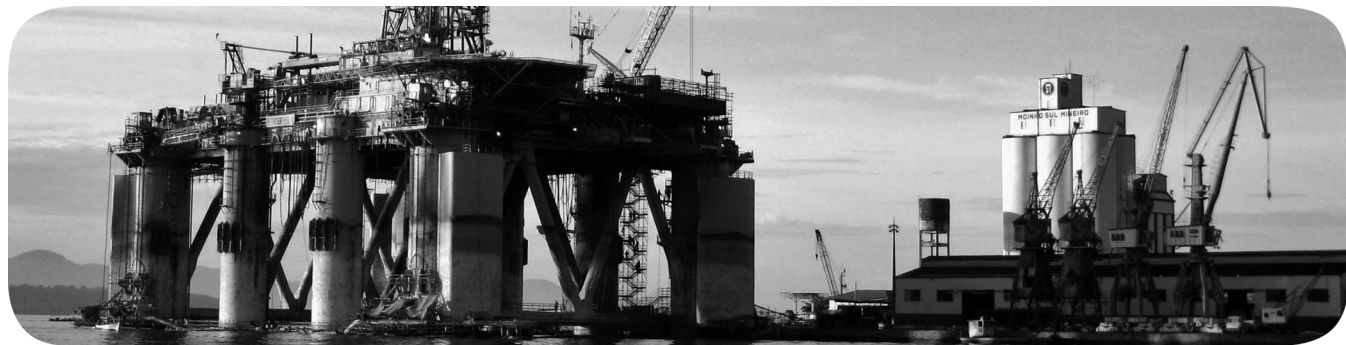


# 1769 CompactLogix Controllers User Manual

Catalog Numbers 1769-L31, 1769-L32C, 1769-L32E, 1769-L35CR, 1769-L35E



## Important User Information

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

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.



**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.

---

**IMPORTANT**

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

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

### New and Updated Information

This table contains the changes made to this revision.

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Added installation instructions	15...39

For specifications, see the 1769 CompactLogix Controllers Specifications Technical Data, publication [1769-TD005](#).

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**Dynamic Memory Allocation in CompactLogix Controllers**

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Use this manual to become familiar with the CompactLogix™ controller and its features.

This manual describes the necessary tasks to install, configure, program, and operate a CompactLogix system. In some cases, this manual includes references to additional documentation that provides the more comprehensive details.

## Additional Information

These documents address Logix5000™ products.

Resource	Description
1769 CompactLogix Controllers Specifications Technical Data, publication <a href="#">1769-TD005</a>	Contains technical specifications and certifications for all CompactLogix controllers.
1769-L3x CompactLogix System Quick Start, publication <a href="#">IASIMP-QS001</a>	Provides examples of using a 1769-L3x CompactLogix controller to connect to multiple devices over various networks.
Logix5000 Controller Design Considerations Reference Manual, publication <a href="#">1756-RM094</a>	Provides guidelines you can follow to optimize your system. This manual also provides system information you need to make system design choices.
Logix5000 Controllers Common Procedures Programming Manual, publication <a href="#">1756-PM001</a>	Guides the development of projects for Logix5000 controllers. It provides links to individual guides.
Logix5000 Controllers General Instruction Set Reference Manual, publication <a href="#">1756-RM003</a>	Provides a programmer with details about each available instruction for a Logix5000 controller. You should already be familiar with how the Logix5000 controller stores and processes data.
Logix5000 Controllers Process Control/Drives Instruction Set Reference Manual, publication <a href="#">1756-RM006</a>	Provides a programmer with details about each function block instruction available for a Logix5000 controller. You should already be familiar with how the Logix5000 controller stores and processes data.
EtherNet/IP Communication Modules in Logix5000 Control Systems User Manual, publication <a href="#">ENET-UM001</a>	Decribes how to install and configure EtherNet/IP modules in Logix5000 control systems.
ControlNet Communication Modules in Logix5000 Control Systems User Manual, publication <a href="#">CNET-UM001</a>	Describes how to install and configure ControlNet modules in a Logix5000 control system.

To view or download these publications, go to:

<http://www.rockwellautomation.com/literature>

To obtain a hard copy, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

**Notes:**

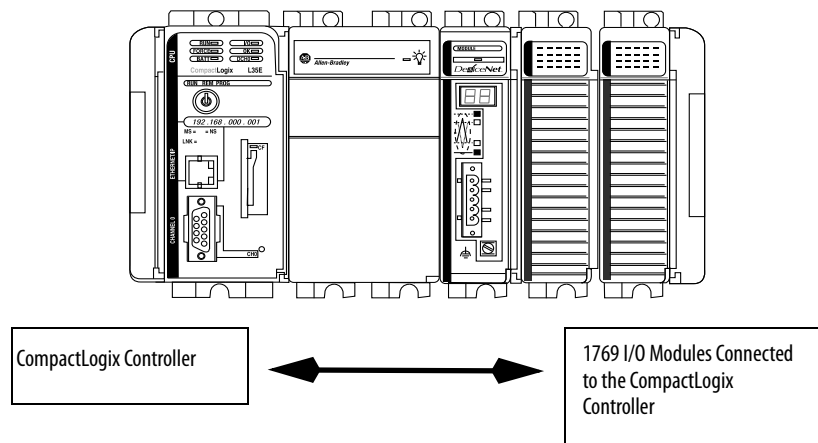
## 1769 CompactLogix Controllers Overview

This chapter introduces the 1769 CompactLogix controllers. These controllers offer state-of-the-art control, communication, and I/O elements in a distributed control package.

### About the 1769 CompactLogix Controller

The 1769 CompactLogix controller offers state-of-the-art control, communication, and I/O elements in a distributed control package.

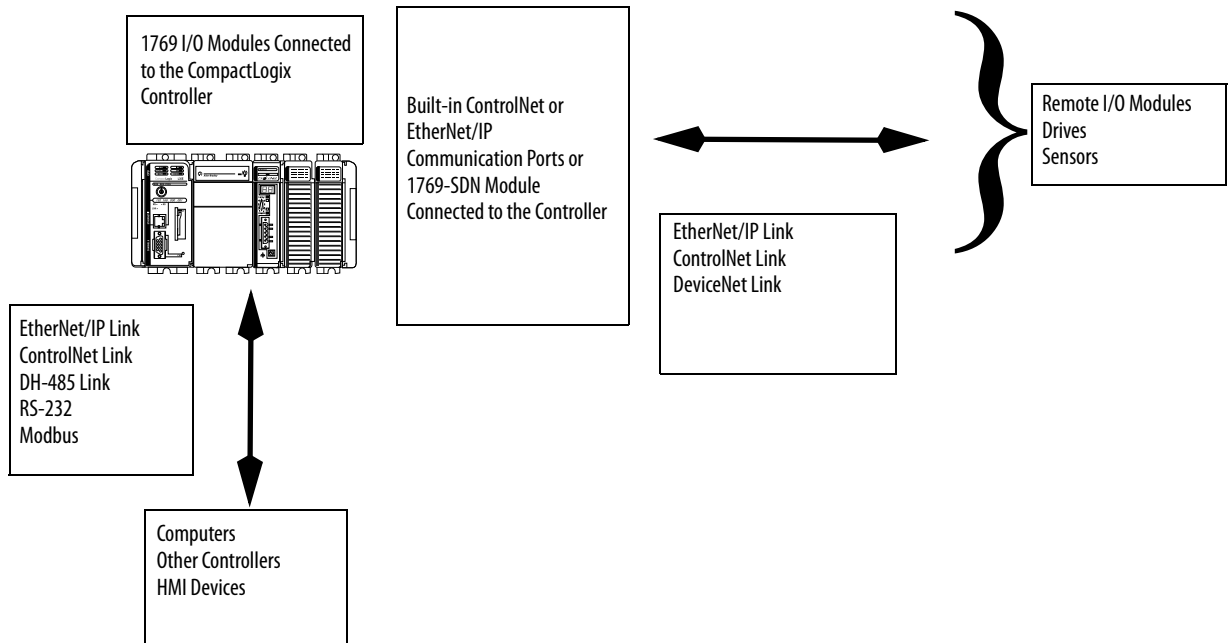
Figure 1 - CompactLogix Controller and 1769 I/O Modules



For a more flexible system, use:

- multiple controllers in a single chassis.
- multiple controllers joined across networks.
- I/O in multiple platforms that is distributed in many locations and connected over multiple I/O links.

**Figure 2 - CompactLogix System Overview**



The CompactLogix controller, part of the Logix family of controllers, provides a small, powerful, cost-effective system consisting of the following:

- RSLogix™ 5000 programming software
- Built-in communication ports for EtherNet/IP (1769-L32E and 1769-L35E only) and ControlNet (1769-L32C and 1769-L35CR only) networks
- A 1769-SDN communication interface module providing I/O control and remote device configuration over DeviceNet networks
- Built-in serial port on every CompactLogix controller
- Compact I/O modules providing a compact, DIN-rail or panel-mounted I/O system

**Table 1 - CompactLogix Controller Combinations**

Controller	Available Memory	Communication Options	Number of Tasks Supported	Number of Local I/O Modules Supported
1769-L35CR	1.5 MB	1 port ControlNet - supports redundant media 1 port RS-232 serial (system or user protocols)	8	30
1769-L35E		1 port EtherNet/IP 1 port RS-232 serial (system or user protocols)		
1769-L32C	750 KB	1 port ControlNet 1 port RS-232 serial (system or user protocols)	6	16
1769-L32E		1 port EtherNet/IP 1 port RS-232 serial (system or user protocols)		
1769-L31	512 KB	1 port RS-232 serial (system or user protocols)	4	
		1 port RS-232 serial (system protocol only)		

## Design a CompactLogix System

When designing a CompactLogix system, determine the network configuration and the placement of components in each location. To design your CompactLogix system, select the following:

- I/O devices
- Communication networks
- Controllers
- Power supplies

**Notes:**

## Install the 1769-L3x Controllers

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Use this chapter to install the CompactLogix™ controller, which must be the leftmost module in the first bank of the system.



**WARNING:** This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters (6562 ft) without derating.

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

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley® publication [1770-4.1](#), for additional installation requirements
- NEMA 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure





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

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



**Table 2 - North American Hazardous Location Approval**

<p><b>The following information applies when operating this equipment in hazardous locations.</b></p>	<p><b>Informations sur l'utilisation de cet équipement en environnements dangereux.</b></p>
<p>Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.</p>	<p>Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.</p>
<div style="display: flex; align-items: center;">  <div> <p><b>WARNING: Explosion Hazard –</b></p> <ul style="list-style-type: none"> <li>• Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.</li> <li>• Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.</li> <li>• Substitution of components may impair suitability for Class I, Division 2.</li> <li>• If this product contains batteries, they must only be changed in an area known to be nonhazardous.</li> </ul> </div> </div>	<div style="display: flex; align-items: center;">  <div> <p><b>AVERTISSEMENT: Risque d'Explosion –</b></p> <ul style="list-style-type: none"> <li>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.</li> <li>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.</li> <li>• La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.</li> <li>• S'assurer que l'environnement est classé non dangereux avant de changer les piles.</li> </ul> </div> </div>

**Table 3 - European Hazardous Location Approval**

<p><b>European Zone 2 Certification (The following applies when the product bears the Ex or EEx Marking)</b></p>
<p>This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in potentially explosive atmospheres, given in Annex II to this Directive. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.</p>



**WARNING:**

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Allen-Bradley.
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.



**ATTENTION:** This equipment is not resistant to sunlight or other sources of UV radiation.

## Verify Compatibility

**IMPORTANT** The series B controllers are compatible only with the following:

- Controller firmware revision 20 and later
- RSLogix 5000 software version 20 and later.

Attempting to use controllers with incompatible software and firmware revisions may result in the following:

- An inability to connect to the series B controller in RSLogix 5000 software
- Unsuccessful firmware upgrades in ControlFLASH™ or AutoFlash utilities



## Before You Begin

Consider the following when planning your CompactLogix system:

- The CompactLogix controller is always the leftmost module in the system.
- The controller must be within four modules of the system power supply. Some I/O modules may be up to eight modules away from the power supply. See the documentation for your 1769 I/O modules for details.
- The 1769-L32E controller supports as many as 16 I/O modules and the 1769-L35E controller supports as many as 30 I/O modules. Both controllers can use a maximum of 3 I/O banks with 2 expansion cables.
- The 1769-L32C controller supports as many as 16 I/O modules in a maximum of 3 I/O banks with 2 expansion cables. The 1769-L35CR controller supports as many as 30 I/O modules in a maximum of 3 I/O banks with 2 expansion cables.
- The 1769-L31 controller supports as many as 16 I/O modules in a maximum of 3 I/O banks with 2 expansion cables.
- Each I/O bank requires its own power supply.
- Only one controller can be used in a CompactLogix system.
- A 1769-ECR right end cap or 1769-ECL left end cap is required to terminate the end of the communication bus.

## Parts List

These components are shipped with the controller.

Component	Description
	1769-BA battery
	1747-KY controller key

You may also use these components with the controller.

If you want to	Then use this component
Connect a device to the RS-232 port	1756-CP3 or 1747-CP3 serial cable
Add nonvolatile memory	1784-CF128 Industrial CompactFlash card
Connect to the EtherNet/IP port	Standard Ethernet cable with RJ-45 connector
Connect to the ControlNet port	<ul style="list-style-type: none"> <li>ControlNet taps for connections from controller channels A or B to the ControlNet network</li> <li>1786-CP cable for connections from a programming terminal to the ControlNet network via the controller's network access port (NAP)</li> </ul>

## Set the Node Address (ControlNet only)

Every ControlNet network requires at least one module that can store parameters and configure the network with those parameters upon startup. The CompactLogix controller is called a keeper because it keeps the network configuration.

The CompactLogix controller can keep the network parameters at any legal node address (01...99). Multiple devices on any one network can act as the network keepers. Each device capable of being the network keeper acts to back up the current keeper. This back-up function is automatic and requires no action on your part.

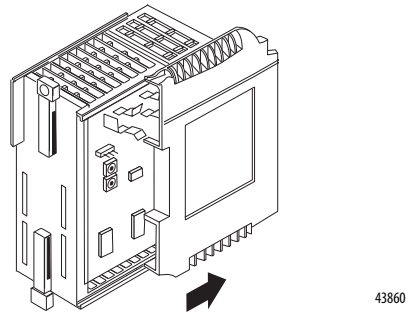
Node address switches are set to the 99 position at shipment, as shown in the figure.



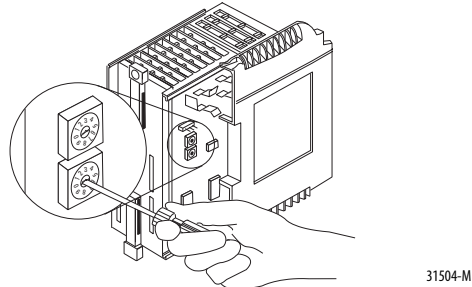
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Use these steps to set the node address.

1. Slide the side cover forward.



2. Use a small screwdriver to set the node address via the controller switches.



3. Write the node address on the front panel overlay after setting the node address switches.

## Connect the 1769-BA Battery

The controller is shipped with the 1769-BA battery that is packed separately. To connect the battery, follow this procedure.



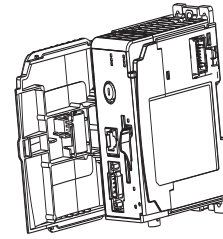
**ATTENTION:** The 1769-BA battery is the only battery you can use with the 1769-L32E and 1769-L35E controllers. The 1747-BA battery is not compatible with the 1769-L32E and 1769-L35E controllers and may cause problems.



**WARNING:** When you connect or disconnect the battery, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

For safety information on the handling of lithium batteries, including handling and disposal of leaking batteries, see Guidelines for Handling Lithium Batteries Technical Data, publication [AG-5.4NOV04](#).

1. Remove the battery door by sliding it forward.




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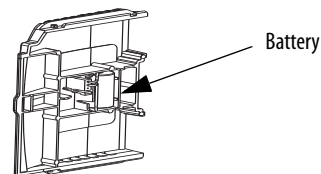
**IMPORTANT** Do not remove the plastic insulation covering the battery. The insulation is necessary to protect the battery contacts.

---

2. Insert the battery connector into the connector port.

The connector is keyed to be installed with the correct polarity.

3. Insert the battery into the battery port in the battery door.



4. Slide the battery door back until it clicks into position.

**TIP** At the end of its life, the used battery should be collected separately from any unsorted municipal waste and recycled.



## Install a CompactFlash Card (optional)




---

**ATTENTION:** Do not remove the CompactFlash card while the controller is reading from or writing to the card, as indicated by a flashing green CF status indicator. This could corrupt the data on the card or in the controller, as well as corrupt the latest firmware in the controller.

---

The optional industrial CompactFlash card provides nonvolatile memory for a CompactLogix controller. The card is not required for controller operation.




---

**WARNING:** When you insert or remove the CompactFlash card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

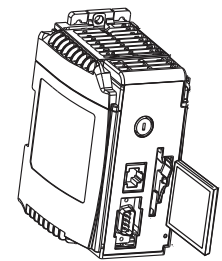
Be sure that power is removed or the area is nonhazardous before proceeding.

---

To install a CompactFlash card, push the locking tab to the right and insert the industrial CompactFlash card into the socket on the front of the controller.

The label of the CompactFlash card faces toward the left. Match the orientation arrow on the card with the arrow on the front of the controller.

To remove the CompactFlash card, push the locking tab away from the CompactFlash card and pull the CompactFlash card from the socket.



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## Assemble the System

The controller can be attached to an adjacent I/O module or power supply before or after mounting.

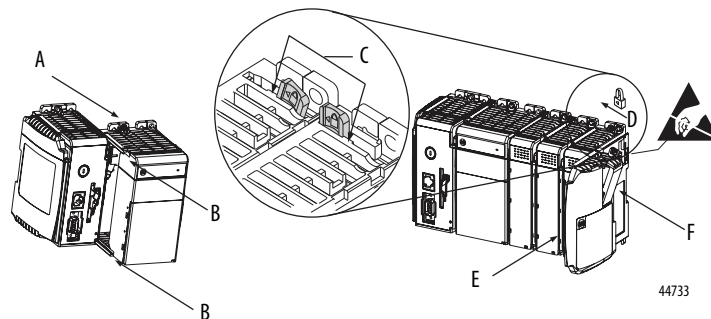


**WARNING:** The CompactLogix controller is not designed for removal and insertion under power.

If you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

Refer to the illustration when installing a controller.



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1. Disconnect line power.
2. Check that the lever of the adjacent module (A) is in the unlocked (fully right) position.
3. Use the upper and lower tongue-and-groove slots (B) to secure the modules together.
4. Move the module back along the tongue-and-groove slots until the bus connectors line up with each other.
5. Use your fingers or a small screwdriver to push the module's bus lever back slightly to clear the positioning tab (C).

6. Move the module's bus lever fully to the left (D) until it clicks, being sure it is locked firmly in place.



**ATTENTION:** When attaching the controller, power supply, and I/O modules, make sure the bus connectors are securely locked together to be sure of proper electrical connection.

This equipment is not resistant to sunlight or other sources of UV radiation.

7. Attach an end-cap terminator (E) to the last module in the system by using the tongue-and-groove slots as before.
8. Lock the end-cap bus terminator (F).

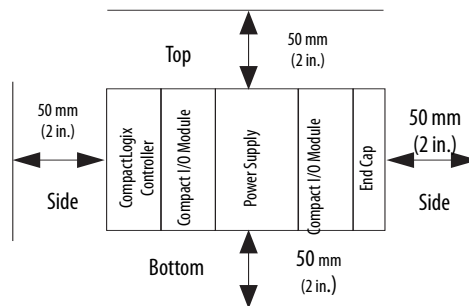
## Mount the System



**ATTENTION:** During panel or DIN-rail mounting of all devices, be sure that all debris (such as metal chips or wire strands) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

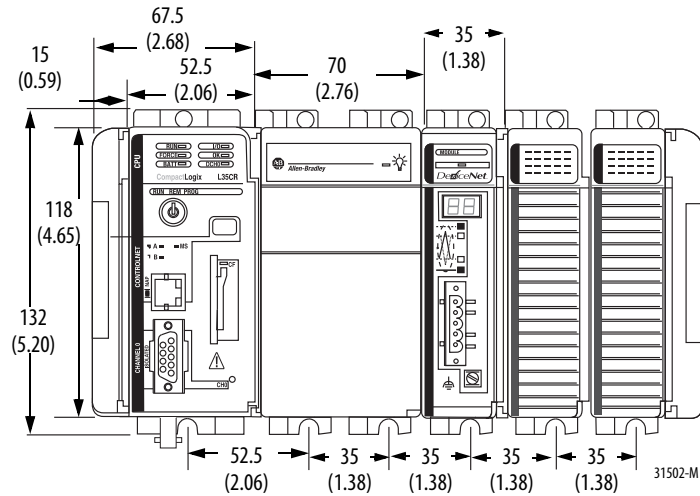
## Minimum Spacing

Maintain spacing from enclosure walls, wireways, and adjacent equipment. Allow 50 mm (2 in.) of space on all sides, as shown. This provides ventilation and electrical isolation.



## Dimensions

The figure shows dimensions in mm (in.). Hole spacing tolerance is  $\pm 4$  mm (0.016 in.).



### IMPORTANT

Compact I/O expansion cables have the same dimensions as the end caps. Expansion cables can be used on either the right or left end.

A 1769-ECR right end cap or 1769-ECL left end cap terminates the end of the communication bus.

## Ground the Wiring



**ATTENTION:** This product is grounded through the DIN rail to chassis ground. Use zinc-plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (such as aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the controller's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.

Refer to Allen-Bradley Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#), for additional information.



## Mount the Panel

Mount the controller to a panel by using two screws per module. Use M4 or #8 panhead screws. Mounting screws are required on every module. This procedure lets you use the assembled modules as a template for drilling holes in the panel.

---

**IMPORTANT** Due to module-mounting hole tolerance, it is important to follow these procedures.

---

1. On a clean work surface, assemble no more than three modules.
2. Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the assembled modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the recommended M4 or #8 screw.
5. Place the modules back on the panel and check for proper hole alignment.

**TIP** The grounding plate, that is, where you install the mounting screws, enables the module to be grounded when it is panel-mounted.

6. Attach the modules to the panel by using the mounting screws.

**TIP** If you are mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time when you are drilling and tapping the next group of modules.

7. Repeat steps 1...6 for any remaining modules.

## Mount the Controller on the DIN Rail

The controller can be mounted on the following DIN rails:

- EN 50 022 - 35 x 7.5 mm (1.38 x 0.30 in.)
- EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.)



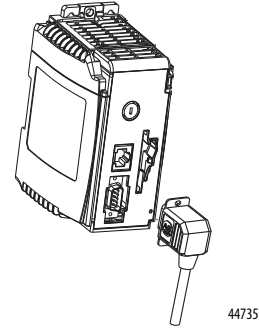
**ATTENTION:** This product is grounded through the DIN rail to chassis ground. Use zinc-plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

1. Before mounting the controller on a DIN rail, close the DIN rail latches.
2. Press the DIN-rail mounting area of the controller against the DIN rail.

The latches will momentarily open and lock into place.

## Make RS-232 Connections to the Controller

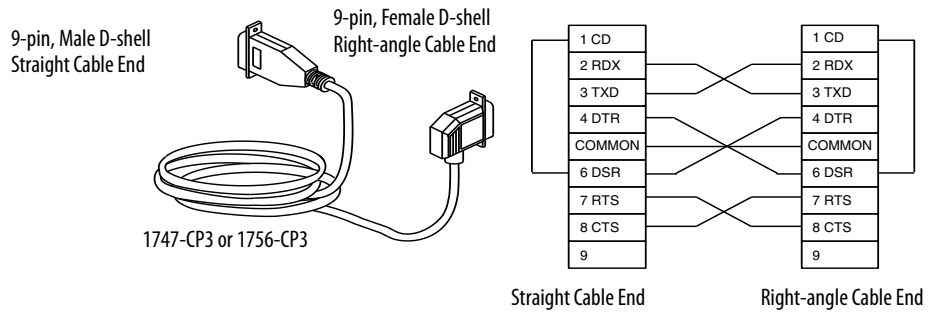
Connect the 9-pin female end of the serial cable to the serial port of the controller.



