port is blocked for DLR protocol frames.
Speed	Whether the Ethernet port is operating at 10 MBps or 100 MBps.
Duplex	Whether the Ethernet port is operating at half-duplex or full-duplex.
Autonegotiate Status	Whether the port speed and Duplex mode were determined via autonegotiation or whether they were manually configured.

Table 26 - Ethernet Statistics Web Page (Continued)

Field	Specifies
Media Counters Port 1	
Alignment Errors	A frame containing bits that do not total an integral multiple of eight.
FCS Errors	A frame that contains eight bits, at least one of which has been corrupted.
Single Collisions	The number of outgoing packets that encountered only one collision during transmission.
Multiple Collisions	The number of outgoing packets that encountered 2…15 collisions during transmission.
SQE Test Errors	A test to detect the collision-present circuit between a transceiver and a network interface card (NIC). **IMPORTANT:** Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter.
Deferred Transmissions	The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them.
Late Collisions	The number of times two devices transmit data simultaneously.
Excessive Collisions	The number of frames that experience 16 consecutive collisions.
MAC Transmit Errors	Frames for which transmission fails due to an internal MAC sublayer transmit error.
Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Frame Too Long	The number of incoming packets that exceed the maximum Ethernet packet size.
MAC Receive Errors	Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error.

Connection Manager Cmd Object Info Web Page

The **Connection Manager Cmd Object Info** link provides a summary of connection request activity on the Ethernet network.
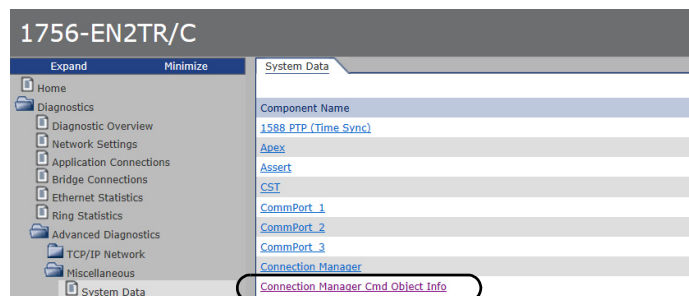
The most commonly used field on this web page is **Connections Closed due to a Timeout**. This field shows the number of CIP connection timeouts that have occurred on the module.
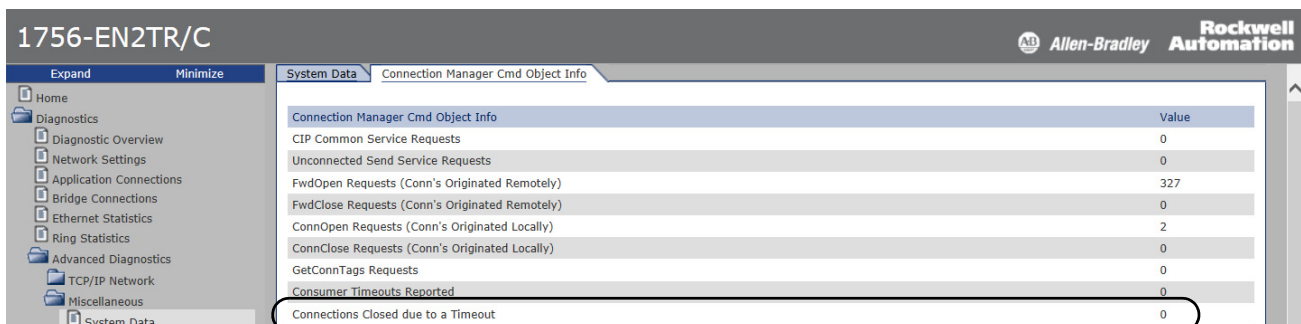
Ring Statistics Web Page

> **TIP**   The Ring Statistics web page, and the descriptions in this section, only apply to modules you can use in a Device Level Ring (DLR) network:
>
> - 1756-EN2TR communication module
> - 1756-EN3TR communication module

The Ring Statistics web page provides a summary of the operating state of the module in a DLR application.

The most commonly monitored fields are circled in the graphic and described in Table 27.

Table 27 describes the field that is most commonly used on the Ring Statistics web page.

Table 27 - Ring Statistics Web Page

Field	Specifies
Ring Supervisor	
Ring Supervisor Mode	Whether a module is configured to function as supervisor node or a ring node.
Ring Supervisor Status	Whether a module that is configured to function as a supervisor node is functioning as the active ring supervisor or a backup supervisor node.
Ring Fault Location	
Last Active Node on Port 1	The IP or MAC ID address of the last active node between port 1 on the module and the faulted part of the network.
Last Active Node on Port 2	The IP or MAC ID address of the last active node between port 2 on the module and the faulted part of the network.
Active Ring Supervisor	
Address	The IP or MAC ID address of the active ring supervisor.
Precedence	The precedence value of the module. If the operation of the active supervisor node is interrupted, the backup supervisor with the next highest precedence value becomes the active supervisor node.

1756-ENBT Module

These pages are the most commonly used diagnostic web pages for the 1756-ENBT module:

- Diagnostic Overview Page
- Ethernet Statistics

> **TIP** The 1756-ENBT module also offers these diagnostic web pages for monitoring the module:
>
> - Network Settings
> - Message Connections
> - I/O Connections
>
> These web pages are not as commonly used as the three described in this section and are not described here.

Diagnostic Overview Page

The Diagnostic Overview web page presents a summary of the current configuration and overall status of the module. The most commonly monitored fields are circled in the graphic and described in Table 28.

Table 28 - Diagnostic Overview Web Page

Field	Specifies
Ethernet Link	
Speed	Whether the Ethernet port is operating at 10 Mbps or 100 Mbps.
Duplex	Whether the Ethernet port is operating at half-duplex or full-duplex.
Autonegotiate Status	Whether the port speed and duplex mode were determined via autonegotiation or manual configuration.
System Resource Utilization	Number of times a page has been requested for which you have insufficient privilege.
CPU	Current percent CPU utilization for the module.
CIP Connection Statistics	
Current CIP MSG Connections	Current number of CIP connections for message.
Current CIP I/O Connections	Current number of CIP connections for I/O.
Conn Timeouts	Number of CIP connection timeouts.
TCP Connections (CIP)	
Current TCP Connections	Current number of active TCP connections for CIP messaging.
I/O Packet / Second Statistics	
Total	Total number of Class 1 UDP packets the module transmitted and received in the last one-second snapshot. The Total is the sum of the Sent, Received, Inhibited, and Rejected numbers.
I/O Packet Counter Statistics	
Missed	Cumulative number packets that were not received in order. Each UDP packet has a sequence number and if a packet is missing (corrupted or dropped), the module will recognize this void upon receipt of the next packet received.

Ethernet Statistics

The Ethernet Statistics diagnostic web page presents a summary of the status of communication activity on the Ethernet network.

The most commonly monitored fields are circled in the graphic and described in Table 29.

Table 29 - Ethernet Statistics Web Page

Field	Specifies
Ethernet Link	
Speed	Whether the Ethernet port is operating at 10 MBps or 100 MBps.
Duplex	Whether the Ethernet port is operating at half-duplex or full-duplex.
Autonegotiate Status	Whether the port speed and Duplex mode were determined via autonegotiation or whether they were manually configured.
Media Counters	
Alignment Errors	A frame containing bits that do not total an integral multiple of eight.
FCS Errors	A frame that contains eight bits, at least one of which has been corrupted.
Single Collisions	The number of outgoing packets that encountered only one collision during transmission.
Multiple Collisions	The number of outgoing packets that encountered 2…15 collisions during transmission.
SQE Test Errors	A test to detect the collision-present circuit between a transceiver and a network interface card (NIC). **Important:** Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter.
Deferred Transmissions	The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them.
Media Counters	
Late Collisions	The number of times two devices transmit data simultaneously.

Table 29 - Ethernet Statistics Web Page (Continued)

Field	Specifies
Excessive Collisions	The number of frames that experience 16 consecutive collisions.
MAC Transmit Errors	Frames for which transmission fails due to an internal MAC sublayer transmit error.
Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Frame Too Long	The number of incoming packets that exceed the maximum Ethernet packet size.
MAC Receive Errors	Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error.

1756-EN2TP Module

These pages are the most commonly used diagnostic web pages for the 1756-EN2TP module:

- Diagnostic Overview Page
- Ethernet Statistics Web Page
- PRP Statistics
- PRP Nodes

> **TIP**   The 1756-EN2TP module also offers these diagnostic web pages for monitoring the module:
>
> - Network Settings
> - Application Connections
> - Bridge Connections
>
> These web pages are not as commonly used as the three described in this section and are not described here.

Diagnostic Overview

The Diagnostic Overview web page presents a summary of the current configuration and overall status of the module.

Table 30 describes the fields that are most commonly used on the Diagnostics Overview web page.