**WARNING:** If you connect or disconnect the serial cable with power applied to this module or the serial device on the other end of the cable, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

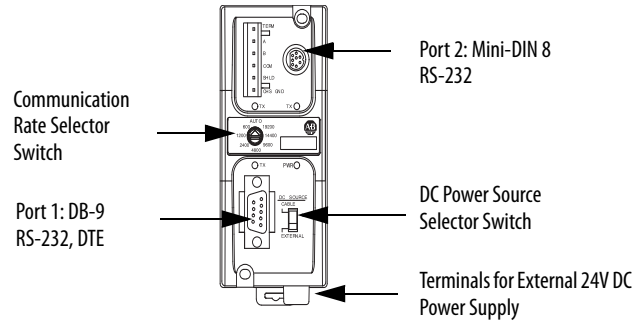
### RS-232 Cable



**TIP** This cable must be shielded and tied to the connector housing.

### Optical Isolator (1769-L31 only)

Channel 0 is fully isolated and does not need a separate isolation device. Channel 1 is nonisolated. If you connect channel 1 to a device outside of the system's enclosure, consider installing an isolator (such as the 1761-NET-AIC interface converter) between the controller and device..



Select the appropriate cable.

Isolator Use	Cable
No	The 1756-CP3 cable attaches the controller directly to the controller. If you make your own cable, it must be shielded and the shields must be tied to the metal shell surrounding the pins on the ends of the cable. You can also use a 1747-CP3 cable. This cable has a taller right-angle connector housing than the 1756-CP3 cable.
Yes	The 1761-CBL-AP00 cable (right-angle connector to controller) or the 1761-CBL-PM02 cable (straight connector to the controller) attaches the controller to port 2 on the 1761-NET-AIC isolator. The mini-DIN connector is not commercially available, so you cannot make this cable.

Pin	DB-9 End	Mini-DIN End
1	DCD	DCD
2	RxD	RxD
3	TxD	TxD
4	DTR	DTR
5	Ground	Ground
6	DSR	DSR
7	RTS	RTS
8	CTS	CTS
9	N/A	N/A

DB-9 Right-angle or Straight Cable End

8-pin, Mini-DIN Cable End

### Default Serial Configuration

Channel 0 (serial port) has the following default communication configuration.

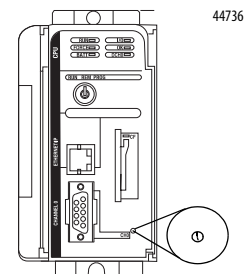
Parameter	Default
Protocol	DF1 full-duplex
Communication Rate	19.2 Kbps
Parity	None
Station Address	0
Control Lines	No Handshaking

Parameter	Default
Error Detection	BCC
Embedded Responses	Auto Detect
Duplicate Packet (Message) Detect	Enabled
ACK Timeout	50 (x 20 ms)
NAK Receive Limit	3 Retries
ENQ Transmit Limit	3 Retries
Data Bits	8
Stop Bits	1

**TIP** Only Channel 0 has a default communication push button.

### Use the Channel 0 Default Communication Push Button

The Channel 0 default communication push button is on the front of the controller in the lower right corner as shown in the illustration.



Use the Channel 0 default communication push button to change from the user-defined communication configuration to the default communication mode. The Channel 0 default communication (DCH0) status indicator turns on (green, steady) to indicate that the default communication configuration is active.

**TIP** The default communication push button is recessed. Before pressing the default communication push button, be sure to note the present communication configuration for Channel 0. Pushing the default communication push button resets all configured parameters to their default settings. To return the channel to its user-configured parameters, you must enter them manually while online with the controller or download them as part of an RSLogix 5000 software project file. To do this online with RSLogix 5000 software, access the Controller Properties dialog box and enter parameters on the Serial Port, System Protocol, and User Protocol tabs.

## Make Ethernet Connections to the Controller

The 1769-L32E and 1769-L35E controller are shipped with the BOOTP utility enabled. You must assign an IP address to the Ethernet port for the controller to communicate over an EtherNet/IP network.



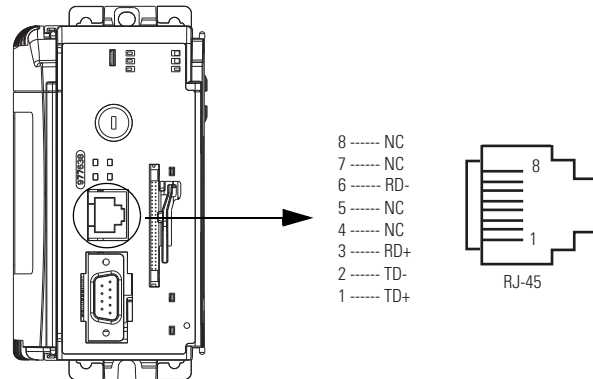
**WARNING:** If you connect or disconnect the communication cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding

Connect the RJ-45 connector of the Ethernet cable to the Ethernet port (top port) on the controller.



**ATTENTION:** Do not plug a DH-485 network cable or a NAP cable into the Ethernet port. Undesirable behavior or damage to the port may result.



## Assign an IP Address

You can set the IP address by using any of these utilities:

- Rockwell BOOTP Utility (available with RSLinx® and RSLogix 5000 software)
- RSLinx software
- RSLogix 5000 software

### *Use BOOTP to Set the IP Address*

The BOOTP utility is a standalone program in one of the following directories:

- RSLinx Tools directory in the Rockwell Software program folder on the Start menu

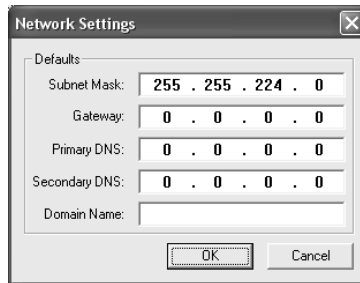
The utility is automatically installed when you install RSLinx software.

- Utils directory on the RSLogix 5000 software installation CD

Follow this procedure to use the BOOTP utility.

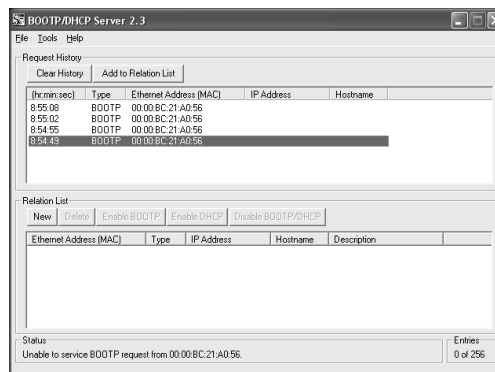
1. Start the BOOTP software.
2. Select Tools>Network Settings.
3. Enter the Ethernet mask and gateway.

4. Click OK.



In the BOOTP Request History dialog box, you see the hardware addresses of devices issuing BOOTP requests.

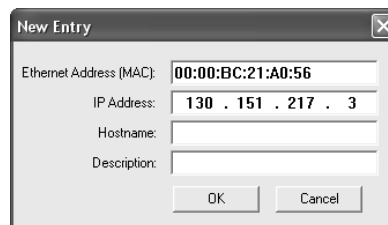
5. Double-click the hardware address of the device you want to configure.



**TIP** The hardware address is on the sticker on the left-side circuit board of the controller next to the battery.  
The hardware address will be in this format: 00-0b-db-14-55-35.

The New Entry dialog box displays the device’s Ethernet Address (MAC).

6. Enter the IP address.
7. Click OK.



8. To permanently assign this configuration to the device, highlight the device and click Disable BOOTP/DHCP.

When you cycle power, the device uses the configuration you assigned and does not issue a BOOTP request.

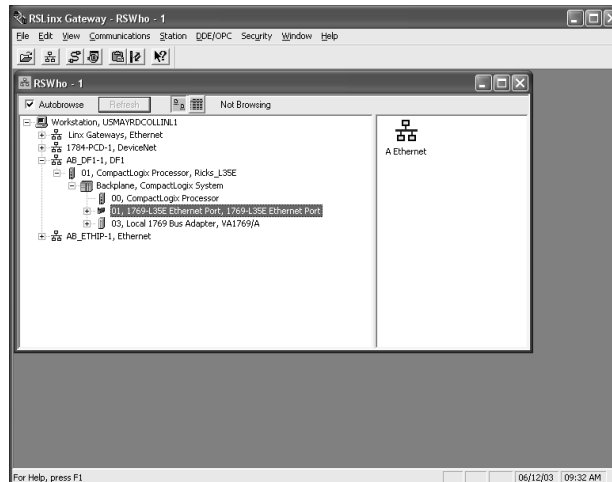
### Use RSLinx Software to Set the IP Address

You can use RSLinx software, version 2.41 or later, to set the IP address.

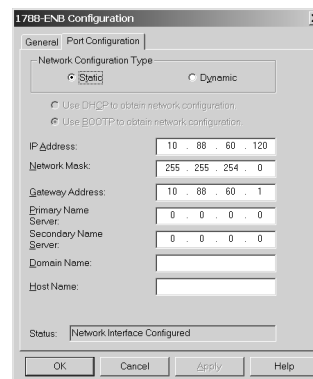
1. Make sure the controller that uses the IP address is installed and running.
2. Connect to the controller via the serial connection (see [page 26](#)).
3. Start RSLinx software.

The RSWho dialog box opens.

4. Navigate to the Ethernet network via the serial network.



5. Right-click the Ethernet port (not the controller) and select Module Configuration.
6. Select the Port Configuration tab.
7. Click the appropriate radio button to choose the Network Configuration type.

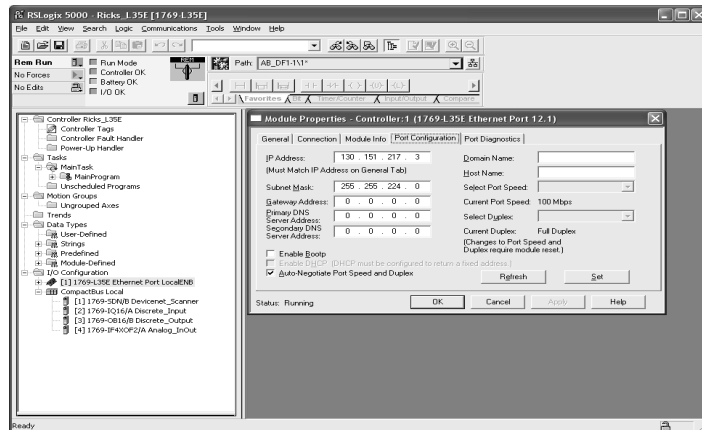


8. Enter the IP address, network (subnet) mask, and gateway address (if needed).

### Use RSLogix 5000 Software to Set the IP Address

You can use RSLogix software to set the IP address.

1. Make sure the controller that uses the IP address is installed and running.
2. Connect to the controller via the serial connection (see [page 26](#)).
3. Start RSLogix 5000 software.
4. In the Controller Organizer, select properties for the Ethernet port.



5. Choose the Port Configuration tab.
6. Specify the IP address.
7. Click Apply.
8. Click OK.

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

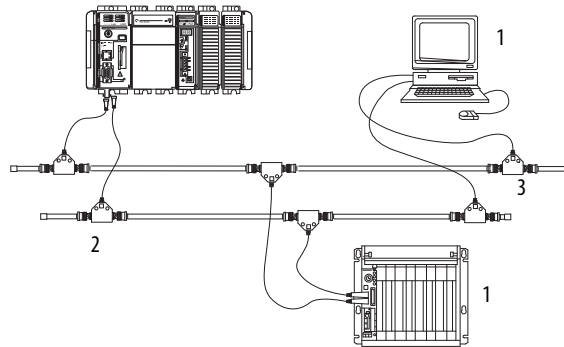
## Make ControlNet Connections to the Controller

The CompactLogix 1769-L32C and 1769-L35CR controllers connect to the ControlNet network. The CompactLogix 1769-L32C controller supports channel A connections only. The CompactLogix 1769-L35CR controller supports channels A and B (redundant media) connections.

For permanent connections to the network, you connect the module to the ControlNet network by using a ControlNet tap (for example, 1786-TPR, 1786-TPS, 1786-TPYR, 1786-TPYS).



The figure shows an example ControlNet network using redundant media.



Item	Description
1	ControlNet node
2	Redundant media available on 1769-L35CR only
3	ControlNet link

When connecting the CompactLogix controller to a ControlNet network, also refer to the following documentation:

- ControlNet Coax Tap Installation Instructions, publication [1786-IN007](#)
- ControlNet Coax Media Planning and Installation Guide, publication [CNET-IN002](#)
- ControlNet Fiber Media Planning and Installation Guide, publication [CNET-IN001](#)

---

**IMPORTANT** For network connections we recommend taps with a straight connector (catalog number 1786-TPS or 1786-TPYS) because of the location of the BNC connectors on the bottom of the module.

---

## Connect the Controller to the Network via a ControlNet Tap

Typically, ControlNet taps are used to make permanent connections from the CompactLogix controller to the network. Perform the following steps to connect the module to the network by using a ControlNet tap.

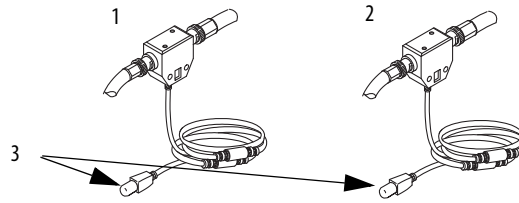


**ATTENTION:** Do not allow any metal portions of the tap to contact any conductive material.

If you disconnect the tap from the module, place the dust cap back on the straight or right angle connector to prevent the connector from accidentally contacting a metallic grounded surface.

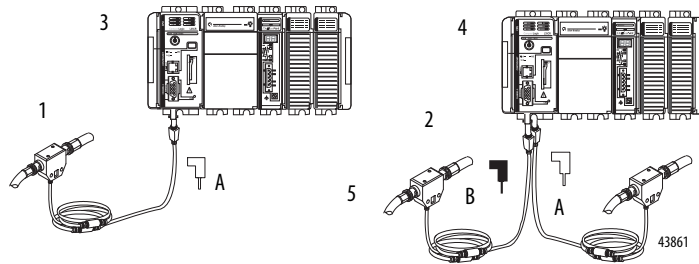
---

1. Remove and save the dust caps from the ControlNet taps.



Item	Description
1	Segment 1
2	Segment 2
3	Dust caps

2. Connect the tap's straight or right-angle connector to the module's BNC connector as shown in the figure.



Item	Description
1	Segment 1
2	Segment 2
3	Tap connected to a CompactLogix controller not using redundant media
4	Tap connected to a CompactLogix controller using redundant media (1769-L35CR unit only)
5	Tap

**IMPORTANT** To prevent inadvertent reversal of the tap connections (resulting in incorrect status displays requiring troubleshooting), check the tap drop cable for the label indicating the attached segment before making your connection.

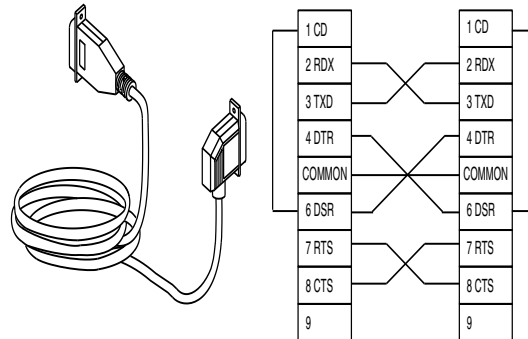


**WARNING:** If you connect or disconnect the communication cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding

## Connect a Programming Terminal to the Network via a 1786-CP Cable

You can use the CompactLogix controller's network access port (NAP) to connect a programming terminal to the ControlNet network. The figure shows the 1786-CP cable connections.



**WARNING:** The NAP port is intended for temporary local-programming purposes only and not intended for permanent connection. If you connect or disconnect the NAP cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

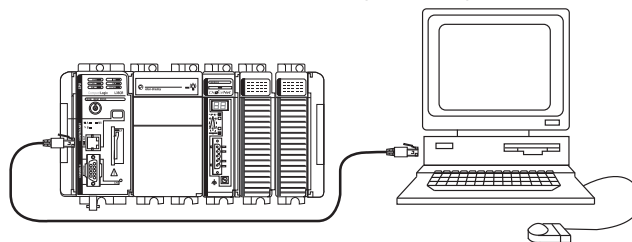
Be sure that power is removed or the area is nonhazardous before proceeding



**ATTENTION:** Use the 1786-CP cable when you connect a programming terminal to the network through the NAP.

Using another cable could result in possible network failures or product damage.

Connect one end of the 1786-CP cable to the CompactLogix controller and the other end to the NAP of the programming terminal.



**ATTENTION:** Do not plug a DH-485 network cable or an RJ45 connector for the EtherNet/IP network to the NAP. Undesirable behavior and/or damage to the port may result.

## Install the Appropriate EDS Files

If you have RSLinx software, version 2.42 or later, the most current EDS files were installed with the software. If you are using an earlier version of RSLinx software, you might need to install EDS files.

You need EDS files for these devices:

- 1769 CompactLogix controllers
- 1769 CompactBus
- 1769 local adapter

All of these EDS files, except for the 1769 CompactBus file, are updated for each firmware revision. There is also a version 1 of the controller EDS file that you need for new controllers. Each controller is shipped with revision 1 firmware. To update the firmware, you must have the revision 1 EDS file (0001000E00410100.eds) installed for the controller.

The EDS files are available on the RSLogix 5000 Enterprise Series software CD. The files are also available at <http://www.ab.com/networks/eds>.

## Load the Controller Firmware

You must download the current firmware before you can use the controller.

To load firmware, you can use any of the following:

- ControlFLASH utility that is shipped with RSLogix 5000 programming software
- AutoFlash that launches through RSLogix 5000 software when you download a project and the controller does not have the matching firmware revision
- CompactFlash card (catalog number 1784-CF128) with valid memory already loaded

If you use the ControlFLASH or AutoFlash utilities, you need a network connection to the controller.

The firmware is available with RSLogix 5000 software or you can download it from the support website. Go to <http://www.rockwellautomation.com/support/>.

Follow these steps to download firmware from the support website.

1. On the Rockwell Automation Support Page, click Software Updates, Firmware and Other Downloads under the Other Tools heading.
2. Click Firmware Updates.
3. Select the appropriate firmware update.
4. Select the firmware revision.
5. Click a revision file to unzip the data.

## Use the ControlFLASH Utility to Load Firmware

You can use the ControlFLASH utility to load firmware through a serial connection.

1. Make sure the appropriate network connection is made before starting.
2. Start the ControlFLASH utility.
3. When the Welcome dialog box appears, click Next.
4. Choose the catalog number of the controller and click Next.
5. Expand the network until you see the controller.
6. If the required network is not shown, first configure a driver for the network in RSLinx software.
7. Choose the controller and click OK.
8. Choose the revision level to which you want to update the controller and click Next.
9. To start the update of the controller, click Finish and then click Yes.
10. After the controller is updated, the status dialog box displays Update complete.
11. Click OK.
12. To close the ControlFLASH utility, click Cancel and then click Yes.

## Use AutoFlash to Load Firmware

You can use AutoFlash to load firmware through a network connection.

---

**IMPORTANT** When upgrading your controller firmware, it is extremely important to allow the upgrade to complete without interruption.

If you interrupt the firmware upgrade either in the software or by disturbing the physical media, you may render the controller inoperable.

For more information about upgrading your CompactLogix controller firmware, see information posted at <http://www.rockwellautomation.com/knowledgebase/>.

---

1. Make sure the appropriate network connection is made and your network driver is configured in RSLinx software.
2. Use RSLogix 5000 programming software to create a controller project.
3. Click RSWho to specify the controller path.

4. Select your controller and click Download.

You may also choose to click Update Firmware to complete this process. If you do so, skip to step 8.

A dialog box displays indicating that the project revision and controller firmware revision are different.

5. Click Update Firmware.
6. Use the checkbox and pull-down menu to select your controller and firmware revision.
7. Click Update.
8. Click Yes.

The firmware upgrade begins.

---

**IMPORTANT DO NOT INTERRUPT THE FIRMWARE UPGRADE ONCE IT HAS BEGUN.**

Interrupting the firmware upgrade may result in an inoperable controller.

---

When the firmware upgrade is complete, the Download dialog box appears and you may continue by downloading your project to the controller.

## Use a CompactFlash Card to Load Firmware

If you have an existing controller that is already configured and has firmware loaded, you can store the current controller user program and firmware on the CompactFlash card and use that card to update other controllers.

1. Use RSLogix 5000 software to store the controller user program and firmware of a currently configured controller to the CompactFlash card.
2. Access the Nonvolatile Memory tab of the Controller Properties dialog box.

Be sure to select Load Image On Powerup when you save to the card.

3. Remove the card and insert it into a controller that will use the same firmware and controller user program.

When you apply power to the second controller, the image stored on the CompactFlash card is loaded into the controller.

## Select the Controller's Operating Mode

Use the keyswitch on the front panel of the controller to determine the controller's operating mode.

Keyswitch Position	Description	
Run	<ul style="list-style-type: none"> <li>• Upload projects.</li> <li>• Run the program and enable outputs.</li> <li>• You cannot create or delete tasks, programs, or routines. You cannot create or delete tags or edit online while the keyswitch is in the Run position.</li> <li>• You cannot change the mode by using the programming software while the keyswitch is in the Run position.</li> </ul>	
Prog	<ul style="list-style-type: none"> <li>• Disable outputs.</li> <li>• Upload/download projects.</li> <li>• Create, modify, and delete tasks, programs, or routines.</li> <li>• The controller does not execute (scan) tasks while the keyswitch is in the Prog position.</li> <li>• You cannot change the mode through the programming software while the keyswitch is in the Prog position.</li> </ul>	
Rem	<ul style="list-style-type: none"> <li>• Upload/download projects.</li> <li>• Change between Remote Program, Remote Test, and Remote Run modes through the programming software.</li> </ul>	
	Remote Run	<ul style="list-style-type: none"> <li>• The controller executes (scans) tasks.</li> <li>• Enable outputs.</li> <li>• Edit online.</li> </ul>
	Remote Program	<ul style="list-style-type: none"> <li>• Disable outputs.</li> <li>• Create, modify, and delete tasks, programs, or routines.</li> <li>• Download projects.</li> <li>• Edit online.</li> <li>• The controller does not execute (scan) tasks.</li> </ul>
	Remote Test	<ul style="list-style-type: none"> <li>• Execute tasks with outputs disabled.</li> <li>• Edit online.</li> </ul>

**Notes:**



## Connect to the Controller via the Serial Port

This chapter describes how to connect to the controller via the serial port so that you can configure the controller and upload or download a project to the controller.

Topic	Page
Connect to the Controller via the Serial Port	41
Configure the Serial Driver	43
Select the Controller Path	45

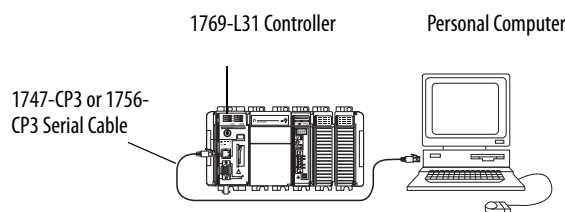
For the CompactLogix controller to operate on a serial network, you need:

- a workstation with a serial port.
- RSLogix software to configure the serial communication driver.
- RSLogix5000 programming software to configure the serial port of the controller.

### Connect to the Controller via the Serial Port

Channel 0 on the CompactLogix controllers is fully isolated and does not need a separate isolation device. Channel 1 on the 1769-L31 is not an isolated serial port.

**Figure 3 - Serial Connection to Controller**

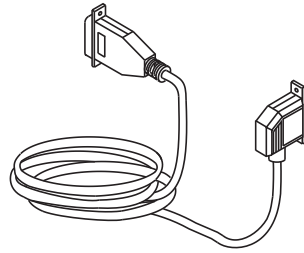


If you connect channel 1 of the 1769-L31 controller to a modem or an ASCII device, consider installing an isolator between the controller and modem or ASCII device. An isolator is also recommended when connecting the controller directly to a programming workstation. One possible isolator is the 1761-NET-AIC interface converter.

For more information on installing an isolator, see [Configure an Isolator on page 57](#).

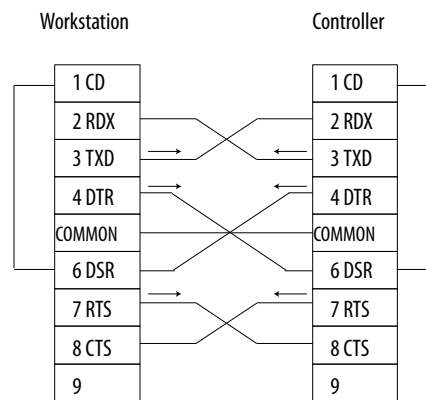
To connect a serial cable, perform this procedure.

1. Obtain a 1747-CP3 or 1756-CP3 serial cable.

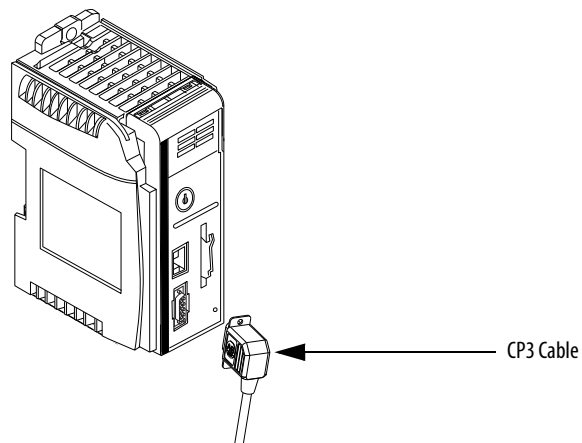


**TIP** If you make your own serial cable, complete this procedure.

- Limit the length to 15.2 m (50 ft).
- Wire the connectors.



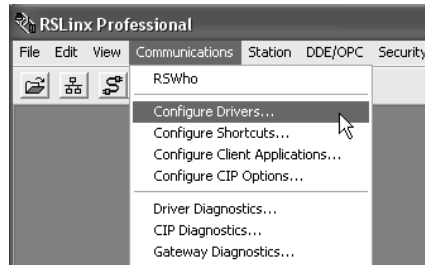
2. Connect the cable to your controller and workstation.



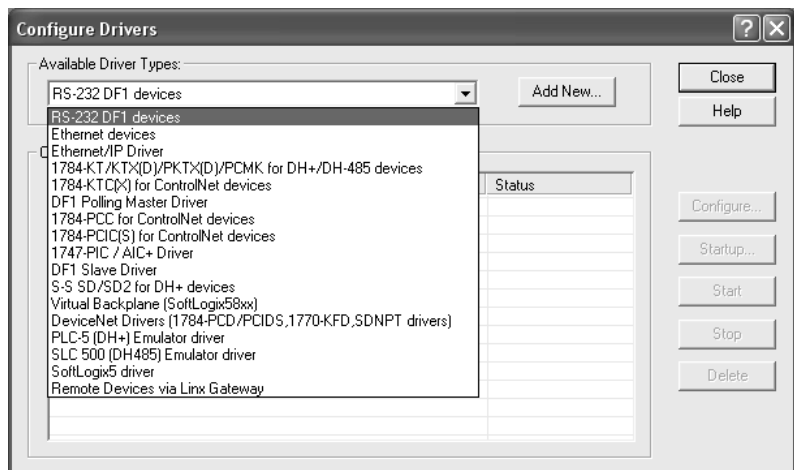
## Configure the Serial Driver

Use RSLinx software to configure the RS-232 DF1 Device driver for serial communication. To configure the driver, perform this procedure.

1. From the communication pull-down menu, choose Configure Drivers.

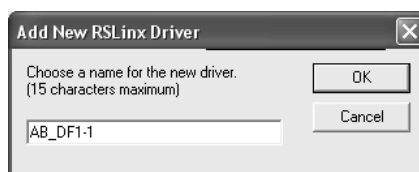


The Configure Drivers dialog box appears.



2. From the Available Driver Types pull-down menu, choose the RS-232 DF1 Device driver.
3. Click Add New to add the driver.

The Add New RSLinx Driver dialog box appears.



4. Specify the driver name and click OK.

The Configure RS-232 DF1 Devices dialog box appears.



5. Specify the serial port settings.
  - a. From the Comm Port pull-down menu, choose the serial port on the workstation to which the cable is connected.
  - b. From the Device pull-down menu, choose Logix 5550-Serial Port.
  - c. Click Auto-Configure.
6. Verify that the Auto-Configuration was successful.

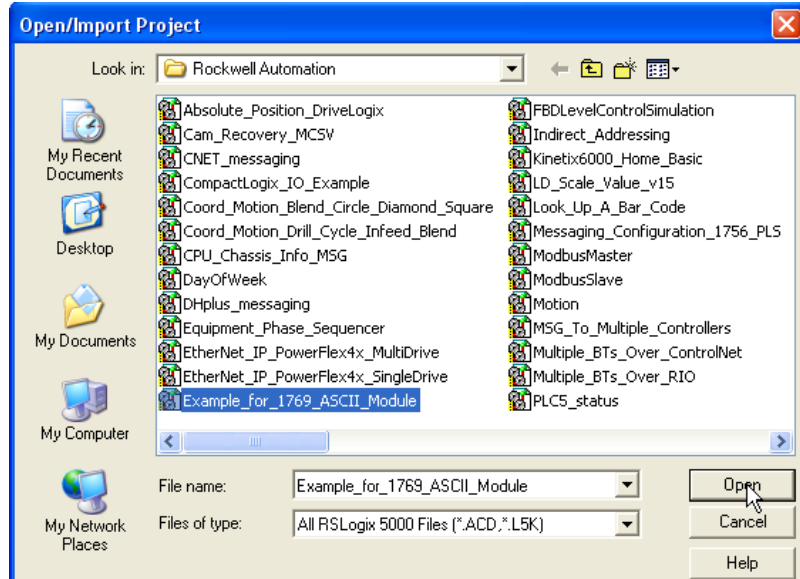
If	Then
Yes	Click OK.
No	Go to step 5 and verify that you selected the correct communication port.

7. Click Close.

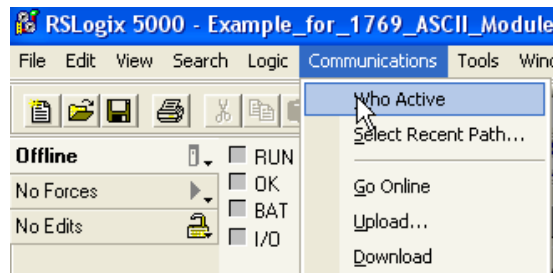
## Select the Controller Path

To select the controller path, perform this procedure.

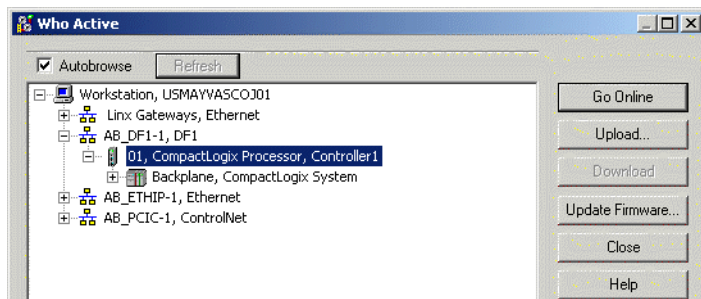
1. In RSLogix 5000 programming software, open a project for the controller.



2. From the Communications pull-down menu, choose Who Active.



The Who Active dialog box appears.



3. Expand the communication driver to the level of the controller.
4. Select the controller.

## Controller Options

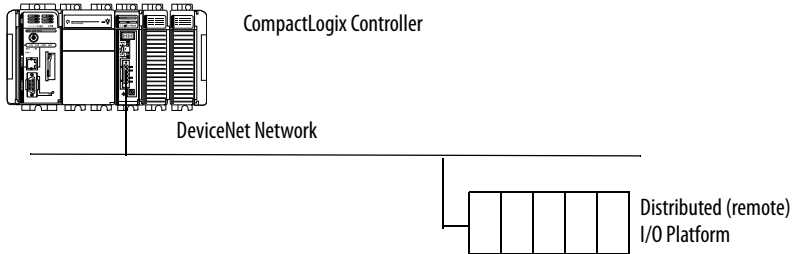
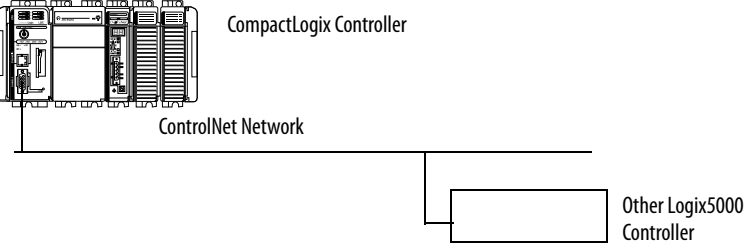
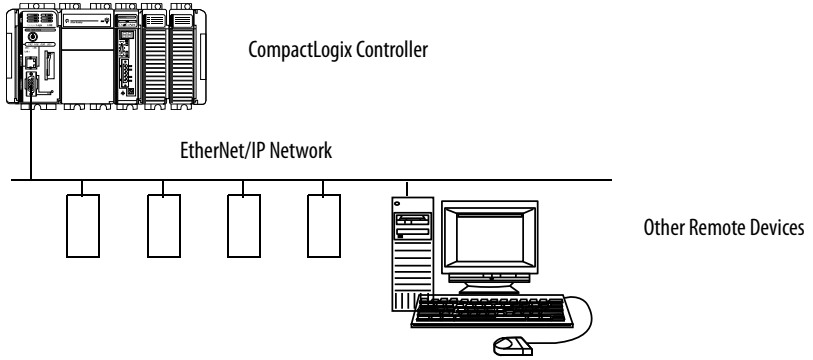
Once you have selected a controller, you have several options.

To	Choose
Monitor the project in the controller	Go Online
Transfer a copy of the project from the controller to RSLogix 5000 software	Upload
Transfer the open project to the controller	Download

## Communicate over Networks

This chapter explains how CompactLogix controllers support additional networks to enable various functions.

**Table 4 - CompactLogix Controller Network Support**

Function	Example
Control distributed (remote) I/O. <ul style="list-style-type: none"> <li>• EtherNet/IP</li> <li>• ControlNet</li> <li>• DeviceNet</li> </ul>	 <p>The diagram shows a CompactLogix Controller on the left. A horizontal line labeled 'DeviceNet Network' extends from the controller to the right. From this line, a vertical line goes down to a box representing the 'Distributed (remote) I/O Platform'.</p>
Produce/consume (interlock) data between controllers. <ul style="list-style-type: none"> <li>• EtherNet/IP</li> <li>• ControlNet</li> </ul>	 <p>The diagram shows a CompactLogix Controller on the left. A horizontal line labeled 'ControlNet Network' extends from the controller to the right. From this line, a vertical line goes down to a box representing an 'Other Logix5000 Controller'.</p>
Send and receive messages to and from other devices. This includes access to the controller via RSLogix 5000 programming software. <ul style="list-style-type: none"> <li>• EtherNet/IP</li> <li>• ControlNet</li> <li>• DeviceNet (to devices only)</li> <li>• serial</li> <li>• DH-485</li> </ul>	 <p>The diagram shows a CompactLogix Controller on the left. A horizontal line labeled 'EtherNet/IP Network' extends from the controller to the right. Below this line, there are four vertical lines connecting to four small rectangular boxes representing 'Other Remote Devices'. To the right of these boxes, there is a computer system consisting of a tower PC, a monitor, a keyboard, and a mouse.</p>

Topic	Page
EtherNet/IP Network Communication	48
ControlNet Network Communication	50
DeviceNet Communication	53
Serial Communication	55
DH-485 Network Communication	72

## EtherNet/IP Network Communication

The EtherNet/IP network offers a full suite of control, configuration and data collection services by layering the Common Industrial Protocol (CIP) over the standard Internet protocols, such as TCP/IP and UDP. This combination of well-accepted standards provides the capability required to both support information data exchange and control applications.

The EtherNet/IP network also uses commercial, off-the-shelf Ethernet components and physical media, providing you with a cost-effective plant-floor solution.

For EtherNet/IP communication, you can use these CompactLogix controllers with a built-in EtherNet/IP communication port:

- 1769-L32E CompactLogix controller
- 1769-L35E CompactLogix controller

You can use several software products with a 1769 CompactLogix controller on an EtherNet/IP network.

**Table 5 - EtherNet/IP Network Software Combinations**

Software	Functions	Requirement
RSLogix 5000 programming software	<ul style="list-style-type: none"> <li>• Configure the CompactLogix project</li> <li>• Define EtherNet/IP communication</li> </ul>	Yes
BOOTP/DHCP utility with RSLogix 5000 programming software	Assign IP addresses to devices on an EtherNet/IP network	No
RSNetWorx software for an EtherNet/IP network	Configure EtherNet/IP devices by IP addresses and/or host names	No

The EtherNet/IP communication modules:

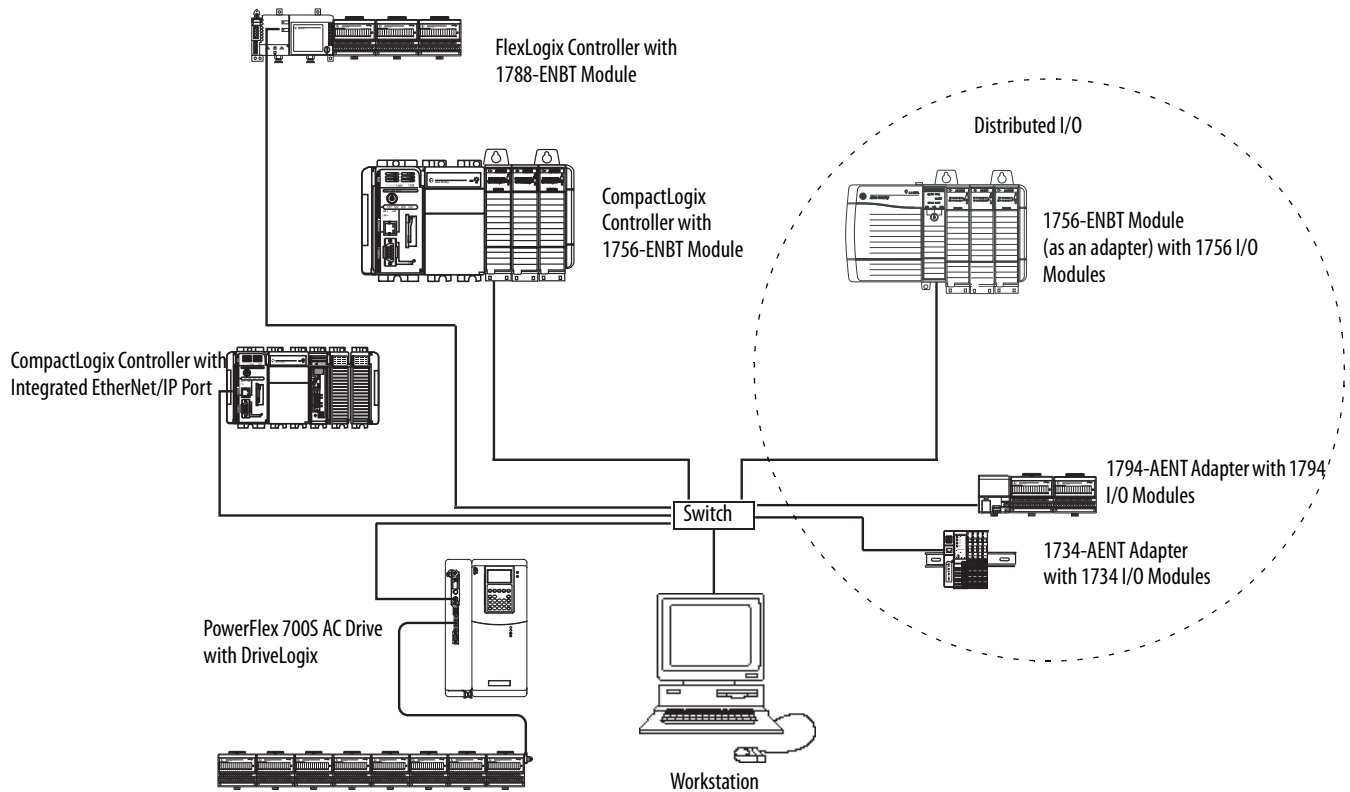
- support messaging, produced/consumed tags, HMI, and distributed I/O.
- encapsulate messages within standard TCP/UDP/IP protocol.
- share a common application layer with ControlNet and DeviceNet.
- interface via RJ45, category 5, unshielded, twisted-pair cable.
- support half/full-duplex 10 Mbps or 100 Mbps operation.
- support standard switches.
- require no network scheduling.
- require no routing tables.

In this example:

- the controllers produce and consume tags amongst themselves.
- the controllers initiate MSG instructions that send and receive data or configure devices.
- the personal computer uploads or downloads projects to the controllers.
- the personal computer configures devices on an EtherNet/IP network.



Figure 4 - CompactLogix EtherNet/IP Overview



## Connections over an EtherNet/IP Network

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. Connections are allocations of resources that provide more reliable communication between devices than unconnected messages.

All EtherNet/IP connections are unscheduled. An unscheduled connection is a message transfer between controllers that is triggered by the requested packet interval (RPI) or the program, such as a MSG instruction. Unscheduled messaging lets you send and receive data when needed.

The 1769-L32E and 1769-L35E controllers support 100 connections. However, the built-in EtherNet/IP port supports only 32 CIP connections over an EtherNet/IP network. With these controllers, the number of end-node connections they effectively support depends on a connection's RPI.

Requested Packet Interval	Max EtherNet/IP Port Communication Connections
2 ms	2
4 ms	5
8 ms	10
16 ms	18
32 ms+	25+

You can use all 32 communication connections on the built-in EtherNet/IP port. However, we recommend that you leave some connections available for tasks such as going online and non-I/O purposes.

## ControlNet Network Communication

ControlNet is a real-time control network that provides high-speed transport of both time-critical I/O and interlocking data and messaging data, including uploading and downloading of programming and configuration data on a single physical-media link. The ControlNet network's highly-efficient data transfer capability significantly enhances I/O performance and peer-to-peer communication in any system or application.

The ControlNet network is highly deterministic and repeatable and remains unaffected as devices are connected or disconnected from the network. This robust quality results in dependable, synchronized, and coordinated real-time performance.

The ControlNet network often functions as:

- the default network for the CompactLogix platform.
- a substitute/replacement for the remote I/O (RIO) network because the ControlNet network adeptly handles large numbers of I/O points.
- a backbone to multiple distributed DeviceNet networks.
- a peer interlocking network.

For ControlNet communication, you can use these CompactLogix controllers with a built-in ControlNet communication port:

- 1769-L32C CompactLogix controller
- 1769-L35CR CompactLogix controller

You can use these software products with a 1769 CompactLogix controller on a ControlNet network.

**Table 6 - ControlNet Network Software Combinations**

Software	Functions	Requirement
RSLogix 5000 programming software	<ul style="list-style-type: none"> <li>• Configure the CompactLogix project</li> <li>• Define EtherNet/IP communication</li> </ul>	Yes
RSNetWorx for ControlNet software	<ul style="list-style-type: none"> <li>• Configure the ControlNet network</li> <li>• Define the NUT (network update time)</li> <li>• Schedule the ControlNet network</li> </ul>	

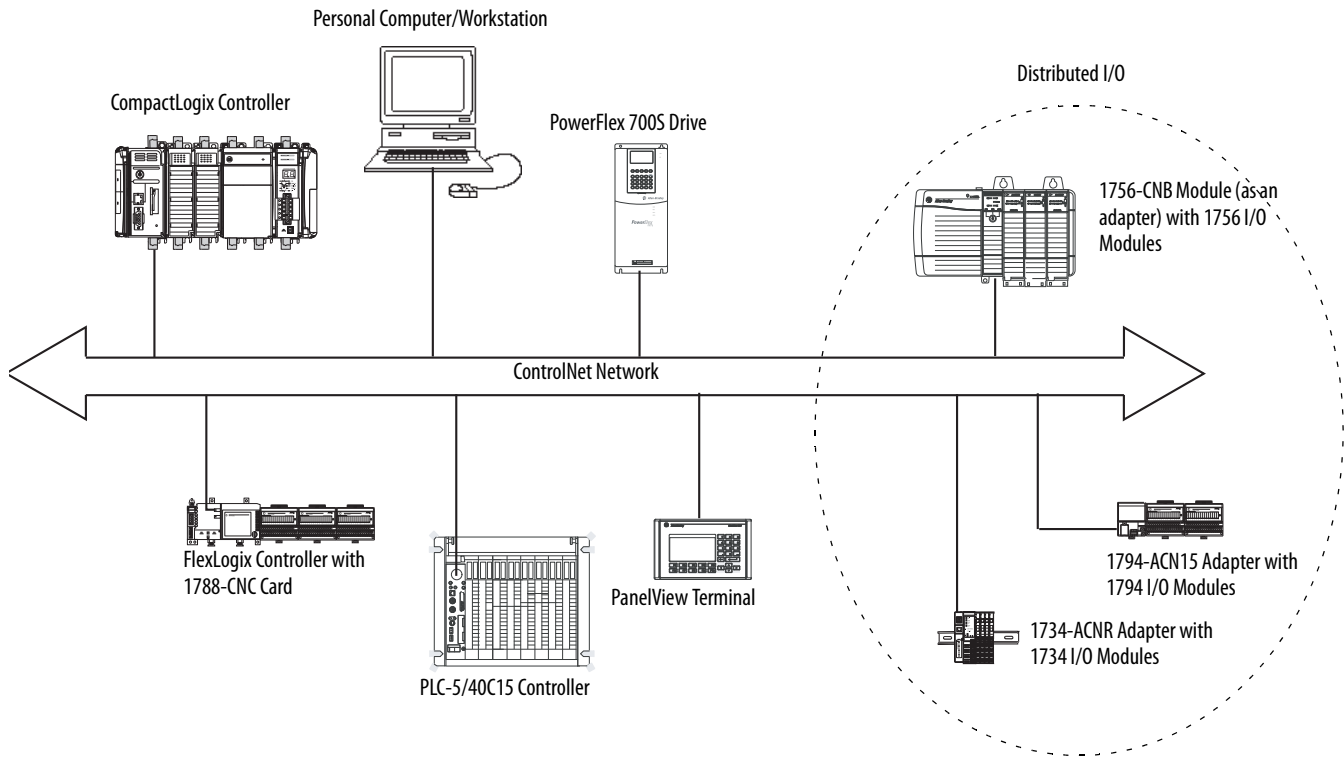
The ControlNet communication modules:

- support messaging, produced/consumed tags and distributed I/O.
- share a common application layer with DeviceNet and EtherNet/IP networks.
- require no routing tables.
- support the use of coax and fiber repeaters for isolation and increased distance.

In this example:

- the controllers produce and consume tags amongst themselves.
- the controllers initiate MSG instructions that send and receive data or configure devices.
- the personal computer uploads or downloads projects to the controllers.
- the personal computer configures devices on ControlNet, and configures the network itself.

**Figure 5 - CompactLogix ControlNet Overview**



## Connections over ControlNet

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. Connections are allocations of resources that provide more reliable communication between devices compared to unconnected messages.

**Table 7 - ControlNet Connection Methods**

Connection Method	Description
Scheduled	<p>A scheduled connection is unique to ControlNet communication. A scheduled connection lets you send and receive data repeatedly at a set interval, which is the requested packet interval (RPI). For example, a connection to an I/O module is a scheduled connection because you repeatedly receive data from the module at a specified interval. Other scheduled connections include connections to:</p> <ul style="list-style-type: none"> <li>• communication devices.</li> <li>• produced/consumed tags.</li> </ul> <p>On a ControlNet network, you must use RSNetWorx for ControlNet to enable all scheduled connections and establish a network update time (NUT). Scheduling a connection reserves network bandwidth to specifically handle the connection.</p>
Unscheduled	<p>An unscheduled connection is a message transfer between nodes that is triggered by ladder logic or the program (such as a MSG instruction). Unscheduled messaging lets you send and receive data when needed. Unscheduled messages use the remainder of network bandwidth after scheduled connections are allocated.</p>

The 1769-L32C and 1769-L35CR controllers support 100 connections. However, the built-in ControlNet port only supports 32 communication connections. With these controllers, the number of end-node connections they effectively support depends on the connection’s NUT and RPI.

NUT	RPI	Supported ControlNet Communication Connections <sup>(1)</sup>
2 ms	2 ms	0...1
3 ms	3 ms	1...2
5 ms	5 ms	3...4
10 ms	10 ms	6...9
14 ms	14 ms	10...12
5 ms	20 ms	12...16
4 ms	64 ms	31

(1) For each NUT/RPI combination, the number of connections supported is listed in a range. The lower number is the number of connections we recommend you make to maintain reasonable ControlNet port CPU utilization rates. The higher number is the maximum number of connections possible for that NUT/RPI combination.

You can use all 32 communication connections on the built-in ControlNet port. However, we recommend that you leave some connections available for tasks such as going online and unscheduled network traffic.

## DeviceNet Communication

The DeviceNet network uses the Common Industrial Protocol (CIP) to provide the control, configuration, and data collection capabilities for industrial devices. The DeviceNet network uses the proven Controller Area Network (CAN) technology, which lowers installation costs and decreases installation time and costly downtime.