Table 30 - 1756-EN2TP Communcation Module Diagnostic Overview

Field	Specifies
Module Resource Utilization (All Ports)	
CPU	Current percent CPU utilization for the module
CIP Connection Statistics (All Ports)	
Active Total	Total number of active CIP connections used for both messaging and I/O
TCP Connections (EtherNet/IP Port)	
Active	Number of active TCP connections for CIP messaging
HMI/MSG (EtherNet/IP Port)	
Sent packets per second	Number of CIP messages sent in the last one-second snapshot
Received packets per second	Number of CIP packets received in the last one-second snapshot
I/O and Prod/Cons Packets Per Second (EtherNet/IP Port)	
Total	Total number CIP I/O packets that are sent and received in the last one-second snapshot.
I/O and Prod/Cons Packets Count (EtherNet/IP Port)	
Missed	Number of CIP I/O packets missed

Ethernet Statistics

The Ethernet Statistics diagnostic web page presents a summary of the status of communication activity on the Ethernet network.

Table 31 describes the fields that are most commonly used on the Ethernet Statistics web page.

Table 31 - 1756-EN2TP Communication Module Ethernet Statistics

Field	Specifies
Ethernet Port A and B	
Interface State	Whether the interface for the port is enabled.
Link Status	Whether the link is active or not.
Speed	Whether the Ethernet port is operating at 10 MBps or 100 MBps.
Duplex	Whether the Ethernet port is operating at half-duplex or full-duplex.
Autonegotiate Status	Whether the port speed and Duplex mode were determined via autonegotiation or whether they were manually configured.
Media Counters, Port A and B	
Alignment Errors	A frame containing bits that do not total an integral multiple of eight.
FCS Errors	A frame that contains eight bits, at least one of which has been corrupted.
Single Collisions	The number of outgoing packets that encountered only one collision during transmission.
Multiple Collisions	The number of outgoing packets that encountered 2...15 collisions during transmission.

Table 31 - 1756-EN2TP Communcation Module Ethernet Statistics (Continued)

Field	Specifies
SQE Test Errors	A test to detect the collision-present circuit between a transceiver and a network interface card (NIC). **Important:** Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter.
Deferred Transmissions	The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them.
Late Collisions	The number of times two devices transmit data simultaneously.
Excessive Collisions	The number of frames that experience 16 consecutive collisions.
MAC Transmit Errors	Frames for which transmission fails due to an internal MAC sublayer transmit error.
Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Frame Too Long	The number of incoming packets that exceed the maximum Ethernet packet size.
MAC Receive Errors	Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error.

PRP Statistics Tab

The most commonly monitored fields are circled in the graphic and described in the table that follows.

Figure 12 - 1756-EN2TP PRP Module Diagnostics

Table 32 describes the fields that are most commonly used on the Ethernet Statistics web page.

Table 32 - 1756-EN2TP Communication Module PRP Statistics

Field	Specifies
Counters Port A and B	
Transmit Count	Number of PRP-tagged frames that are transmitted over each LAN since the last Reset Counters operation or powerup.
Receive Count	Number of PRP-tagged frames that are received on each LAN since the last Reset Counters operation or powerup.
Warning Count	A potential issue with the PRP ports exists. Count increments every time Active transitions from False to True.
Warning Active	Active is True when no PRP packets received on this LAN in the previous 3 seconds, or if an entry in the PRP nodes table has False in the corresponding Receiving on Port A/B column.

PRP Nodes Tab

The most commonly monitored fields are circled in the graphic and described in the table that follows. Any node that the 1756-EN2TP module communicates with displays on the PRP Nodes tab, including DANs, SANs, RedBoxes, and VDANs.

Figure 13 - 1756-EN2TP PRP Nodes

The fields to monitor are Receiving on Port A and B. If either of those fields are False, it is indicative of a loss of PRP redundancy. Some IP addresses can display as 0.0.0.0. An IP address displayed as 0.0.0.0 is an indication that the device is not communicating directly with that device.

1769-AENTR Adapter

These pages are the most commonly used diagnostic web pages for the 1769-AENTR adapter:

- Diagnostic Overview Page
- Ethernet Statistics

> **TIP** The 1769-AENTR adapter also offers these diagnostic web pages for monitoring the adapter:
>
> - Network Settings
> - I/O Connections
>
> These web pages are not as commonly used as the two described in this section and are not described here.