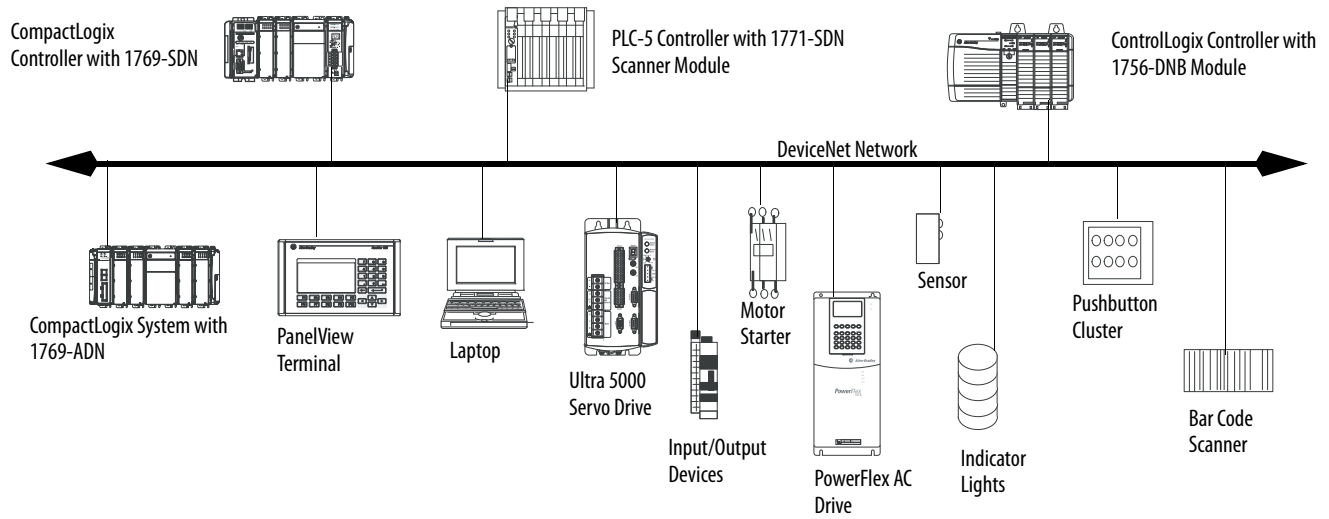
A DeviceNet network provides access to the intelligence present in your devices by letting you connect devices directly to plant-floor controllers without having to hard wire each device into an I/O module.

**Table 8 - CompactLogix DeviceNet Communication Interfaces**

If your application	Select
<ul style="list-style-type: none"> <li>Communicates with other DeviceNet devices</li> <li>Uses the controller as a master or slave on DeviceNet</li> <li>Uses a controller ControlNet, Ethernet or serial port for other communication</li> </ul>	1769-SDN DeviceNet scanner module
<ul style="list-style-type: none"> <li>Accesses remote Compact I/O over a DeviceNet network</li> <li>Sends remote I/O data for as many as 30 modules back to scanner or controller</li> </ul>	1769-ADN DeviceNet adapter module <sup>(1)</sup>

(1) This table specifically describes using the 1769-ADN module to access remote Compact I/O over DeviceNet. However, CompactLogix controllers can access other Allen-Bradley remote I/O over DeviceNet. In those cases, you must select the appropriate interface. For example, if accessing remote POINT I/O modules, you must select the 1734-ADN.

**Figure 6 - CompactLogix DeviceNet Overview**



You can use these software products with a 1769 CompactLogix controller on a DeviceNet network.

**Table 9 - CompactLogix DeviceNet Software Combinations**

Software	Functions	Requirement
RSLogix 5000 programming software	<ul style="list-style-type: none"> <li>Configure the CompactLogix project</li> <li>Define EtherNet/IP communication</li> </ul>	Yes
RSNetWorx software for DeviceNet	<ul style="list-style-type: none"> <li>Configure DeviceNet devices</li> <li>Define the scan list for DeviceNet devices</li> </ul>	

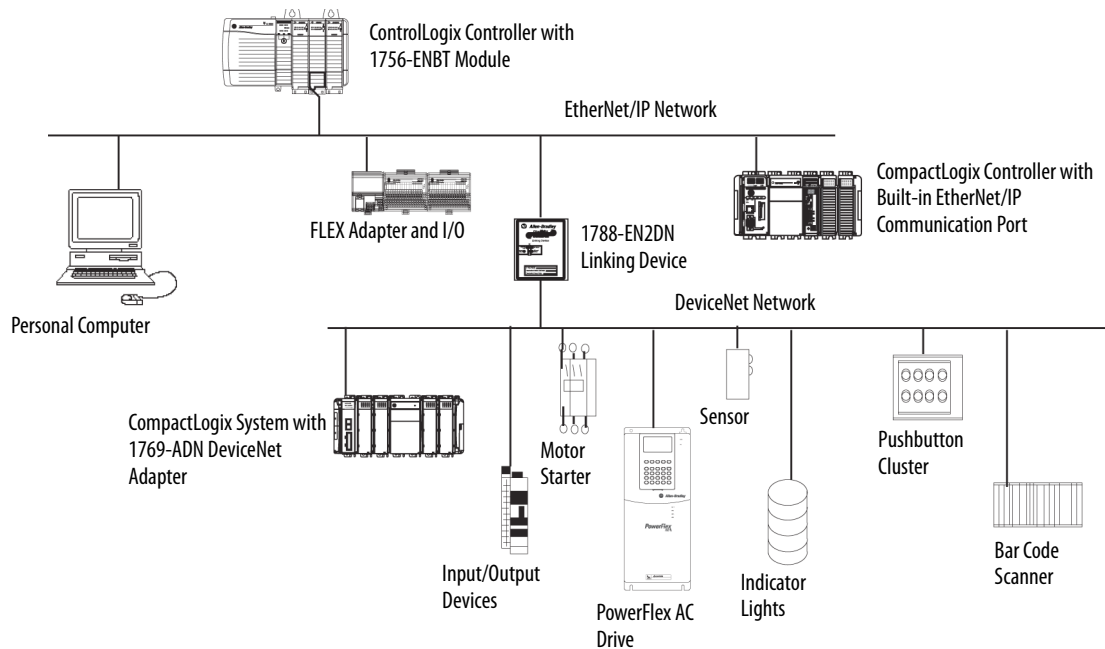
The DeviceNet communication module:

- supports messaging to devices, not controller to controller.
- shares a common application layer with ControlNet and EtherNet/IP.
- offers diagnostics for improved data collection and fault detection.
- requires less wiring than traditional, hardwired systems.

You can use a linking device as a:

- gateway to connect information.
- control-level network to device-level network for programming, configuration, control or data collection.
- router/bridge to connect the EtherNet/IP or ControlNet network to the DeviceNet network.

**Figure 7 - CompactLogix Linking Device Overview**



## Serial Communication

CompactLogix controllers have a built-in RS-232 port.

- 1769-L32C, -L32E, -L35CR, and -L35E CompactLogix controllers have one built-in RS-232 port. By default, that port is channel 0 on these controllers.
- The 1769-L31 CompactLogix controller has two RS-232 ports. One port only allows DF1 protocol only. The second port accepts DF1 and ASCII protocol.

---

**IMPORTANT** Limit the length of serial (RS-232) cables to 15.2 m (50 ft).

---

You can configure the serial port of the controller for several modes.

**Table 10 - CompactLogix Serial Port Configurations**

Mode	Modes
DF1 Point-to-Point	<p>Communicate between the controller and one other DF1-protocol-compatible device. This is the default system mode. Default parameters are:</p> <ul style="list-style-type: none"> <li>• Baud Rate: 19,200</li> <li>• Data Bits: 8</li> <li>• Parity: None</li> <li>• Stop Bits: 1</li> <li>• Control Line: No Handshake</li> <li>• RTS send Delay: 0</li> <li>• RTS Off Delay: 0</li> </ul> <p>This mode is typically used to program the controller through its serial port.</p>
DF1 Master	<p>Control polling and message transmission between the master and slave nodes.</p> <ul style="list-style-type: none"> <li>• The master/slave network includes one controller configured as the master node and as many as 254 slave nodes. Link slave nodes using modems or line drivers.</li> <li>• A master/slave network can have node numbers from 0...254. Each node must have a unique node address. Also, at least 2 nodes must exist to define your link as a network (1 master and 1 slave station are the two nodes).</li> </ul>
DF1 Slave	<p>Use a controller as a slave station in a master/slave serial communication network.</p> <ul style="list-style-type: none"> <li>• When there are multiple slave stations on the network, link slave stations using modems or line drivers to the master. When you have a single slave station on the network, you do not need a modem to connect the slave station to the master. You can configure the control parameters for no handshaking. You can connect 2...255 nodes to a single link. In DF1 slave mode, a controller uses DF1 half-duplex protocol.</li> <li>• One node is designated as the master and it controls who has access to the link. All the other nodes are slave stations and must wait for permission from the master before transmitting.</li> </ul>
DF1 Radio Modem	<ul style="list-style-type: none"> <li>• Compatible with SLC500 and MicroLogix1500 controllers.</li> <li>• This mode supports master and slave, and store and forward modes.</li> </ul>
User (channel 0 only)	<p>Communicate with ASCII devices. This requires your program to use ASCII instructions to transmit data to and from ASCII device.</p>
DH-485	<ul style="list-style-type: none"> <li>• Communicate with other DH-485 devices.</li> <li>• This multi-master, token-passing network allows programming and peer-to-peer messaging.</li> </ul>



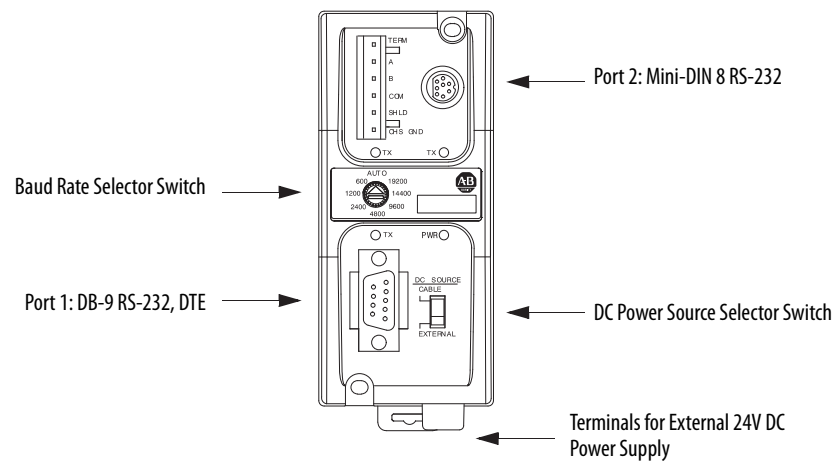
## Configure an Isolator

Channel 0 on the CompactLogix controllers is fully isolated and does not need a separate isolation device. Channel 1 on the 1769-L31 controller is not an isolated serial port. To configure an isolator, perform this procedure.

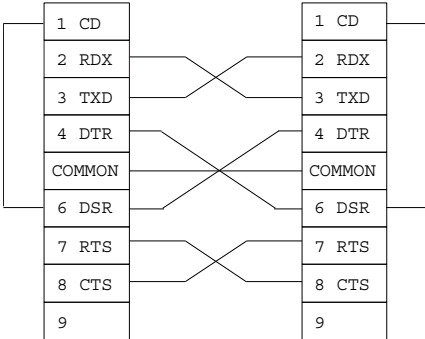
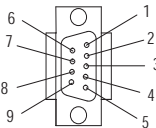
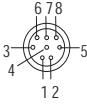
1. Determine whether you need an isolator.

If you connect channel 1 of the 1769-L31 controller to a modem or an ASCII device, consider installing an isolator between the controller and modem or ASCII device. An isolator is also recommended when connecting the controller directly to a programming workstation.

One possible isolator is the 1761-NET-AIC interface converter.



2. Select the appropriate cable.

Are you using an isolator?	Then use this cable																														
No	<p>The 1756-CP3 cable attaches the controller directly to the controller.</p>  <p>If you make your own cable, it must be shielded, and the shields must be tied to the metal shell (that surrounds the pins) on both ends of the cable.</p> <p>You can also use a 1747-CP3 cable from the SLC product family. This cable has a taller right-angle connector housing than that of the 1756-CP3 cable.</p>																														
Yes	<p>The 1761-CBL-AP00 cable (right-angle connector to controller) or the 1761-CBL-PM02 cable (straight connector to the controller) attaches the controller to port 2 on the 1761-NET-AIC isolator. The mini-DIN connector is not commercially available, so you cannot make this cable.</p>   <p>DB-9 Right-angle or Straight Cable End      8-pin, Mini-DIN Cable End</p> <table border="1" data-bbox="597 1033 1079 1381"> <thead> <tr> <th>Pin</th> <th>DB-9 End</th> <th>Mini-DIN End</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>DCD</td> <td>DCD</td> </tr> <tr> <td>2</td> <td>RxD</td> <td>RxD</td> </tr> <tr> <td>3</td> <td>TxD</td> <td>TxD</td> </tr> <tr> <td>4</td> <td>DTR</td> <td>DTR</td> </tr> <tr> <td>5</td> <td>Ground</td> <td>Ground</td> </tr> <tr> <td>6</td> <td>DSR</td> <td>DSR</td> </tr> <tr> <td>7</td> <td>RTS</td> <td>RTS</td> </tr> <tr> <td>8</td> <td>CTS</td> <td>CTS</td> </tr> <tr> <td>9</td> <td>NA</td> <td>NA</td> </tr> </tbody> </table>	Pin	DB-9 End	Mini-DIN End	1	DCD	DCD	2	RxD	RxD	3	TxD	TxD	4	DTR	DTR	5	Ground	Ground	6	DSR	DSR	7	RTS	RTS	8	CTS	CTS	9	NA	NA
Pin	DB-9 End	Mini-DIN End																													
1	DCD	DCD																													
2	RxD	RxD																													
3	TxD	TxD																													
4	DTR	DTR																													
5	Ground	Ground																													
6	DSR	DSR																													
7	RTS	RTS																													
8	CTS	CTS																													
9	NA	NA																													

3. Connect the appropriate cable to the serial port.

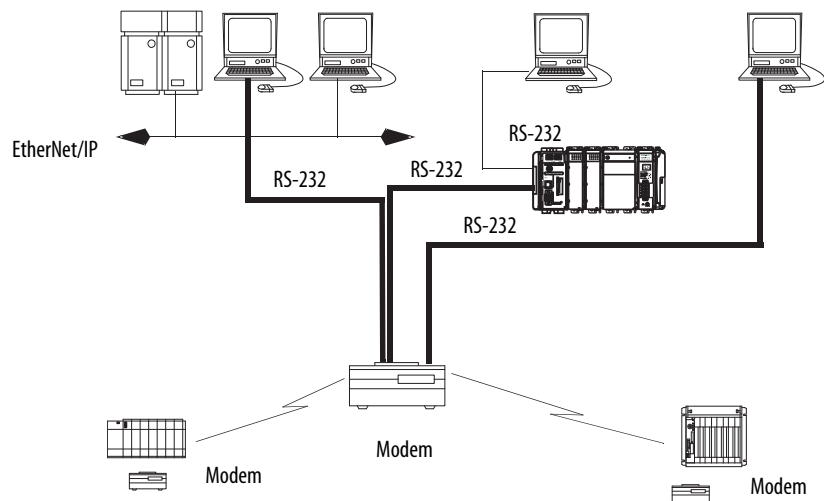
## Communicate with DF1 Devices

You can configure the controller as a master or slave on a serial communication network. Use serial communication when:

- the system contains three or more stations.
- communication occur regularly and require leased-line, radio, or power-line modem.

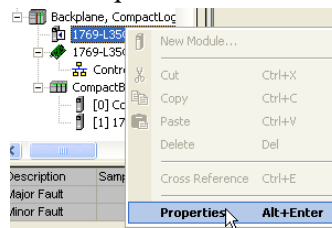


**ATTENTION:** Only the 1769-L31 controller has more than one RS-232 port. All other 1769 controllers are limited to one RS-232 port.

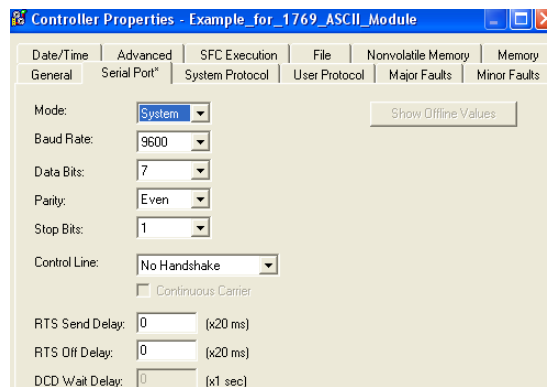


To configure the controller for DF1 communication, perform this procedure.

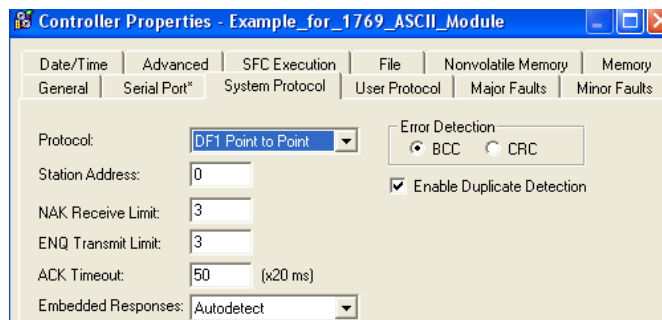
1. In RSLogix 5000 programming software, right-click your controller and select Properties.



The Controller Properties dialog box appears.



2. Click the Serial Port tab.
3. From the Mode pull-down menu, choose System.
4. Specify communication settings.
5. Click the System Protocol tab.



6. From the Protocol pull-down menu, choose a DF1 protocol.
7. Specify DF1 settings.

## DF1 Radio Modem Support

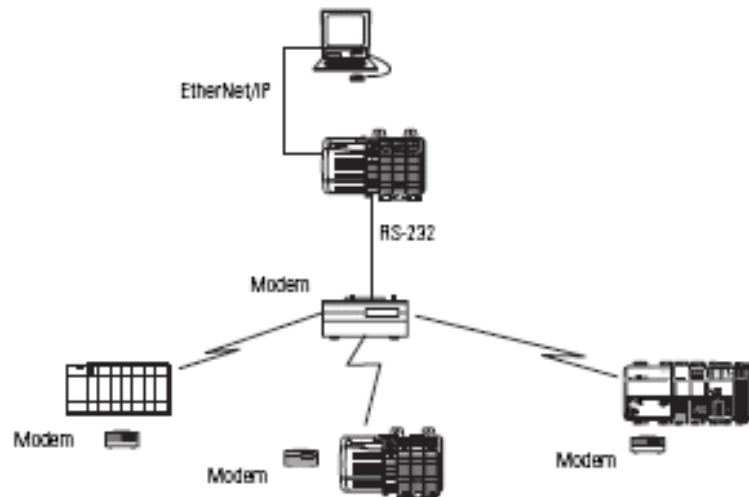
Your ControlLogix controller includes a driver that lets it to communicate over the DF1 Radio Modem protocol. This driver implements a protocol, optimized for use with radio modem networks, that is a hybrid between DF1 full-duplex protocol and DF1 half-duplex protocol, and therefore is not compatible with either of these protocols.

---

**IMPORTANT** The DF1 radio modem driver should be used only among devices that support and are configured for the DF1 radio modem protocol.

Additionally, there are some radio modem network configurations that will not work with the DF1 radio modem driver. In these configurations, continue to use DF1 half-duplex protocol.

---



Like DF1 full-duplex protocol, DF1 radio modem lets any node to connect to any other node at any time (if the radio modem network supports full-duplex data port buffering and radio transmission collision avoidance). Like DF1 half-duplex protocol, a node ignores any packets received that have a destination address other than its own, with the exception of broadcast packets and pass-through packets.

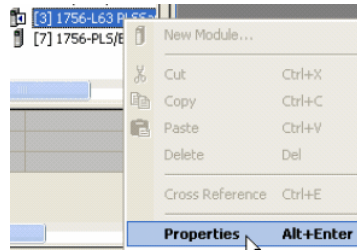
Unlike either DF1 full-duplex or DF1 half-duplex protocols, DF1 radio modem protocol does not include ACKs, NAKs, ENQs, or poll packets. Data integrity is assured by the CRC checksum.

### *Using the DF1 Radio Modem Driver*

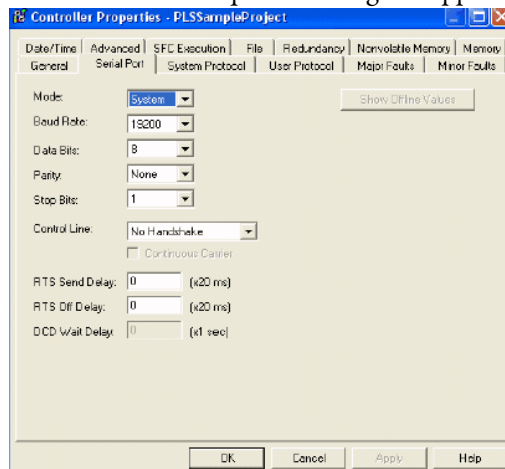
The DF1 radio modem driver can be configured as the system mode driver by using RSLogix 5000 programming software, version 17 or later.

To configure the controller for DF1 Radio Modem communication, perform this procedure.

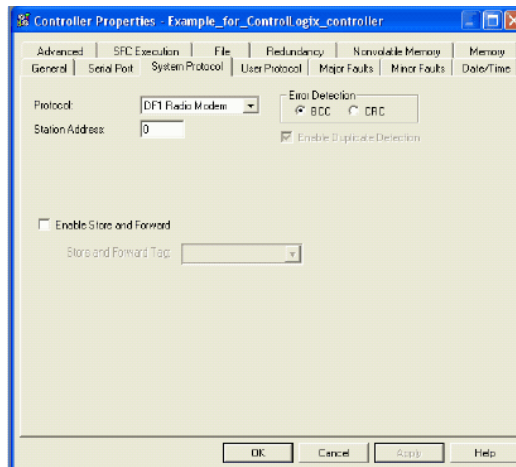
1. In the Controller Organizer of RSLogix 5000 programming software, right-click your controller and select Properties.



The Controller Properties dialog box appears.



2. Click the System Protocol tab.



3. From the Protocol pull-down menu, choose DF1 Radio Modem.

**4. Specify DF1 Radio Modem system protocol settings.**

<b>Setting</b>	<b>Description</b>
Station Address	Specifies the node address of the controller on the serial network. Select a number 1... 254 decimal, inclusive. To optimize network performance, assign node addresses in sequential order. Initiators, such as personal computers, should be assigned the lowest address numbers to minimize the time required to initialize the network.
Error Detection	Click one of the radio buttons to specify the error detection scheme used for all messages. <ul style="list-style-type: none"> <li>• BCC - the processor sends and accepts messages that end with a BCC byte.</li> <li>• CRC - the processor sends and accepts messages with a 2-byte CRC.</li> </ul>
Enable Store and Forward	Check the Enable Store and Forward checkbox if you want to enable the store and forward functionality. When enabled, the destination address of any received message is compared to the Store and Forward tag table. If there is a match, the message is then forwarded (re-broadcasted) from the port. From the Store and Forward Tag pull-down menu, choose an integer (INT[16]) tag. Each bit represents a station address. If this controller reads a message destined for a station that has its bit set in this table, it forwards the message. Also note, the Enable Store and Forward function is usable only if the controller is connected to the master radio modem.

**5. Click OK.***Advantage of Using DF1 Radio Modem Protocol*

The primary advantage of using DF1 radio modem protocol for radio modem networks is in transmission efficiency. Each read/write transaction (command and reply) requires only one transmission by the initiator (to send the command) and one transmission by the responder (to return the reply). This minimizes the number of times the radios need to key-up to transmit, which maximizes radio life and minimizes radio power consumption. In contrast, DF1 half-duplex protocol requires five transmissions for the DF1 master to complete a read/write transaction with a DF1 slave - three by the master and two by the slave.

The DF1 radio modem driver can be used in a pseudo master/slave mode with any radio modems, as long as the designated master node is the only node initiating MSG instructions, and as long as only one MSG instruction is triggered at a time.

For modern serial radio modems that support full-duplex data port buffering and radio transmission collision avoidance, the DF1 radio modem driver can be used to set up a masterless peer-to-peer radio network. In a peer-to-peer radio network, any node can initiate communication to any other node at any time, as long as all of the nodes are within radio range so that they receive each other's transmissions.

### *DF1 Radio Modem System Limitations*

The following questions need to be answered to determine if you can implement the new DF1 radio modem driver in your radio modem network.

- If all of the devices on the network are ControlLogix controllers, you must configure them with the DF1 radio modem driver by using RSLogix 5000 programming software, version 17 or later. If not, then make sure that all of the nodes can support the DF1 radio modem protocol.
- If each node receives the radio transmissions of every other node, being both within radio transmission/reception range and on a common receiving frequency (either via a Simplex radio mode or via a single, common, full-duplex repeater) the radio modems must handle full-duplex data port buffering and radio transmission collision avoidance.

If this is the case, you can take full advantage of the peer-to-peer message initiation capability in every node (for example, the ladder logic in any node can trigger a MSG instruction to any other node at any time).