Diagnostic Overview Page

The Diagnostic Overview web page presents a summary of the current configuration and overall status of the adapter. The most commonly monitored fields are circled in the graphic and described in <u>Table 33</u>.

Ethernet Statistics

Table 33 - Diagnostic Overview Web Page

Field	Specifies
Ring Status	
Network Topology	Whether the Ethernet network is linear or DLR topology.
Network Status	Whether the Ethernet network is operating normally or otherwise.
Ring Supervisor	The IP and MAC ID of the ring supervisor.
Beacon Interval	Beacon interval values. These values affect network recovery time. Use default values unless the ring includes more than 50 devices. For more information, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.
Beacon Timeout	Beacon timeout values. These values affect network recovery time. Use default values unless the ring includes more than 50 devices. For more information, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.
System Resource Utilization	Number of times a page has been requested for which you have insufficient privilege.
CPU	Current percent CPU utilization for the module.
CIP Connection Statistics	
Current CIP MSG Connections	Current number of CIP connections for message.
Current CIP I/O Connections	Current number of CIP connections for I/O.
Conn Timeouts	Number of CIP connection timeouts.
TCP Connections (CIP)	
Active	Current number of active TCP connections for CIP messaging.

The Ethernet Statistics diagnostic web page presents a summary of the status of communication activity on the Ethernet network.

The most commonly monitored fields are described in [Table 34].

Table 34 - Ethernet Statistics Web Page

Field	Specifies
Ethernet Port 1 (These definitions apply to the same fields in the Ethernet Port 2 section.)	
Interface State	Whether the port is turned off or on. Active or inactive indicates whether there is a cable connected.
Link Status	Whether the port is blocked for DLR protocol frames.
Speed	Whether the Ethernet port is operating at 10 MBps or 100 MBps.
Duplex	Whether the Ethernet port is operating at half-duplex or full-duplex.
Autonegotiate Status	Whether the port speed and Duplex mode were determined via autonegotiation or whether they were manually configured.

Table 34 - Ethernet Statistics Web Page (Continued)

Field	Specifies
Media Counters Port 1	
Alignment Errors	A frame containing bits that do not total an integral multiple of eight.
FCS Errors	A frame that contains eight bits, at least one of which has been corrupted.
Single Collisions	The number of outgoing packets that encountered only one collision during transmission.
Multiple Collisions	The number of outgoing packets that encountered 2...15 collisions during transmission.
SQE Test Errors	A test to detect the collision-present circuit between a transceiver and a network interface card (NIC). **IMPORTANT:** Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter.
Deferred Transmissions	The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them.
Late Collisions	The number of times two devices transmit data simultaneously.
Excessive Collisions	The number of frames that experience 16 consecutive collisions.
MAC Transmit Errors	Frames for which transmission fails due to an internal MAC sublayer transmit error.
Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Frame Too Long	The number of incoming packets that exceed the maximum Ethernet packet size.
MAC Receive Errors	Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error.

1756 EtherNet/IP Status Indicators

This graphic shows the front of the module for these modules (extended-temperature versions not shown).

Single-port Module

Dual-port Module

Single-port Module

Dual-port Module

1756-EN2TP

Table 35 - Single-port Module Status Indicators

Status Indicator	Description	Status	State
Module Status Display	Alphanumeric display that scrolls messages. For example, when a module is operating normally, the display scrolls the module's IP address.	N/A	N/A

Link Status (LINK)	Indicates the module's current state with respect to transmitting data on the EtherNet/IP network.	Off	One of these conditions exists:
			
			• The module is not powered.
			  – Verify there is chassis power.
			  – Verify that the module is completely inserted into the chassis and backplane.
			  – Make sure the module has been configured.
			
			• No link exists on the port.

		Flashing green	Activity exists on the port.
		Green	Activity exists on the port.
OK Status (OK)	Indicates the module's current state. For example, this status indicator indicates if the module is executing power-up testing, in the process of a firmware update or operating normally.	Off	The module is not powered. • Verify there is chassis power. • Verify that the module is completely inserted into the chassis and backplane. • Make sure the module has been configured.
		Flashing green	The module is not configured. The Module Status display scrolls: BOOTP or DHCP<Mac_address_of_module> For example: BOOTP 00:0b:db:14:55:35 Configure the module.
		Green	The module is operating correctly. The module's IP address scrolls across the Module Status display.
		Flashing red	The module detected a recoverable minor fault. Check the module configuration. If necessary, reconfigure the module.
		Red	The module detected an unrecoverable major fault. Cycle power to the module. If this does not clear the fault, replace the module.

Network Status (NET)	Indicates if CIP connections are established.	Off	One of these conditions exists:
			
			• The module is not powered.
			
			  – Verify there is chassis power.
			
			  – Verify that the module is completely inserted into the chassis and backplane.
			
			  – Make sure the module has been configured.
			
			• The module is powered but does not have an IP address. Assign an IP address to the module.

		Flashing green	The controller has an IP address and one of these conditions exists: • The module has not established any CIP connections. If connections are configured for this module, check the connection originator for the connection error code. • One or more connections have timed out. For example, an HMI or I/O connection has timed out. Reestablish the connection.

Table 35 - Single-port Module Status Indicators

Status Indicator	Description	Status	State
Network Status (NET)	Indicates if CIP connections are established.	Green	The module has established at least 1 CIP connection and is operating properly. The module's IP address scrolls across the Module Status display.
		Red	The module is in conflict mode. It shares an IP address with another device on the network. The module's current IP address scrolls across the Module Status display. 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 Change the module's IP address.
		Flashing green/flashing red	The module is performing its power-up testing.

Table 36 - Dual-port Module Status Indicators

Status Indicator	Description	Status	State
Module Status Display	Alphanumeric display that scrolls messages. For example, when a module is operating normally, the display scrolls the module's IP address.	N/A	N/A
OK	Indicates the module's current state. For example, this status indicator indicates if the module is executing power-up testing, in the process of a firmware update or operating normally.	Off	The module is not powered. • Verify there is chassis power. • Verify that the module is completely inserted into the chassis and backplane. • Make sure the module has been configured.
		Flashing green	The module is not configured. The Module Status display scrolls: BOOTP or DHCP<Mac_address_of_module> For example: BOOTP 00:0b:db:14:55:35 Configure the module.
		Green	The module is operating correctly. The Module Status display scrolls: OK <IP_address_of_this_module> For example: OK 10.88.60.160
		Flashing red	The module detected a recoverable minor fault. Check the module configuration. If necessary, reconfigure the module.
		Red	The module detected an unrecoverable major fault. Cycle power to the module. If this does not clear the fault, replace the module.
		Both of these conditions exist: • Status Indicator is Red • Module Status Display is scrolling: Image Update Needed	The module's main firmware image needs to be updated. Follow these steps: 1. Update the firmware image. 2. Cycle power to the module. 3. If the status indicators remain the same, that is, red and scrolling Image Update Needed, replace the module.
		Flashing red and green	The module is performing its power-up testing.

Table 36 - Dual-port Module Status Indicators

Status Indicator	Description	Status	State
Network Status (NET)	Indicates if CIP connections are established. **IMPORTANT:** The new-series 1756-EN2TR and 1756-EN3TR modules have a NET status indicator. The older-series 1756-EN2TR and 1756-EN3TR modules do not have a NET status indicator.	Off	One of these conditions exists: • The module is not powered. – Verify there is chassis power. – Verify that the module is completely inserted into the chassis and backplane. – Make sure the module has been configured. • The module is powered but does not have an IP address. Assign an IP address to the module.
		Flashing green	The controller has an IP address and one of these conditions exists: • The module has not established any CIP connections. If connections are configured for this module, check the connection originator for the connection error code. • One or more connections have timed out. For example, an HMI or I/O connection has timed out. Reestablish the connection.
		Green	The module has established at least 1 CIP connection and is operating properly. The module's IP address scrolls across the Module Status display.
		Red	The module is in conflict mode. It shares an IP address with another device on the network. The module's current IP address scrolls across the Module Status display. 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 Change the module's IP address.
		Flashing green/ flashing red	The module is performing its power-up testing.
LINK 1 (3) LINK 2 (4)		Off	One of these conditions exists: • The module is not powered. – Verify there is chassis power. – Verify that the module is completely inserted into the chassis and backplane. – Make sure the module has been configured. • No link exists on the port. • The port is administratively disabled (LNK2). • The port is disabled due to rapid ring faults (LNK2).
		Flashing green	Activity exists on the port.
		Green	One of these conditions exists: • A link exists on the port. • The ring network is operating normally on active ring supervisor (LNK2). • A ring partial network fault was detected on the active ring supervisor (LNK2).
LAN A LAN B		Flashing red	When the corresponding LAN A/B Parallel Redundancy Protocol (PRP) Warning bit is set.

Notes:

Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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EtherNet/IP Network Configuration

User Manual