If not all modems can handle full-duplex data port buffering and radio transmission collision avoidance, you may still be able to use the DF1 radio modem driver, but only if you limit MSG instruction initiation to a single master node whose transmission can be received by every other node.

- If not all nodes receive the radio transmission of every other node, you may still be able to use the DF1 radio modem driver, but only if you limit MSG instruction initiation to the node connected to the master radio modem whose transmissions can be received by every other radio modem in the network.
- You can take advantage of the ControlLogix controller channel-to-channel pass-through to remotely program the other nodes using RSLinx and RSLogix 5000 programming software running on a personal computer connected to a local ControlLogix controller via DH-485, DH+, or Ethernet.

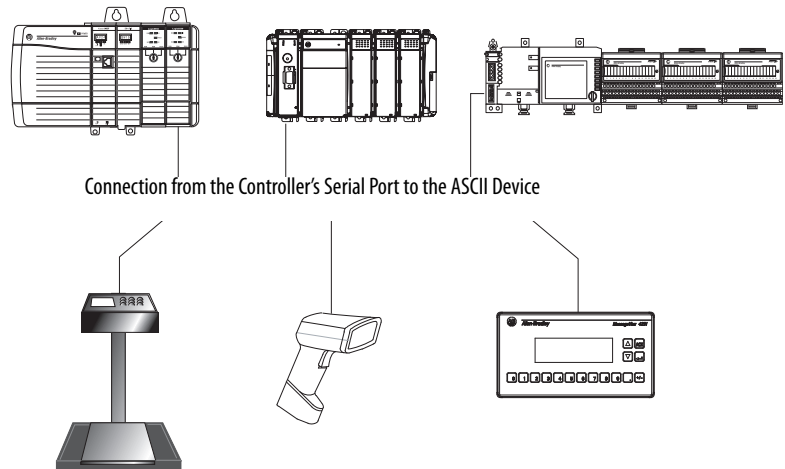
### **Communicate with ASCII Devices**

You can use the serial port to interface with ASCII devices when the controller is configured for user mode. For example, you can use the serial port to:

- read ASCII characters from a weigh scale module or bar code reader.
- send and receive messages from an ASCII triggered device, such as a MessageView terminal.

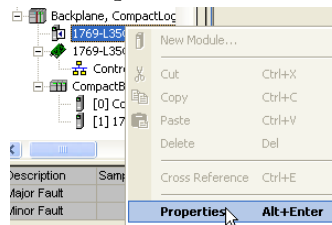


**Figure 8 - ASCII Device Serial Communication**

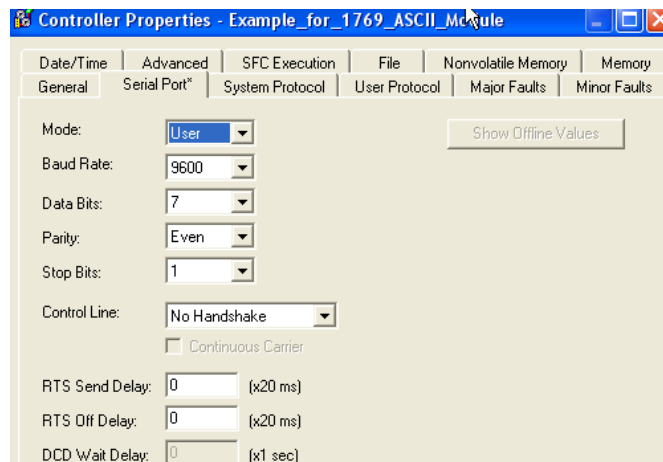


To configure the controller for ASCII communication, perform this procedure.

1. In RSLogix 5000 programming software, right-click your controller and select Properties.

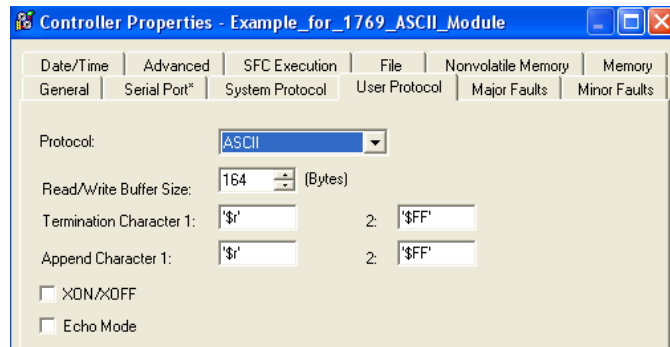


The Controller Properties dialog box appears.



2. Click the Serial Port tab.
3. From the Mode pull-down menu, choose User.
4. Specify communication settings.

5. Click the User Protocol tab.



6. From the Protocol pull-down menu, choose ASCII.

7. Specify ASCII settings.

The controller supports several instructions to manipulate ASCII characters. The instructions are available in ladder diagram (LD) and structured text (ST).

*Read and Write ASCII Characters*

Instruction Code	Description
ABL	Determine when the buffer contains termination characters
ACB	Count the characters in the buffer
ACL	Clear the buffer
	Clear out ASCII Serial Port instructions that are currently executing or are in the queue
AHL	Obtain the status of the serial port control lines
	Turn on or off the DTR signal
	Turn on or off the RTS signal
ARD	Read a fixed number of characters
ARL	Read a varying number of characters, up to and including the first set of termination characters
AWA	Send characters and automatically append one or two additional characters to mark the end of the data
AWT	Send characters

*Create and Modify Strings of ASCII Characters*

Instruction Code	Description
CONCAT	Add characters to the end of a string
DELETE	Delete characters from a string
FIND	Determine the starting character of a substring
INSERT	Insert characters into a string
MID	Extract characters from a string

*Convert Data to or from ASCII Characters*

<b>Instruction Code</b>	<b>Description</b>
STOD	Convert the ASCII representation of an integer value to a SINT, INT, DINT, or REAL value
STOR	Convert the ASCII representation of a floating-point value to a REAL value
DTOS	Convert a SINT, INT, DINT, or REAL value to a string of ASCII characters
RTOS	Convert a REAL value to a string of ASCII characters
UPPER	Convert the letters in a string of ASCII characters to upper case
LOWER	Convert the letters in a string of ASCII characters to lower case

**Modbus Support**

To use Logix5000 controllers on Modbus, connect the controllers through the serial port and execute specific ladder logic routines.

A sample controller project is available with RSLogix 5000 Enterprise programming software.

**Broadcast Messages over a Serial Port**

You can broadcast messages over a serial port connection from a master controller to all of its slave controllers by using several communication protocols. Those protocols are the following:

- DF1 Master
- DF1 Radio Modem
- DF1 Slave

Broadcasting over a serial port is achieved using the 'message' tag. Because messages are sent to receiving controllers, only the 'write' type messages can be used for broadcasting.

The broadcast feature can be set up by using ladder logic programming software or Structured Text programming software.

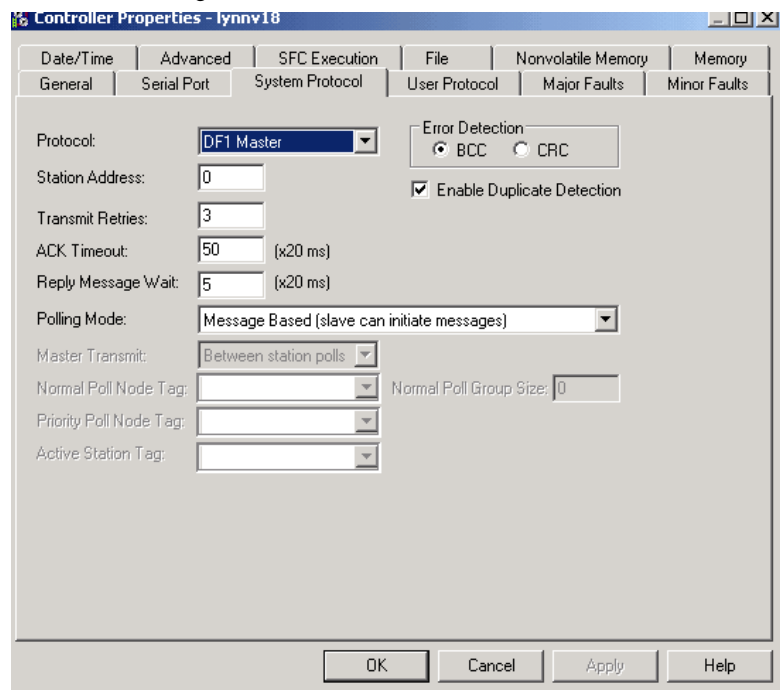
The broadcast feature can also be set by modifying the path value of a message tag in the tag editor.

For this example, Ladder Logic programming software will be used.

*Step 1: Set Broadcast-Controller Properties*

First, set the System Protocol by following these steps.

1. In the Controller Organizer, right-click on the controller and choose Properties.
2. In the Controller Properties dialog box, from the System Protocol tab, choose the settings for the controller, then choose OK.



Field	DF-1 Master Protocol	DF-1 Slave Protocol	DF-1 Radio Modem Protocol
Station Address	Controller station address number	Controller station address number	Controller station address number
Transmit Retries	3	3	N/A
ACK Timeout	50	N/A	N/A
Slave Poll Timeout	N/A	3000	N/A
Reply Message Wait	5	N/A	N/A
Polling Mode	Message: polls the slave by using the Message instruction Slave: initiates messages for slave-to-slave broadcast. Standard: schedules polling for the slave.	N/A	N/A
EOT Suppression	N/A	Disable	N/A

Field	DF-1 Master Protocol	DF-1 Slave Protocol	DF-1 Radio Modem Protocol
Error Detection	BCC	BCC	BCC
Duplicate Detection	Enabled	Enabled	N/A
Enable Store and Forward	N/A	N/A	Choose enable if you want to use the store and forward tag. The last bit of the INT[16] Enable Store and Forward array must be 'enabled.' For example, say you create an INT[16] tag named EnableSandF. Then EnableSandF[15].15 must be set to 1 for broadcast to work on radio modem.

*Step 2: Set Broadcast - Create Controller Scope Message Tag*

Next, create a Message tag by following these steps.

1. In the Controller Organizer, right-click on the Controller Tags folder and choose New Tag.

The new tag must be a 'message' tag.

2. Name the tag and select the Data Type 'Message', then choose OK.

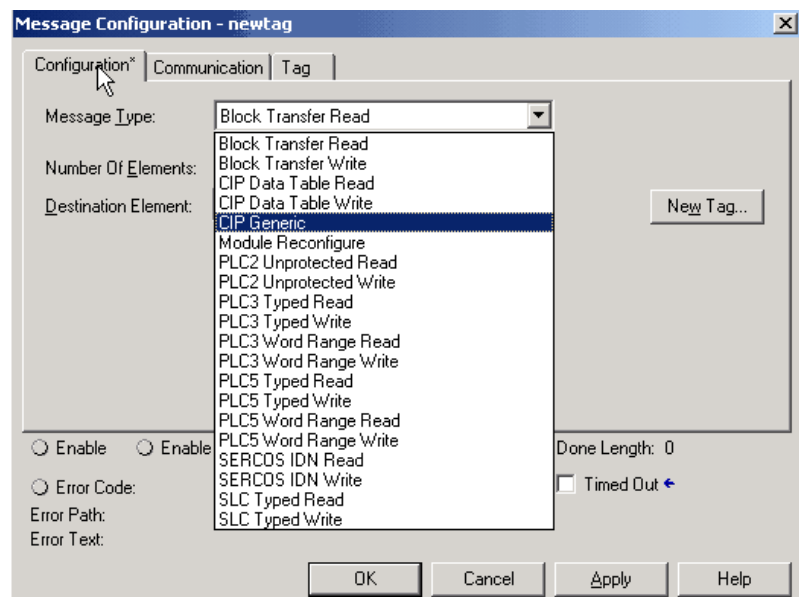
The Message tag in the Controller Scope's Controller Tags folder will look similar to the following.

Name	Value	Force Mask	Style	Data Type
newtag	{...}	{...}		MESSAGE
newtag.Flags	16#0200		Hex	INT
newtag.EW	0		Decimal	BOOL
newtag.ER	0		Decimal	BOOL
newtag.DN	0		Decimal	BOOL
newtag.ST	0		Decimal	BOOL
newtag.EN	0		Decimal	BOOL
newtag.TO	0		Decimal	BOOL
newtag.EN...	1		Decimal	BOOL
newtag.ERR	16#0000		Hex	INT
newtag.FX	16#0000 0000		Hex	DINT

*Step 3: Ladder Logic Programming Software*

Then, to set broadcasting over a serial port, follow these steps.

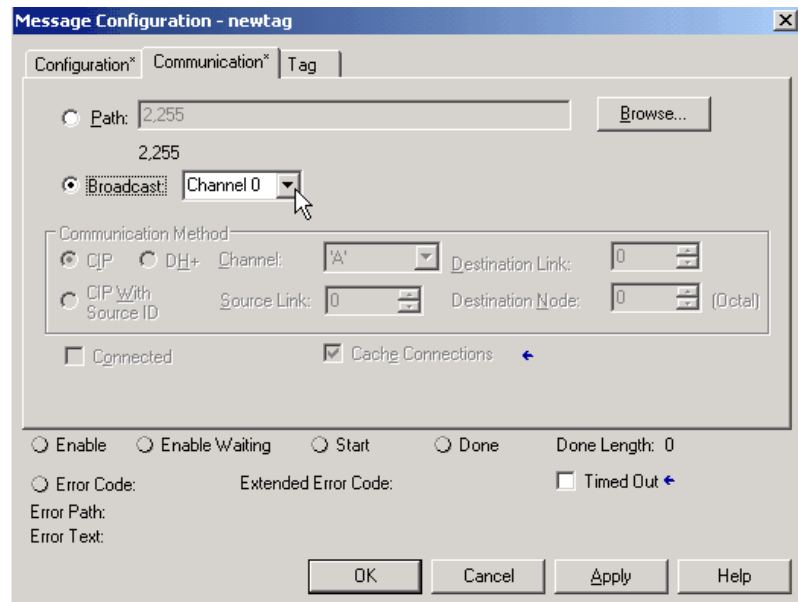
1. In the Controller Organizer, from the Tasks folder, choose Main Routine to display the ladder logic programming software interface.
2. Open a MSG instruction from the Input/Output tab.
3. Double-click in the Message Control field to enable the pull-down menu and select the tag you created.
4. Launch the View Configuration dialog box.
5. In the Message Configuration dialog box, from the Configuration tab, select the message type from the Message Type field.



Valid 'Write' Message Types include the following:

- CIP Generic
  - CIP Data Table Write
  - PLC2 Unprotected Write
  - PLC3 Typed Write
  - PLC3 Word Range Write
  - PLC5 Typed Write
  - PLC5 Word Range Write
  - SLC Typed Write
6. Fill in any other fields needed.

7. From the Communication tab, select the Broadcast Radio button and the Channel from the pull-down, then choose OK.



**ATTENTION:** When using structured text programming software, broadcast over serial is set by typing MSG(aMsg) and right-clicking on a MSG to display the Message Configuration dialog box.

## DH-485 Network Communication

For DH-485 communication, use the controller's serial port.

However, with a CompactLogix controller, we recommend that you use NetLinx networks, such as EtherNet/IP, ControlNet, or DeviceNet, because excessive traffic on a DH-485 network may make it impractical to connect to a controller with RSLogix 5000 programming software.

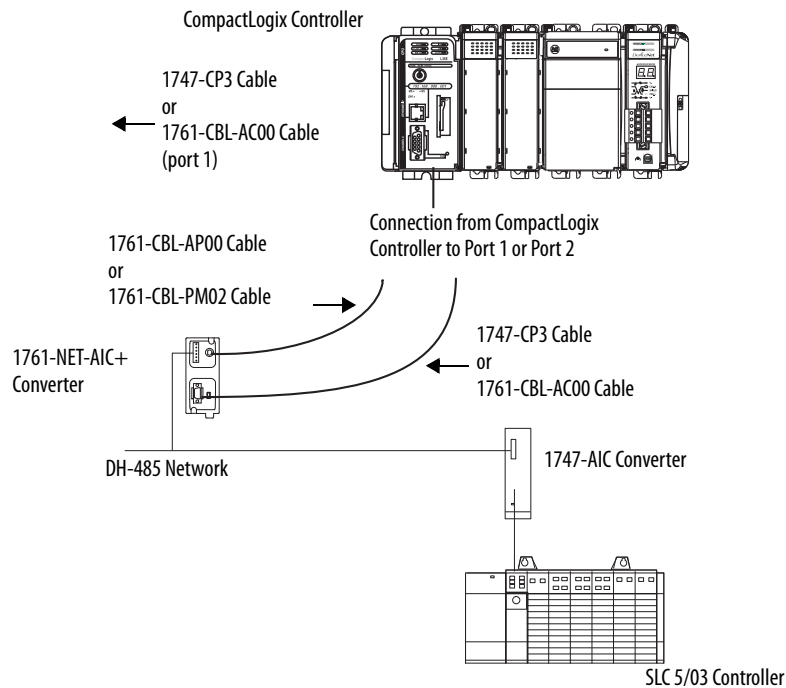
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**IMPORTANT** If your application uses connections to DH-485 networks, select built-in serial ports.

---

The DH-485 protocol uses RS-485 half-duplex as its physical interface. RS-485 is a definition of electrical characteristics, not a protocol. You can configure the CompactLogix controller's RS-232 port to act as a DH-485 interface. By using a 1761-NET-AIC converter and the appropriate RS-232 cable (1756-CP3 or 1747-CP3), a CompactLogix controller can send and receive data on a DH-485 network.

**Figure 9 - CompactLogix DH-485 Communication Overview**



On the DH-485 network, the CompactLogix controller can send and receive messages to and from other controllers.

---

**IMPORTANT** A DH-485 network consists of multiple cable segments. Limit the total length of all the segments to 1219 m (4000 ft).

---

For the controller to operate on a DH-485 network, you need a 1761-NET-AIC interface converter for each controller you want to put on the DH-485 network.

You can have two controllers for each 1761-NET-AIC converter, but you need a different cable for each controller.



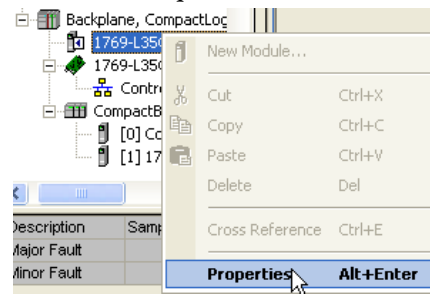
To establish DH-485 communication, perform this procedure.

1. Connect the serial port of the controller to either port 1 or port 2 of the 1761-NET-AIC converter.
2. Use the RS-485 port to connect the converter to the DH-485 network.

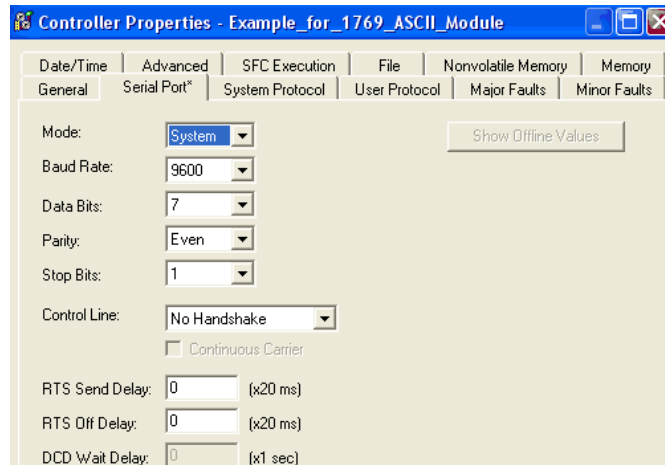
The cable you use to connect the controller depends on the port you use on the 1761-NET-AIC converter.

Connection	Required Cable
Port 1 DB-9 RS-232, DTE connection	1747-CP3 or 1761-CBL-AC00
Port 2 mini-DIN 8 RS-232 connection	1761-CBL-AP00 or 1761-CBL-PM02

3. In RSLogix 5000 programming software, right-click on your controller and choose Properties.



The Controller Properties dialog appears.

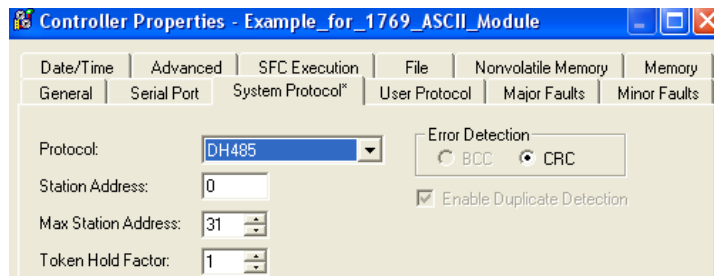


4. Click the Serial Port tab.
5. From the Mode pull-down menu, choose System.

6. Specify communication settings.

**IMPORTANT** The baud rate specifies the communication rate for the DH-485 port. All devices on the same DH-485 network must be configured for the same baud rate. Select 9600 or 19200 KB.

7. Click the System Protocol tab.



8. From the Protocol pull-down menu, choose DH485.

9. Specify DH-485 settings.

10. From the Protocol pull-down menu, choose DF1 Radio.

**Table 11 - System Protocol Specifications**

Characteristic	Description
Station Address	Specifies the node address of the controller on the DH-485 network. Select a number 1...31 decimal, inclusive. To optimize network performance, assign node addresses in sequential order. Initiators, such as personal computers, should be assigned the lowest address numbers to minimize the time required to initialize the network.
Token Hold Factor	Number of transmissions plus retries that a node holding a token can send onto the data link each time it receives the token. Enter a value between 1...4. The default is 1.
Maximum Station Address	Specifies the maximum node address of all the devices on the DH-485 network. Select a number 1...31 decimal, inclusive. To optimize network performance, make sure: <ul style="list-style-type: none"> <li>the maximum node address is the highest node number being used on the network.</li> <li>that all the devices on the same DH-485 network have the same maximum node address.</li> </ul>

## Manage Controller Communication

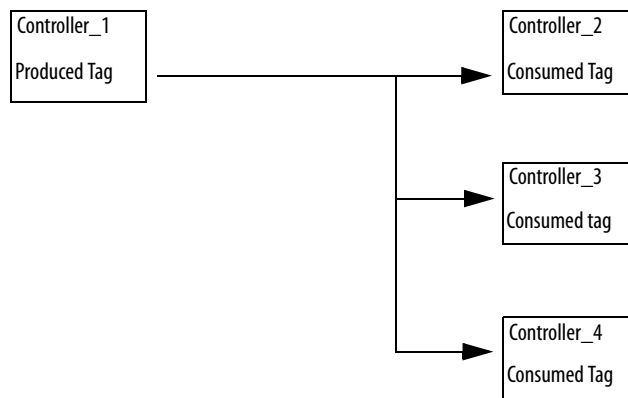
This chapter explains how to manage controller communication.

Topic	Page
Produce and Consume Data	75
Send and Receive Messages	76
Connections	77
Calculate Total Connections	78
Connections Example	79

### Produce and Consume Data

The controller supports the ability to produce (broadcast) and consume (receive) system-shared tags over ControlNet or EtherNet/IP networks. Produced and consumed tags each require connections. Over ControlNet, produced and consumed tags are scheduled connections.

**Figure 10 - Controller Communication Overview**



Tag Type	Description
Produced	<p>A produced tag allows other controllers to consume the tag, which means that a controller can receive the tag data from another controller. The producing controller uses one connection for the produced tag and another for each consumer. The controller's communication device uses one connection for each consumer.</p> <p>As you increase the number of controllers that can consume a produced tag, you also reduce the number of connections the controller and communication device have available for other operations, like communication and I/O.</p>
Consumed	<p>Each consumed tag requires one connection for the controller that is consuming the tag. The controller's communication device uses one connection for each consumer.</p>

For two controllers to share produced or consumed tags, both controllers must be attached to the same control network, such as a ControlNet or Ethernet/IP network. You cannot bridge produced and consumed tags over two networks.

The number of available connections limits the total number of tags that can be produced or consumed. If the controller uses all of its connections for I/O and communication devices, no connections are left for produced and consumed tags.

## Send and Receive Messages

Messages transfer data to other devices, such as controllers or operator interfaces. Messages use unscheduled connections to send or receive data. Connected messages can leave the connection open (cache) or close the connection when the message is done transmitting.

**Table 12 - Message Transmission**

Message Type	Communication Method	Connected Message	Can the message be cached?
CIP data table read or write	NA	Yes	Yes
PLC-2, PLC-3, PLC-5, or SLC (all types)	CIP	No	No
	CIP with Source ID	No	No
	DH+	Yes	Yes
CIP generic	NA	Optional <sup>(1)</sup>	Yes <sup>(2)</sup>
Block-transfer read or write	NA	NA	Yes

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

(2) Consider caching only if the target module requires a connection.

Connected messages are unscheduled connections on both ControlNet and EtherNet/IP networks.

Each message uses one connection, regardless of how many devices are in the message path. You can program the target of a MSG instruction to optimize message transfer time.

## Determine Whether to Cache Message Connections

When you configure a MSG instruction, you can cache or not cache the connection.

**Table 13 - Caching Messages**

Message Execution	Function
Repeatedly	Cache the connection. This keeps the connection open and optimizes execution time. Opening a connection each time the message executes increases execution time.
Infrequently	Do not cache the connection. This closes the connection upon completion of the message, freeing up that connection for other uses.

## Connections

A Logix5000 system uses a connection to establish a communication link between two devices. Connections can be:

- a controller to local I/O modules or local communication modules.
- a controller to remote I/O or remote communication modules.
- a controller to remote I/O (rack-optimized) modules.
- produced and consumed tags.
- messages.
- controller access by RSLogix 5000 programming software.
- controller access by RSLinx software for HMI or other applications.

The limit of connections may ultimately reside in the communication module you use for the connection. If a message path routes through a communication module, the connection related to the message also counts towards the connection limit of that communication module.

**Table 14 - Connections Overview**

Device	Supported Connections
CompactLogix controller (1769-L31)	100
Built-in ControlNet communication port (1769-L32C and 1769-L35CR controllers only)	
Built-in EtherNet/IP communication port (1769-L32E and 1769-L35E controllers only)	

## Calculate Total Connections

You can calculate the total number of local and remote connections the controller uses.

**Table 15 - Local Connections Calculation**

Local Connection Type	Device Quantity	Connections per Device	Total Connections
Local I/O module (always a direct connection)		1	
Built-in ControlNet communication port (1769-L32C and 1769-L35CR controllers only)		0	
Built-in EtherNet/IP communication port (1769-L32E and 1769-L35E controllers only)		0	
1769-SDN DeviceNet scanner module		2	
<b>Total</b>			

The number of remote connections a communication module supports determines how many connections the controller can access through that module.

**Table 16 - Remote Connections Calculation**

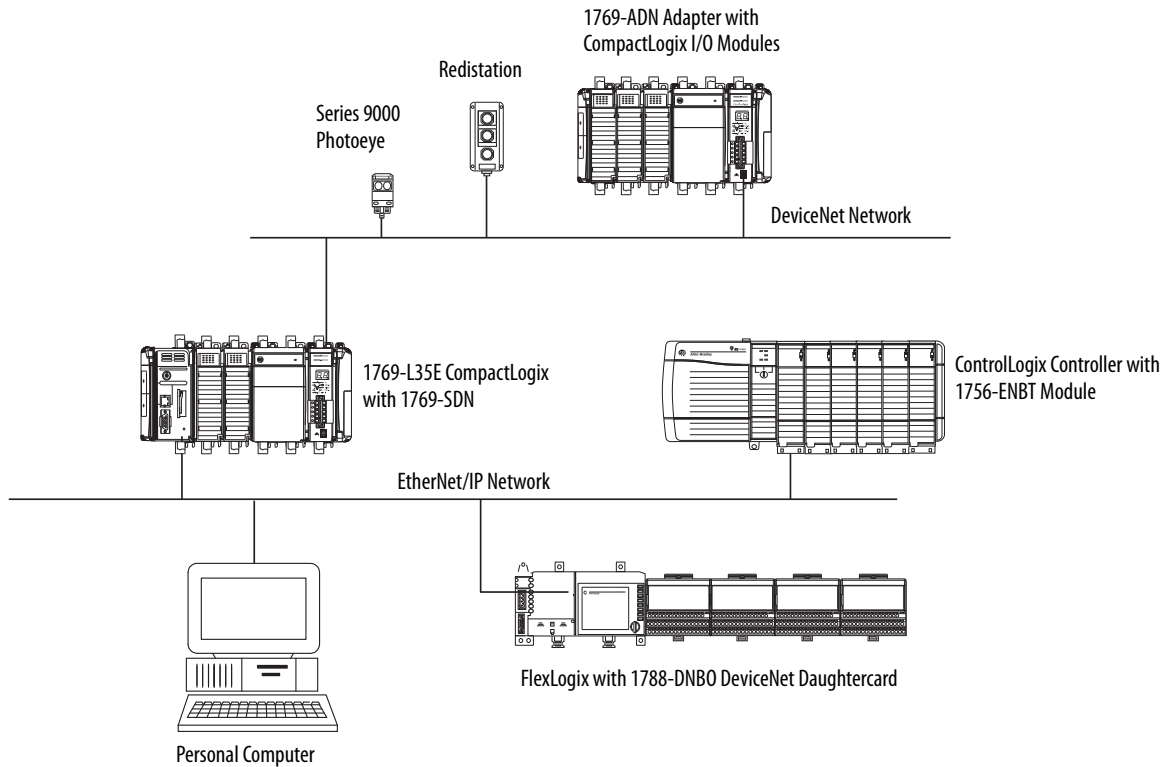
Remote Connection Type	Device Quantity	Connections per Device	Total Connections
Remote ControlNet communication module <ul style="list-style-type: none"> <li>I/O configured as direct connection (none)</li> <li>I/O configured as rack-optimized connection</li> </ul>		0 or 1	
Remote I/O module over ControlNet (direct connection)		1	
Remote EtherNet/IP communication module <ul style="list-style-type: none"> <li>I/O configured as direct connection (none)</li> <li>I/O configured as rack-optimized connection</li> </ul>		0 or 1	
Remote I/O module over a EtherNet/IP network (direct connection)		1	
Remote device over a DeviceNet network (accounted for in rack-optimized connection for local 1769-SDN module)		0	
Other remote communication adapter (POINT and FLEX adapters, for example)		1	
Produced tag Each consumer		1 1	
Consumed tag		1	
Message (depending on type)		1	
Block-transfer message		1	
<b>Total</b>			

## Connections Example

In this example system the 1769-L35E CompactLogix controller:

- controls local digital I/O modules in the same chassis.
- controls remote I/O devices on a DeviceNet network.
- sends and receives messages to/from a ControlLogix controller on an EtherNet/IP network.
- produces one tag that the 1794 FlexLogix controller consumes.
- is programmed via RSLogix 5000 programming software.

**Table 17 - Example - CompactLogix System Connections**



**Table 18 - Example - CompactLogix Connection Types**

Connection Type	Device Quantity	Connections per Device	Total Connections
Controller to local I/O modules (rack-optimized)	2	1	2
Controller to 1769-SDN scanner module	1	2	2
Controller to built-in EtherNet/IP communication port (rack-optimized)	1	0	0
Controller to RSLogix 5000 programming software	1	1	1
Message to ControlLogix controller	2	1	2
Produced tag consumed by FlexLogix controller	2	1	2
<b>Total</b>			<b>9</b>

**Notes:**



## Place, Configure, and Monitor I/O

This chapter explains how to place, configure, and monitor CompactLogix I/O modules.

Topic	Page
Select I/O Modules	81
Place Local I/O Modules	86
Configure I/O	87
Configure Distributed I/O on an EtherNet/IP Network	88
Configure Distributed I/O on a ControlNet Network	89
Configure Distributed I/O on a DeviceNet Network	90
Address I/O Data	91
Determine When Data Is Updated	92
Reconfigure an I/O Module	94

### Select I/O Modules

When choosing 1769 I/O modules, select:

- specialty I/O modules when appropriate.

Some modules have field-side diagnostics, electronic fusing, or individually-isolated inputs and outputs.

- a 1492 wiring system for each I/O module as an alternative to the terminal block that comes with the module.
- 1492 PanelConnect modules and cables if you are connecting input modules to sensors.

## Validate I/O Layout

After you have selected your I/O modules, you need to validate the system you want to design. Before you begin to place your I/O modules, consider that the minimum backplane RPI increases as you add modules. Also, the I/O modules must be distributed so that the current consumed from the left or right side of the power supply never exceeds 2.0 A at 5V DC or 1.0 A at 24V DC.

### Estimate Requested Packet Interval

The requested packet interval (RPI) defines the frequency at which the controller sends and receives all I/O data on the backplane. Each module on the backplane can have its own individual RPI setting.

The effective scan frequency for any individual module is still impacted by the other modules in the system and those modules' RPI settings. The following table provides relative scanning durations for various types of modules. This information should be taken into account when setting an individual module's RPI in order to achieve the desired effective scan frequency for any module in the system.

Type of Module	Request Packet Interval
Digital and analog (any mix)	<ul style="list-style-type: none"> <li>1...4 modules can be scanned in 1 ms.</li> <li>5...30 modules can be scanned in 2 ms.</li> <li>Some input modules have a fixed 8 ms filter, so selecting a greater RPI has no effect.</li> </ul>
Specialty	<ul style="list-style-type: none"> <li>Full-sized 1769-SDN modules add 2 ms per module.</li> <li>1769-HSC modules add 1 ms per module.</li> <li>Full-sized 1769-ASCII modules add 1 ms per module.</li> </ul>

You can always select an RPI that is slower than these. The RPI shows how quickly modules can be scanned, not how quickly an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

## Calculate System Power Consumption

To validate your proposed system, calculate the total 5V DC current and 24V DC to be consumed.

**Table 19 - I/O Module Power Consumption Calculation Table**

Catalog Number	Number of Modules	Module Current Requirements		Calculated Current = (Number of Modules) x (Module Current Requirements)	
		at 5V DC (in mA)	at 24V DC (in mA)	at 5V DC (in mA)	at 24V DC (in mA)
1769-L31		330	40		
1769-L32C		650	40		
1769-L32E		660	90		
1769-L35CR		680	40		
1769-L35E		660	90		
<b>Total Current Required<sup>(1)</sup>:</b>					

(1) This number must not exceed the power supply current capacity.

**Table 20 - Power Supply Current Capacity**

Specification	Power Supply and Capacity			
	1769-PA2	1769-PB2	1769-PA4	1769-PB4
Output Bus Current Capacity 0...55 °C (32...131 °F)	2 A at 5V DC and 0.8 A at 24V DC		4 A at 5V DC and 2 A at 24V DC	
24V DC User Power Capacity 0...55 °C (32...131 °F)	250 mA (maximum)	NA		

## Validate Placement of I/O Modules

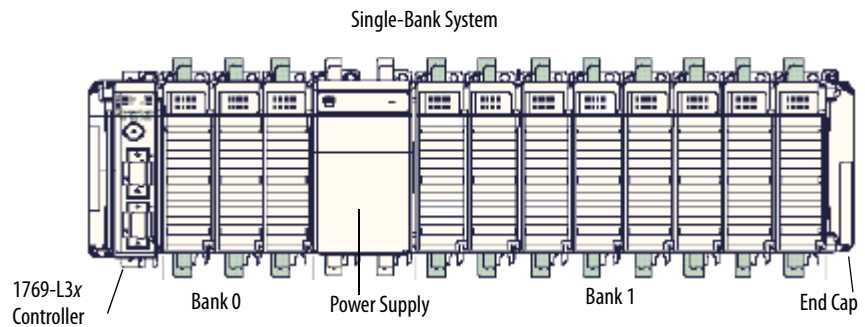
The controller you use determines how many local I/O modules you can configure.

**Table 21 - Controller I/O Support**

Controller	Supported Local I/O Modules	I/O Banks
1769-L35CR	30	3
1769-L35E	30	3
1769-L32C, 1769-L32E and 1769-L31	16	3

To validate the proposed placement of I/O modules in your CompactLogix system, perform this procedure.

1. Verify that your 1769-L3x controller resides on the leftmost side of the bank.



2. Verify that you have placed no more than three I/O modules between your controller and power supply (bank 0).

Placing more than three I/O modules in bank 0 would exceed the distance rating of four and invalidate your system.

3. Validate the number of I/O modules your power supply can support.

In a single-bank system, make sure you have not placed more than eight I/O modules between the power supply and end cap (bank 1).

---

**IMPORTANT**

In a single-bank system, the power supply can support up to eight I/O modules as long as the modules' power consumption does not exceed the power supply's capacity.

So, in a single-bank system, you may not have more than eleven total I/O modules, three to the left of your power supply and eight to the right.

If your system requires additional I/O modules, you must add an additional bank.

---

In a multi-bank system, make sure that your additional bank(s) do not have more than eight I/O modules on either side of the additional power supply.

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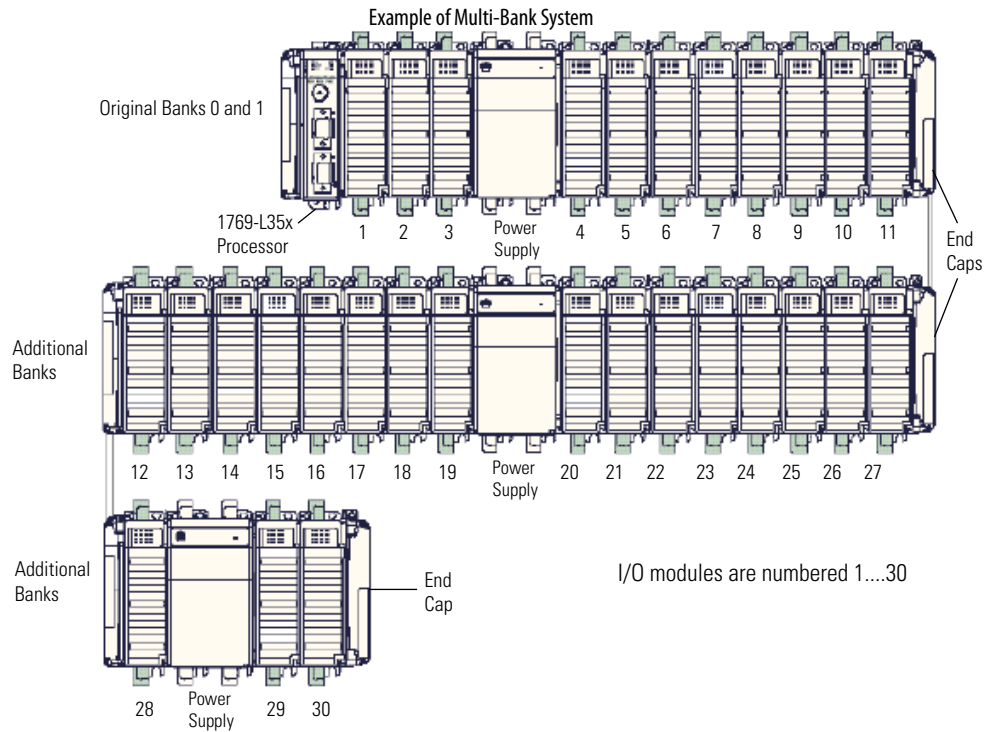
**IMPORTANT**

In a multi-bank system, you may place up to eight I/O modules on either side of the additional power supply so long as the power consumed by these modules does not exceed the power supply's capacity.

---

In this example, the I/O modules 12...30 could be arranged in any way as long as the power supplies' capacity was not exceeded. In other words, the

first additional bank could contain fewer than 16 I/O modules This is just one possible arrangement.



4. Verify that all banks have end caps.

---

#### IMPORTANT

If you place and configure more I/O modules and I/O banks than your controller can support, your system may run well for a period of time. Nothing alerts you to the fact that you have exceeded your controller's capacity.

However, by exceeding your controller's I/O capacity, you put your system at risk of intermittent faults, the most common being Major Fault Type 03 (I/O Fault) Code 23.

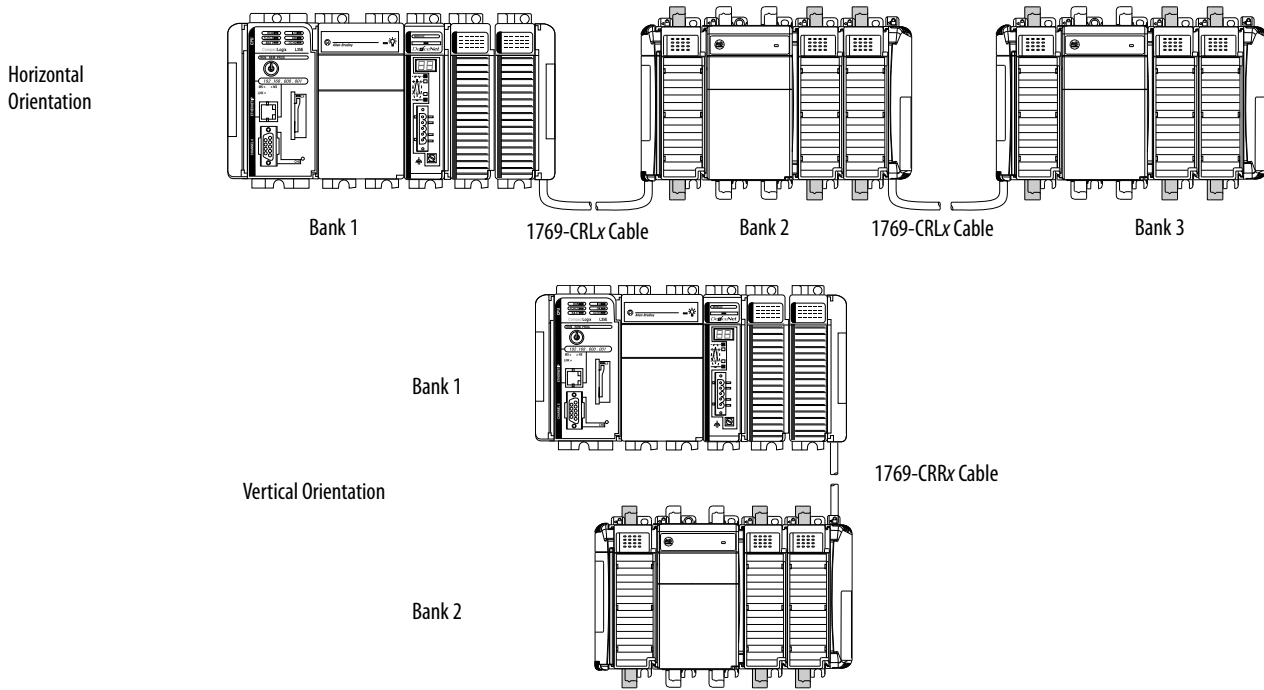
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## Place Local I/O Modules

Use the 1769-CRR1/-CRR3 or 1769-CRL1/-CRL3 expansion cable to connect banks of I/O modules.

Each I/O module also has a power supply distance rating, the number of modules from the power supply. The distance rating is printed on each module's label. Each module must be located within its distance rating.

**Table 22 - Controller I/O Placement**



**ATTENTION:** The CompactLogix system does not support Removal and Insertion Under Power (RIUP). While the CompactLogix system is under power:

- any break in the connection between the power supply and the controller (for example, removing the power supply, controller, or an I/O module) may subject the logic circuitry to transient conditions above the normal design thresholds and may result in damage to system components or unexpected behavior.
- removing an end cap or an I/O module faults the controller and may also result in damage to system components.

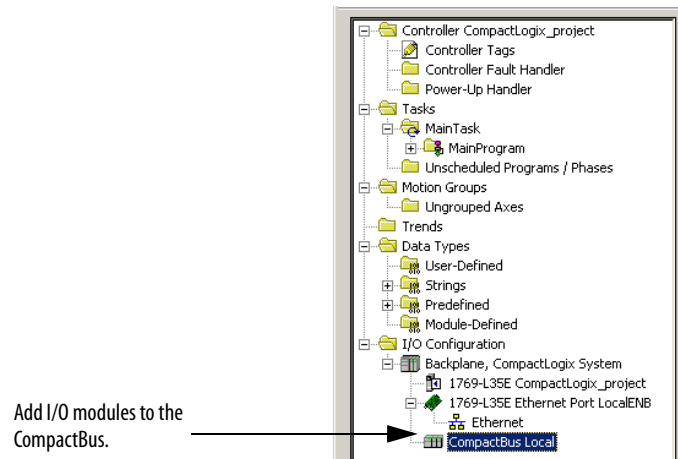
The CompactLogix controller also supports distributed (remote) I/O via these networks:

- EtherNet/IP
- ControlNet
- DeviceNet

## Configure I/O

To communicate with an I/O module in your system, add the module to the I/O Configuration folder of the controller.

**Figure 11 - I/O Module Configuration**



When you add a module, you also define a specific configuration for the module. While the configuration options vary from module to module, there are some common options that you typically configure.

**Table 23 - I/O Configuration Options**

Configuration Option	Description
Requested packet interval (RPI)	<p>The RPI specifies the interval at which data updates over a connection. For example, an input module sends data to a controller at the RPI that you assign to the module.</p> <ul style="list-style-type: none"> <li>Typically, you configure an RPI in milliseconds (ms). The range is 0.1...750 ms.</li> <li>If a ControlNet network connects the devices, the RPI reserves a slot in the stream of data flowing across the ControlNet network. The timing of this slot may not coincide with the exact value of the RPI, but the control system guarantees that the data transfers at least as often as the RPI.</li> </ul>
Change of state (COS)	<p>Digital I/O modules use COS to determine when to send data to the controller. If a COS does not occur within the RPI timeframe, the module multicasts data at the RPI.</p> <p>Because the RPI and COS functions are asynchronous to the logic scan, it is possible for an input to change state during program scan execution. If this is a concern, buffer input data so your logic has a stable copy of data during its scan. Use the Synchronous Copy (CPS) instruction to copy the input data from your input tags to another structure and use the data from that structure.</p>
Communication format	<p>Many I/O modules support different formats. The communication format that you choose also determines:</p> <ul style="list-style-type: none"> <li>data structure of tags.</li> <li>connections.</li> <li>network usage.</li> <li>ownership.</li> <li>returning of diagnostic information.</li> </ul>
Electronic keying	<p>When you configure a module, you specify the slot number for the module. However, it is possible to purposely or accidentally place a different module in that slot. Electronic keying lets you protect your system against the accidental placement of the wrong module in a slot. The chosen keying option determines how closely any module in a slot must match the configuration for that slot before the controller opens a connection to the module. There are different keying options depending on your application needs.</p>

## I/O Connections

A Logix5000 system uses connections to transmit I/O data.

**Table 24 - Logix5000 I/O Connections**

Connection	Description
Direct	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 between the controller and the I/O module. Any break in the connection, such as a module fault or the removal of a module while under power, causes the controller to set fault status bits in the data area associated with the module. Typically, analog I/O modules, diagnostic I/O modules, and specialty modules require direct connections.
Rack-optimized	For digital I/O modules, you can select rack-optimized communication. A rack-optimized connection consolidates connection usage between the controller and all the digital I/O modules on a rack (or DIN rail). Rather than having individual, direct connections for each I/O module, there is one connection for the entire rack (or DIN rail).

### Configure Distributed I/O on an EtherNet/IP Network

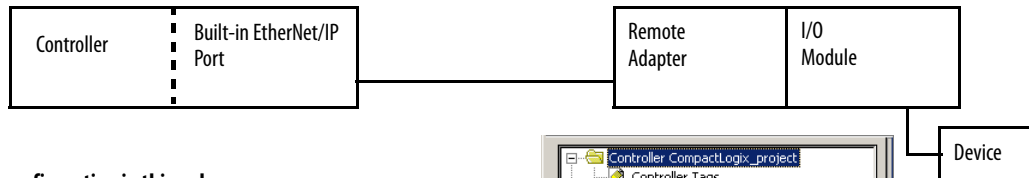
To communicate with distributed I/O modules over an EtherNet/IP network:

- choose a 1769-L32E or 1769-L35E CompactLogix controller with a built-in EtherNet/IP communication port.
- add an EtherNet/IP adapter, and I/O modules to the I/O Configuration folder of the controller.

Within the I/O Configuration folder, organize the modules into a hierarchy of tree/branch and parent/child.

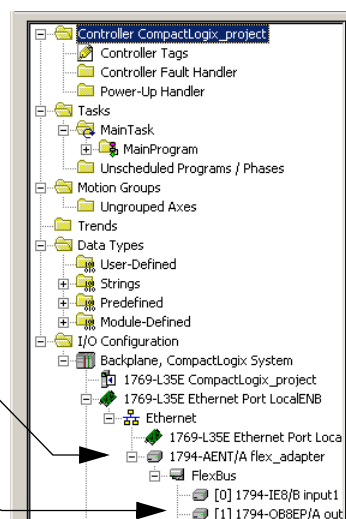
**Figure 12 - EtherNet/IP Distributed I/O Configuration**

For a typical distributed I/O network...



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

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





## Configure Distributed I/O on a ControlNet Network

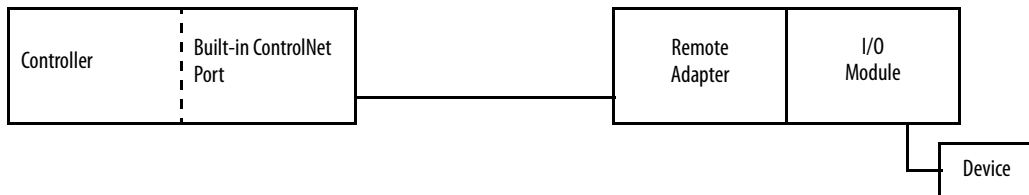
To communicate with distributed I/O modules over a ControlNet network:

- choose a 1769-L32C or 1769-L35CR CompactLogix controller with a built-in ControlNet communication port.
- add a ControlNet adapter, and I/O modules to the I/O Configuration folder of the controller.

Within the I/O Configuration folder, organize the modules into a hierarchy of tree/branch and parent/child.

**Figure 13 - ControlNet Distributed I/O Configuration**

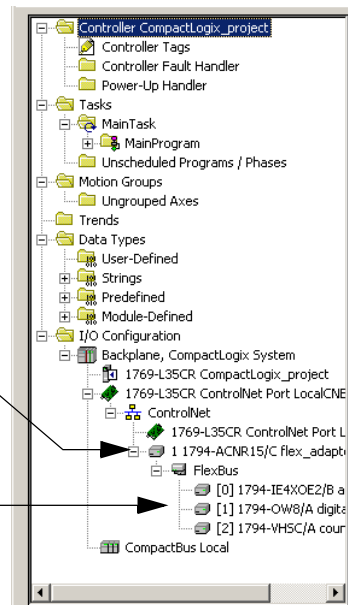
For a typical distributed I/O network...



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

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

2. Add the distributed I/O modules.

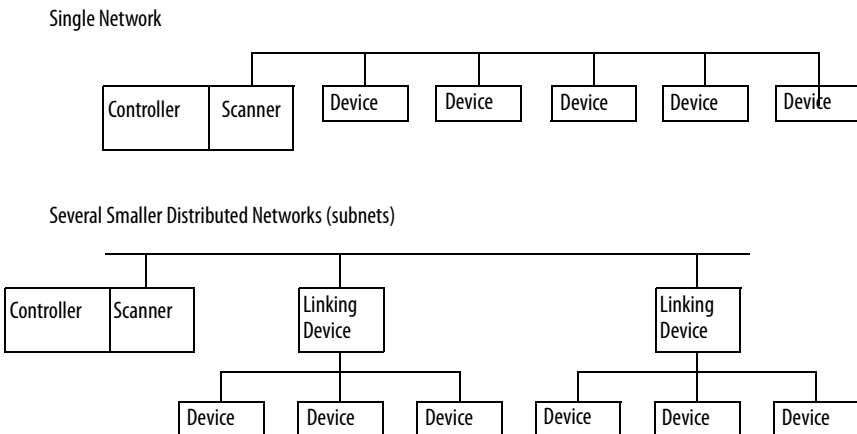


## Configure Distributed I/O on a DeviceNet Network

To communicate with the I/O modules over a DeviceNet network, add the DeviceNet bridge to the I/O Configuration folder of the controller. RSNetWorx for DeviceNet software is used to define the scanlist within the DeviceNet scanner to communicate data between the devices and the controller through the scanner.

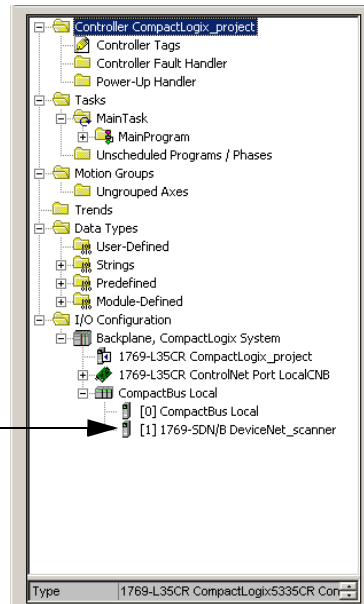
**Figure 14 - DeviceNet Distributed I/O Configuration**

For a typical distributed I/O network...



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

Add the local scanner module.

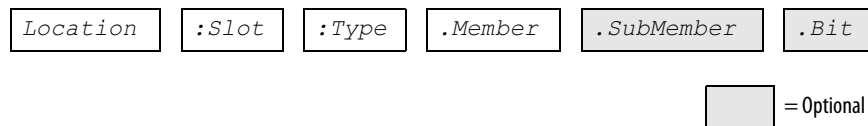


## Address I/O Data

I/O information is presented as a set of tags.

- Each tag uses a structure of data, depending on the specific features of the I/O module.
- The name of the tags is based on the location of the I/O module in the system.

**Figure 15 - I/O Address Format**

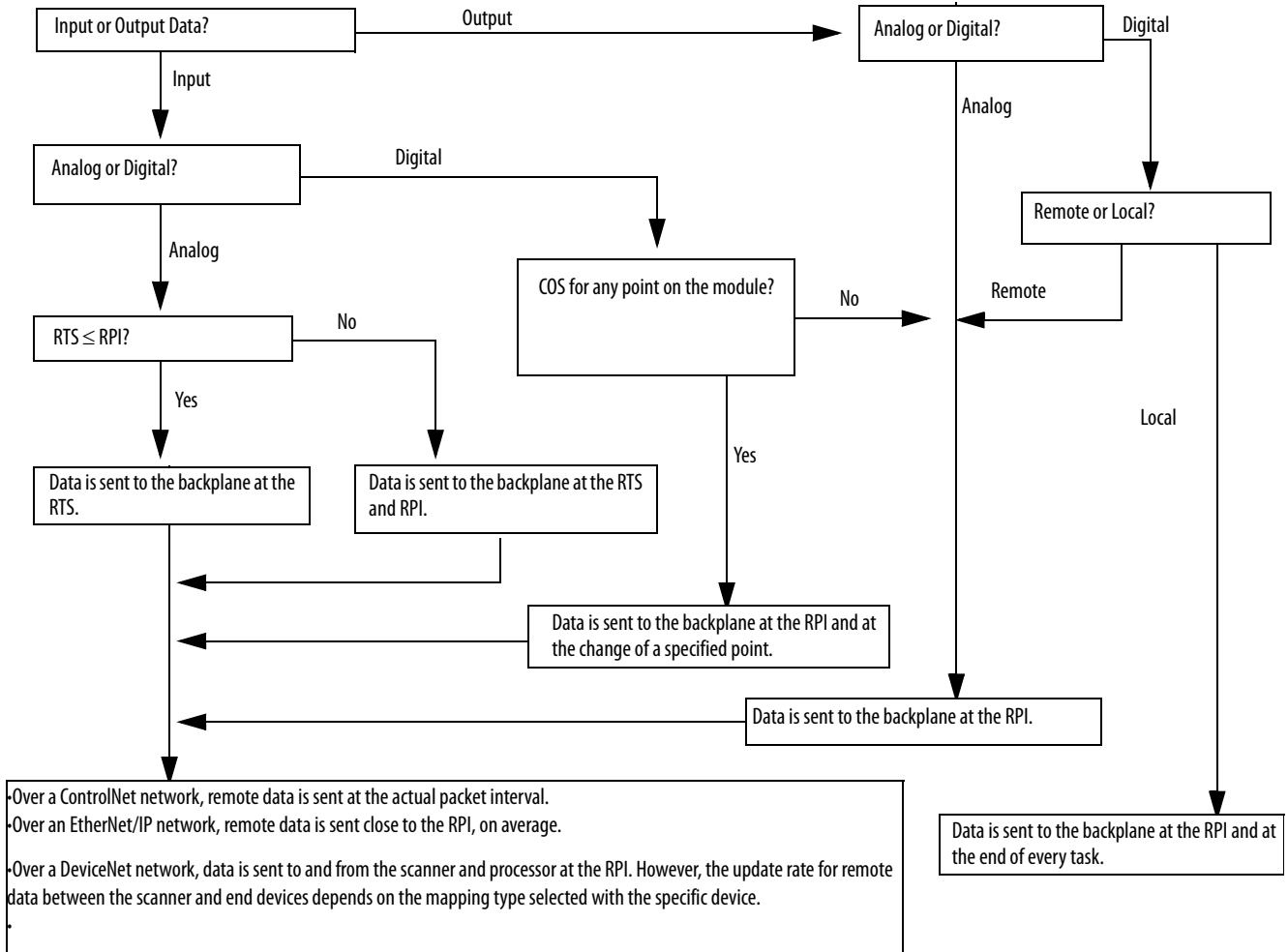


Where	Is
Location	Network location.
	Local = same chassis or DIN rail as the controller.
	Adapter_Name = identifies remote communication adapter or bridge module.
Slot	Slot number of I/O module in its chassis or DIN rail.
Type	Type of data.
	I = input.
	O = output.
	C = configuration.
Member	S = status.
	Specific data from the I/O module, depending on what type of data the module can store. <ul style="list-style-type: none"> <li>• For a digital module, a data member usually stores the input or output bit values.</li> <li>• For an analog module, a channel member (CH#) usually stores the data for a channel.</li> </ul>
SubMember	Specific data related to a member.
Bit	Specific point on a digital I/O module, depending on the size of the I/O module (0...31 for a 32-point module).

## Determine When Data Is Updated

CompactLogix controllers update data asynchronously with the execution of logic. This flowchart illustrates when producers send data. Controllers, input modules and bridge modules are producers.

**Figure 16 - Updating of Data**



**TIP**

If you need to ensure that the I/O values being used during logic execution are from one moment in time, such as at the beginning of a ladder program, use the Synchronous Copy instruction (CPS) to buffer I/O data.

## Monitor I/O Modules

With the CompactLogix controller, you can monitor I/O modules at different levels by:

- using the programming software to display fault data.

Refer to Display Fault Data on page 93.

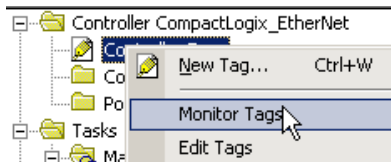
- programming logic to monitor fault data so you can take appropriate action

### Display Fault Data

Fault data for certain types of module faults can be viewed through the programming software.

To display fault data, perform this procedure.

1. In RSLogix 5000 programming software, select Controller Tags in the Controller Organizer and right-click to select Monitor Tags.



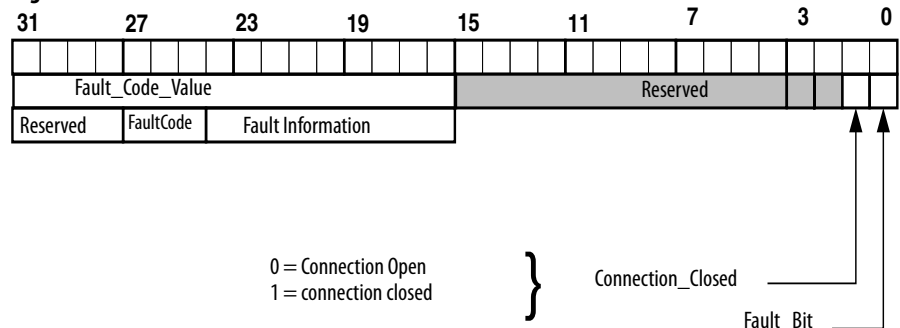
The display style for the fault data defaults to decimal.

Tag Name	Value	Force Mask	Style	Type	Description
Local1.1	{...}	{...}	{...}	AB:1769-D16I:0	
Local1.1.Fault	2#0000_000...		Binary	DINT	
Local1.1.Data	2#0000_000...		Binary	INT	
Local2.C	{...}	{...}	{...}	AB:1769-D016C:0	
Local2.C.Config	2#0000_000...		Binary	INT	
Local2.C.ProgTofaultEn	0		Decimal	BOOL	
Local2.C.ProgMode	2#0000_000...		Binary	INT	
Local2.C.ProgValue	2#0000_000...		Binary	INT	
Local2.C.FaultMode	2#0000_000...		Binary	INT	
Local2.C.FaultValue	2#0000_000...		Binary	INT	

2. Change the display style to Hex to read the fault code.

If the module faults, but the connection to the controller remains open, the controller tags database displays the fault value 16#0E01\_0001. The fault word uses this format.

**Figure 17 - Fault Word Format**



Bit	Description
Fault_Bit	This bit indicates that at least one bit in the fault word is set (1). If all the bits in the fault word are cleared (0), this bit is cleared (0).
Connection_Closed	This bit indicates whether the connection to the module is open (0) or closed (1). If the connection is closed (1), the Fault_Bit is set (1).

### End-cap Detection and Module Faults

If a module not adjacent to an end cap experiences a fault and the connection to the controller is not broken, only the module enters the fault state. If a module adjacent to an end cap experiences a fault, both the module and the controller transition to the fault state.

## Reconfigure an I/O Module

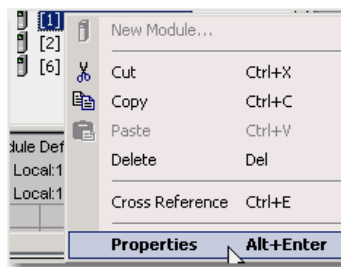
If an I/O module supports reconfiguration, you can reconfigure the module via:

- the Module Properties dialog box in RSLogix 5000 programming software.
- a MSG instruction in program logic.

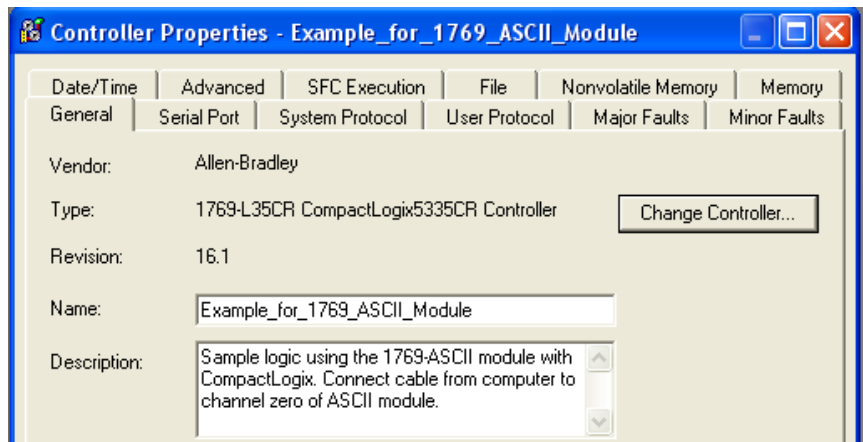
### Reconfigure a Module via RSLogix 5000 Programming Software

To reconfigure an I/O module via RSLogix 5000 programming software, perform this procedure.

1. Highlight the module in the I/O Configuration tree and right-click to choose Properties.



The Controller Properties dialog box appears.



2. Reconfigure the module.

## Reconfigure a Module via a MSG Instruction

To reconfigure an I/O module, use a Module Reconfigure MSG instruction. During the reconfiguration:

- input modules continue to send input data to the controller.
- output modules continue to control their output devices.

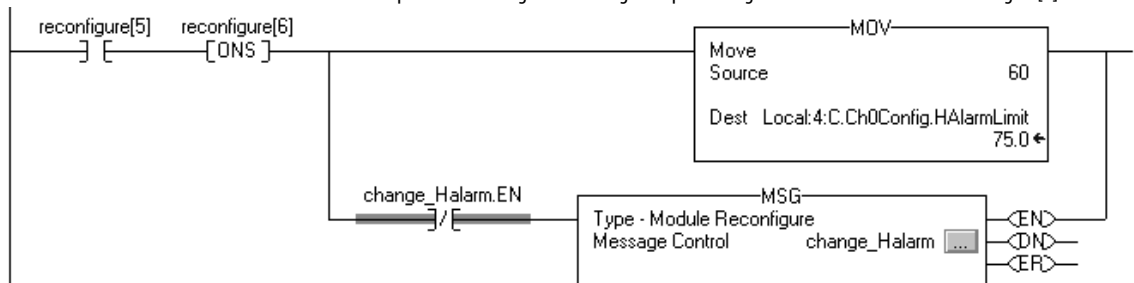
A Module Reconfigure message requires the property Message Type and a selection of Module Reconfigure.

To reconfigure an I/O module, perform this procedure.

1. Set the required member of the configuration tag of the module to the new value.
2. Send a Module Reconfigure message to the module.

### EXAMPLE

When reconfigure[5] is on, the MOV instruction sets the high alarm to 60 for the local module in slot 4. The Module Reconfigure message then sends the new alarm value to the module. The ONS instruction prevents the rung from sending multiple messages to the module while the reconfigure[5] is on.



**Notes:**



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## Develop Applications

This chapter explains how to develop applications.

Topic	Page
Manage Tasks	97
Develop Programs	98
Organize Tags	102
Select a Programming Language	104
Monitor Controller Status	106
Monitor Connections	107
Select a System Overhead Time Slice Percentage	<a href="#">109</a>

### Manage Tasks

With a Logix5000 controller, you can use multiple tasks to schedule and prioritize the execution of your programs based on specific criteria. This divides your controller's processing time among the different operations in your application. Remember that:

- the controller executes only one task at one time.
- one exception task can interrupt another and take control.
- in any given task, only one program executes at one time.

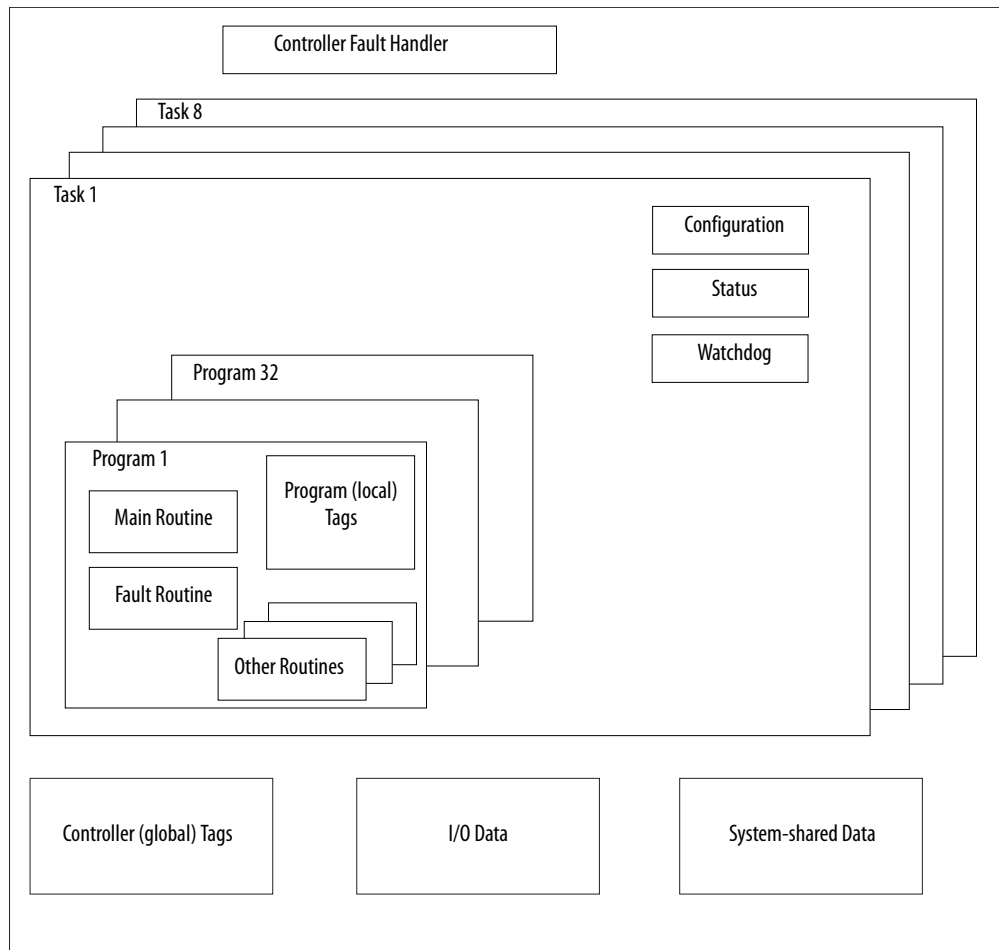
## Develop Programs

The controller's operating system is a preemptive multitasking system that is IEC 1131-3 compliant. This environment provides:

- tasks to configure controller execution.
- programs to group data and logic.
- routines to encapsulate executable code written in a single programming language.

**Figure 18 - Program Development**

Control Application



## Define Tasks

Tasks provide scheduling and priority information for programs. You can configure tasks as continuous, periodic, or event tasks. Only one task can be continuous.

**Table 25 - Task Support**

Controller	Tasks Supported
1769-L35x	8
1769-L32x	6
1769-L31	4

A task can have as many as 32 separate programs, each with its own executable routines and program-scoped tags. Once a task is triggered (activated), all the programs assigned to the task execute in the order in which they are grouped. Programs can only appear once in the Controller Organizer and cannot be shared by multiple tasks.

### *Specify Task Priorities*

Each task in the controller has a priority level. The operating system uses the priority level to determine which task to execute when multiple tasks are triggered. You can configure periodic tasks to execute from the lowest priority of 15 up to the highest priority of 1. A higher-priority task will interrupt any lower-priority task. The continuous task has the lowest priority and is always interrupted by a periodic task.

The CompactLogix controller uses a dedicated periodic task at priority 6 to process I/O data. This periodic task executes at the RPI you configure for the CompactBus, which can be as fast as once each millisecond. Its total execution time is as long as it takes to scan the configured I/O modules.

How you configure your tasks affects how the controller receives I/O data. Tasks at priorities 1...5 take precedence over the dedicated I/O task. Tasks in this priority range can impact I/O processing time. For example, if you use the following configuration:

- I/O RPI = 1 ms
- a task of priority = 1...5 that requires 500  $\mu$ s to execute and is scheduled to run every millisecond

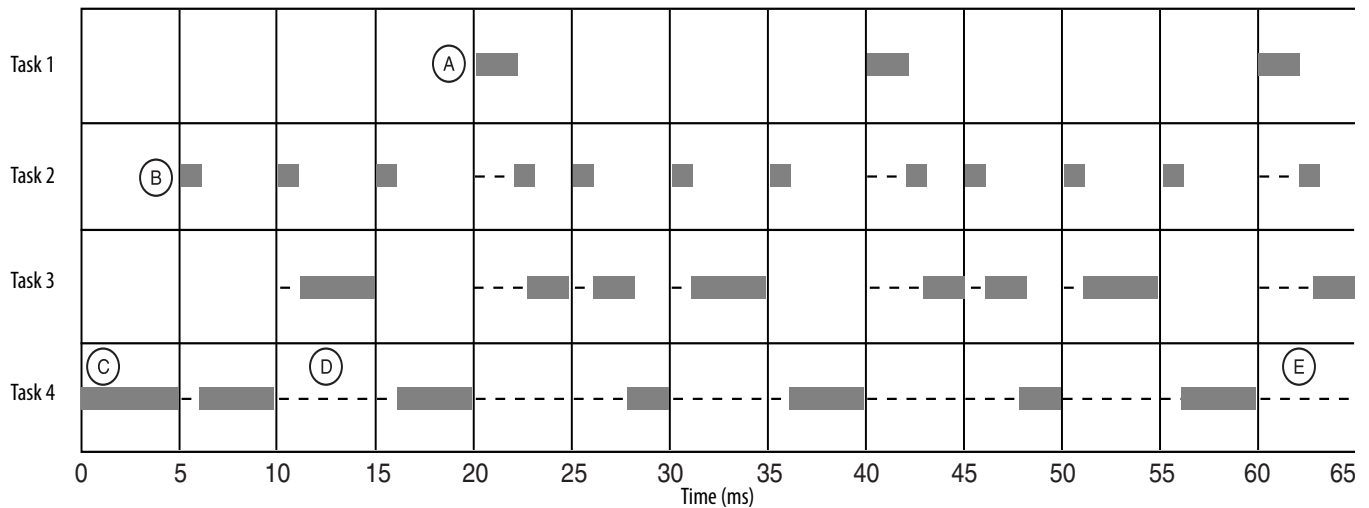
this configuration leaves the dedicated I/O task 500  $\mu$ s to complete its job of scanning the configured I/O.

However, if you schedule two high priority tasks 1...5 to run every millisecond, and they both require 500  $\mu$ s or more to execute, no CPU time would be left for the dedicated I/O task. Furthermore, if you have so much configured I/O that the execution time of the dedicated I/O task approaches 2 ms (or the combination of the high priority tasks and the dedicated I/O task approaches 2 ms) no CPU time is left for low priority tasks 7...15.

**TIP** For example, if your program needs to react to inputs and control outputs at a set rate, configure a periodic task with a priority higher than 6 (1...5). This keeps the dedicated I/O task from affecting the periodic rate of your program. However, if your program contains a lot of math and data manipulation, place this logic in a task with priority lower than 6 (7...15), such as the continuous task, so that the dedicated I/O task is not adversely affected by your program.

**Table 26 - Multiple Tasks Example**

Task	Priority Level	Task Type	Example Execution Time	Worst-Case Completion Time
1	5	20 ms periodic task	2 ms	2 ms
2	7	Dedicated I/O task 5 ms selected RPI	1 ms	3 ms
3	10	10 ms periodic task	4 ms	8 ms
4	None (lowest)	Continuous task	25 ms	60 ms



Remember that:

- the highest priority task interrupts all lower priority tasks.
- the dedicated I/O task can be interrupted by tasks with priority levels 1...5.

The dedicated I/O task interrupts tasks with priority levels 7...15. This task runs at the selected RPI rate scheduled for the CompactLogix system (2 ms in this example).

- the continuous task runs at the lowest priority and is interrupted by all other tasks.
- a lower priority task can be interrupted multiple times by a higher priority task.
- when the continuous task completes a full scan it restarts immediately, unless a higher priority task is running.

## Define Programs

Each program contains:

- program tags.
- a main executable routine.
- other routines.
- an optional fault routine.

Each task can schedule as many as 32 programs.

The scheduled programs within a task execute to completion from first to last. Programs unattached to any task show up as unscheduled programs. You must specify (schedule) a program within a task before the controller can scan the program.

## Define Routines

A routine is a set of logic instructions in a single programming language, such as ladder logic. Routines provide the executable code for the project in a controller. A routine is similar to a program file or subroutine in a PLC or SLC controller.

Each program has a main routine. This is the first routine to execute when the controller triggers the associated task and calls the associated program. Use logic, such as the Jump to Subroutine (JSR) instruction, to call other routines.

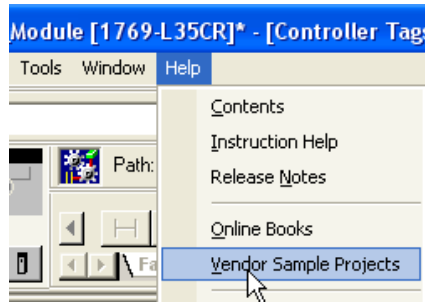
You can also specify an optional program fault routine. The controller executes this routine if it encounters an instruction-execution fault within any of the routines in the associated program.

## Sample Controller Projects

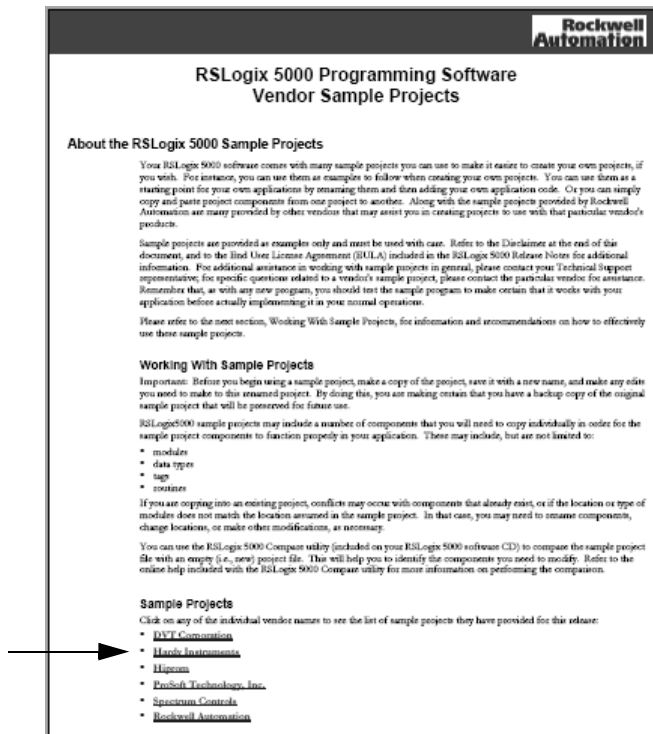
RSLogix 5000 Enterprise programming software includes sample projects that you can copy and then modify to fit your application.

To view a set of sample controller projects, perform this procedure.

1. From the Help pull-down menu, choose Vendor Sample Projects.



2. Scroll down to select a set of sample projects.



## Organize Tags

With a Logix5000 controller, you use a tag (alphanumeric name) to address data (variables). In Logix5000 controllers, there is no fixed, numeric format. The tag name itself identifies the data. This lets you:

- organize your data to mirror your machinery.
- document (through tag names) your application as you develop it.

Figure 19 - Tag Organization

Tag Name	Alias For	Base Tag	Type
north_tank_mix			BOOL
north_tank_pressure			REAL
north_tank_temp			REAL
+one_shots			DINT
+recipe			TANK[3]
+recipe_number			DINT
replace_bit			BOOL
+running_hours			COUNTER
+running_seconds			TIMER
start			BOOL
stop			BOOL

Analog I/O Device → north\_tank\_mix, north\_tank\_pressure, north\_tank\_temp  
 Integer Value → +recipe\_number  
 Storage Bit → replace\_bit  
 Counter → +running\_hours  
 Timer → +running\_seconds  
 Digital I/O Device → start, stop

When you create a tag, assign these properties to the tag:

- Tag type
- Data type
- Scope

## Select a Programming Language

The CompactLogix controller supports these programming languages, both online and offline.

**Table 27 - Programming Language Selection**

Required Language	Program
Ladder diagram (LD)	Continuous or parallel execution of multiple operations (not sequenced)
	Boolean or bit-based operations
	Complex logical operations
	Message and communication processing
	Machine interlocking
	Operations that service or maintenance personnel may have to interpret in order to troubleshoot the machine or process
Function block diagram (FBD)	Continuous process and drive control
	Loop control
	Calculations in circuit flow
Sequential function chart (SFC)	High-level management of multiple operations
	Repetitive sequence of operations
	Batch process
	Motion control using structured text
	State machine operations
Structured text (ST)	Complex mathematical operations
	Specialized array or table loop processing
	ASCII string handling or protocol processing



## Add-on Instructions

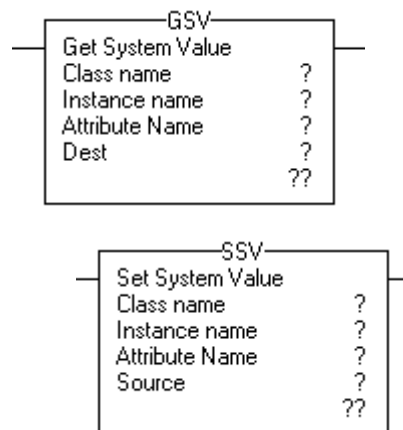
With version 18 of RSLogix 5000 programming software, you can design and configure sets of commonly used instructions to increase project consistency. Similar to the built-in instructions contained in Logix5000 controllers, these instructions you create are called Add-on Instructions. Add-on Instructions reuse common control algorithms. With them, you can:

- ease maintenance by animating logic for a single instance.
- protect intellectual property with locking instructions.
- reduce documentation development time.

You can use Add-on Instructions across multiple projects. You can define your instructions, obtain them from somebody else, or copy them from another project.

Once defined in a project, Add-on Instructions behave similarly to the built-in instructions in Logix5000 controllers. They appear on the instruction tool bar for easy access, as do internal RSLogix 5000 software instructions.

Feature	Description
Save Time	With Add-on Instructions, you can combine your most commonly used logic into sets of reusable instructions. You save time when you create instructions for your projects and then share them with others. Add-on Instructions increase project consistency since commonly used algorithms all work in the same manner, regardless of who implements the project.
Use Standard Editors	You create Add-on Instructions by using one of three RSLogix 5000 software programming editors. <ul style="list-style-type: none"> <li>• Standard Ladder</li> <li>• Function Block Diagram</li> <li>• Structured Text</li> </ul> Once you have created instructions, you can use them in any RSLogix 5000 editor.
Export Add-on Instructions	You can export Add-on Instructions to other projects as well as copy and paste them from one project to another. Give each instruction a unique name so that you don't accidentally overwrite another instruction of the same name.
Add-on Instructions Use Context Views	Context views let you visualize an instruction's logic for a specific instant, simplifying online troubleshooting of your Add-on Instructions. Each instruction contains a revision, a change history, and an auto-generated help page.
Create Custom Help	When you create an instruction, you enter information for the description fields in software dialog boxes, information that becomes what is known as Custom Help. Custom Help makes it easier for users to get the help they need when implementing the instructions.
Apply Source Protection	As the creator of Add-on Instructions, you can limit users of your instruction(s) to read-only access, or you can bar access to the internal logic or local parameters used by the instruction(s). This source protection lets you prevent unwanted changes to your instruction(s) and protects your intellectual property.

*Monitor Controller Status*

The CompactLogix controller uses Get System Value (GSV) and Set System Value (SSV) instructions to get and set (change) controller data. The controller stores system data in objects. There is no status file, as in the PLC-5 processor.

The GSV instruction retrieves the specified information and places it in the destination. The SSV instruction sets the specified attribute with data from the source.

When you enter a GSV/SSV instruction, the programming software displays the:

- valid object classes.
- object names.
- attribute names.

For the GSV instruction, you can get values for all the available attributes. For the SSV instruction, the software displays only those attributes you are allowed to set.

In some cases, there will be more than one of the same type of object, so you might also have to specify the object name. For example, there can be several tasks in your application. Each task has its own TASK object that you access by the task name.


You can access these object classes:

- AXIS
- CONTROLLER
- CONTROLLERDEVICE
- CST
- DF1
- FAULTLOG
- MESSAGE
- MODULE
- MOTIONGROUP

- PROGRAM
- ROUTINE
- SERIALPORT
- TASK
- WALLCLOCKTIME

## Monitor Connections

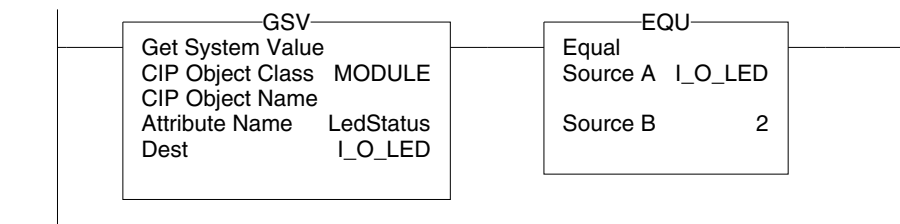
If communication with a device in the I/O configuration of the controller does not occur for 100 ms or 4 times the RPI, whichever is less, the communication times out, and the controller produces these warnings:

- The I/O status indicator on the front of the controller flashes green.
- A  displays over the I/O configuration folder and the device (s) that has timed out.
- A module fault code is produced, which you can access via:
  - the Module Properties dialog box for the module.
  - a GSV instruction.

### Determine if Device Communication Has Timed Out

If communication times out with at least one device (module) in the I/O configuration of the controller, the I/O status indicator on the front of the controller flashes green.

- The GSV instruction gets the status of the I/O status indicator and stores it in the I\_O\_LED tag.
- If I\_O\_LED equals 2, the controller has lost communication with at least one device.



I\_O\_LED is a DINT tag that stores the status of the I/O status indicator on the front of the controller.

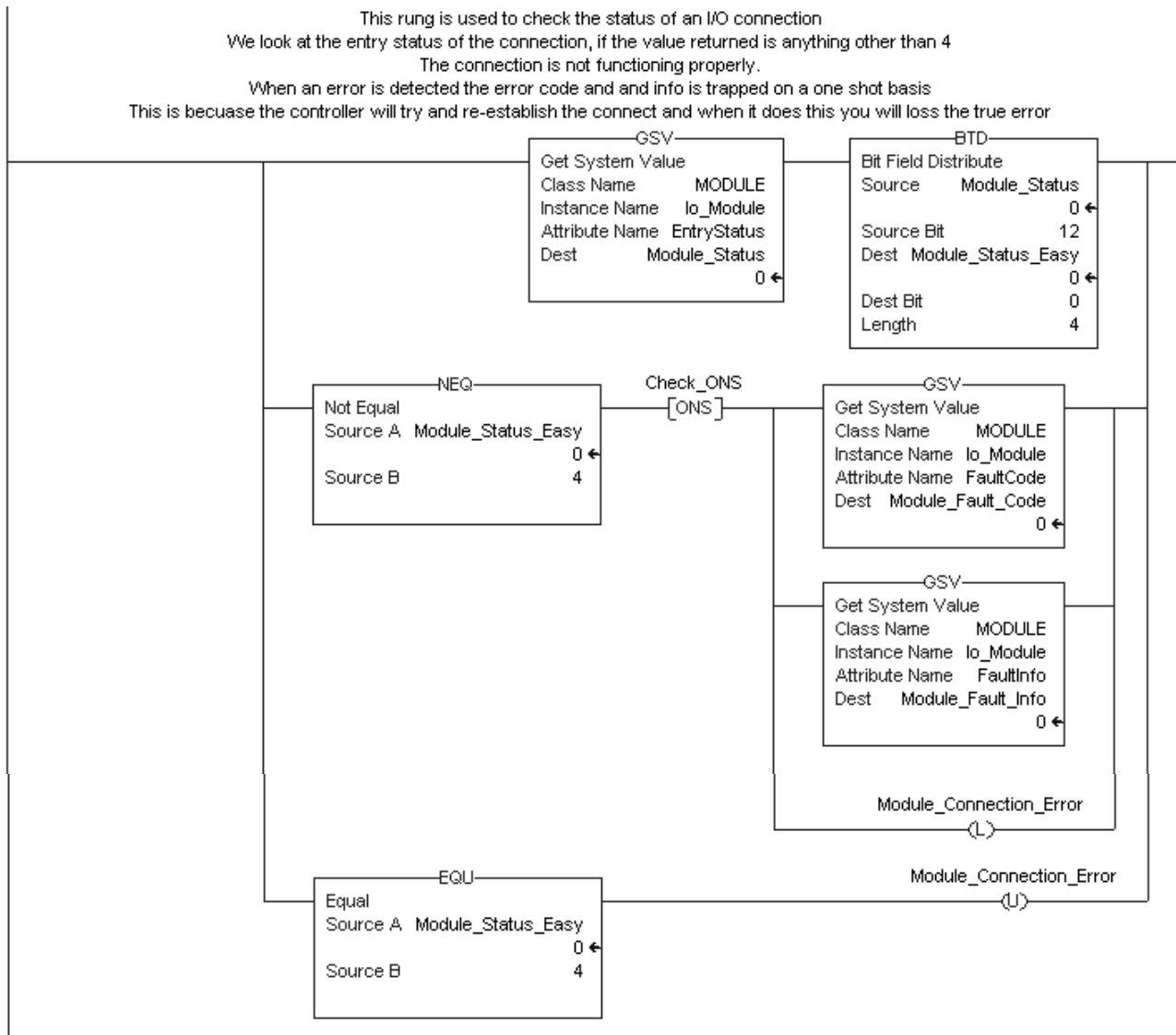
### Determine if I/O Module Communication Has Timed Out

If communication times out with a device (module) in the I/O configuration of the controller, the controller produces a fault code for the module.

- The GSV instruction gets the fault code for IO\_Module and stores it in the Module\_Status tag.
- If Module\_Status is any value other than 4, the controller is not communicating with the module.

**Figure 20 - I/O Module Communication**

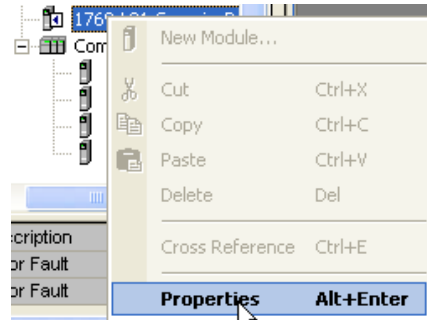
This rung is used to check the status of an I/O connection  
 We look at the entry status of the connection, if the value returned is anything other than 4  
 The connection is not functioning properly.  
 When an error is detected the error code and and info is trapped on a one shot basis  
 This is because the controller will try and re-establish the connect and when it does this you will loss the true error



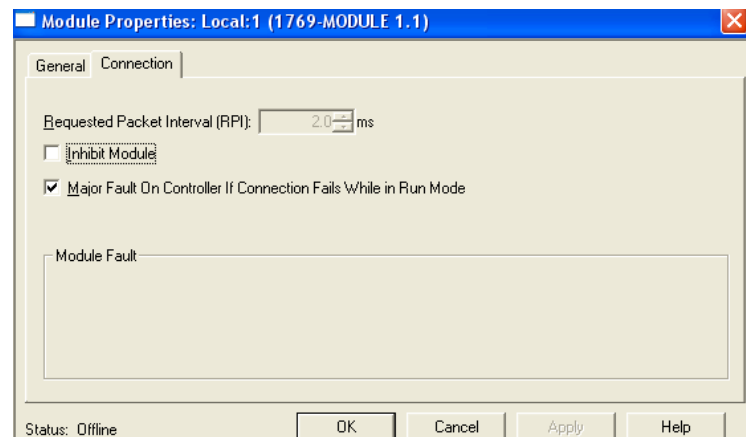
## Interrupt the Execution of Logic and Execute the Fault Handler

To interrupt the execution of logic and execute the fault handler, perform this procedure.

1. In the Controller Organizer of RSLogix 5000 programming software, right-click the module and choose Properties.



The Module Properties dialog box appears.



2. Click the Connection and check Major Fault On Controller If Connection Fails While in Run Mode checkbox.
3. Click OK.
4. Develop a routine for the Controller Fault Handler.

## Select a System Overhead Time Slice Percentage

With RSLogix 5000 programming software, you can specify a percentage for the system overhead time slice. A Logix5000 controller communicates with other devices (I/O modules, controllers, HMI terminals) at either a specified rate (scheduled) or when there is processing time available to service the communication (unscheduled).

Service communication is any communication that you do not configure through the I/O configuration folder of the project.

- The system overhead time slice specifies the percentage of time (excluding the time for periodic or event tasks) that the controller devotes to service communication.

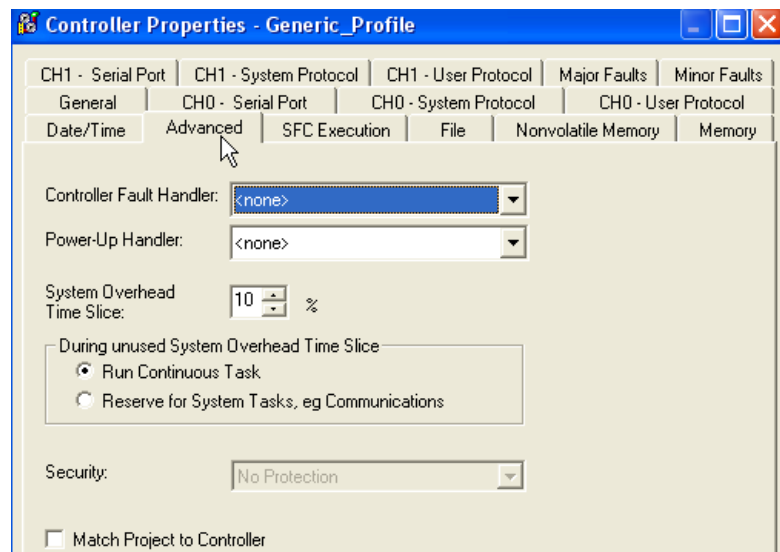
- The controller performs service communication for up to 1 ms at a time and then resumes the continuous task.

To select a system overhead percentage, perform this procedure.

1. In the Controller Organizer of RSLogix 5000 programming software, right-click on your controller and choose Properties.



The Controller Properties dialog box appears.



2. Click the Advanced tab.
3. From the System Overhead Time Slice menu, choose a percentage.

System overhead time slice functions include:

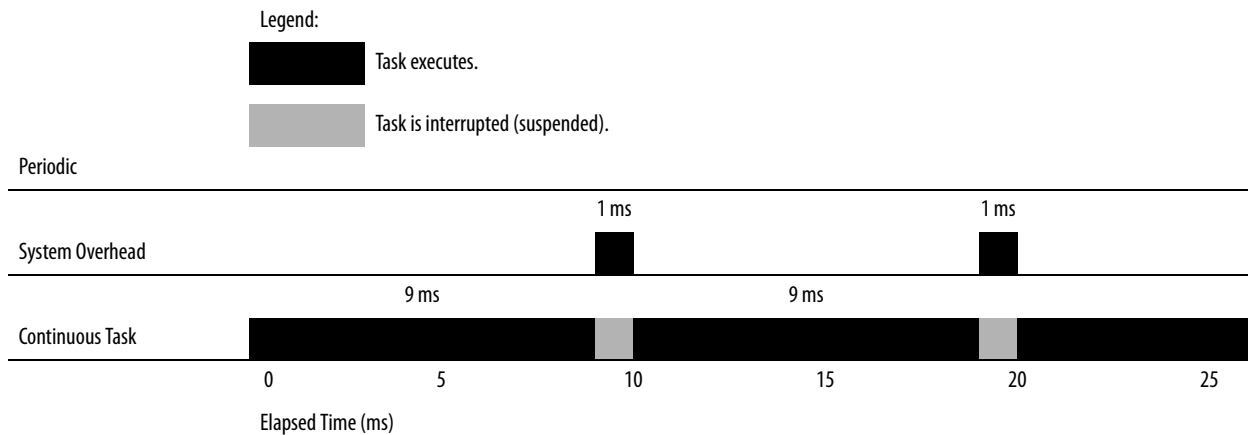
- communicating with programming and HMI devices, such as RSLogix 5000 software.
- responding to messages.
- sending messages.

The controller performs system overhead functions for up to 1 millisecond at a time. If the controller completes the overhead functions in less than one millisecond, it resumes the continuous task.

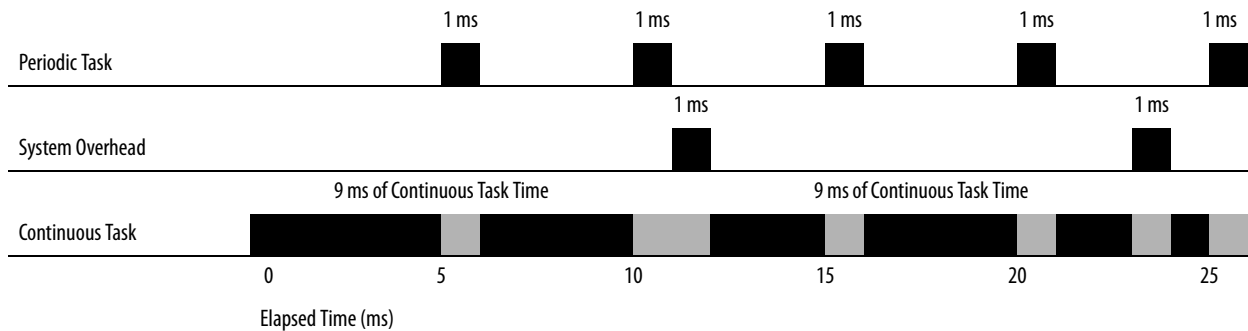
As the system overhead time slice percentage increases, time allocated to executing the continuous task decreases. If there are no communication for the controller to manage, the controller uses the communication time to execute the continuous task. While increasing the system overhead percentage does increase communication performance, it also increases the amount of time it takes to execute a continuous task, increasing overall scan time.

Time Slice (SOTS)	V15 and Lower		V16 and Higher	
	Comms	Continuous Task	Comms	Continuous Task
10%	1 msec	9 msec	1 msec	9 msec
20%	1 msec	4 msec	1 msec	4 msec
33%	1 msec	2 msec	1 msec	2 msec
50%	1 msec	1 msec	1 msec	1 msec
66%	1 msec	0.5 msec	2 msec	1 msec
80%	1 msec	0.2 msec	4 msec	1 msec
90%	1 msec	0.1 msec	9 msec	1 msec

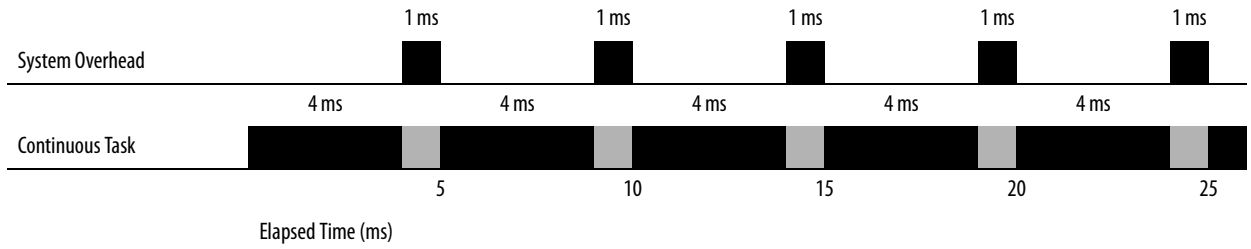
At a time slice of 10%, system overhead interrupts the continuous task every 9 ms of continuous task time.



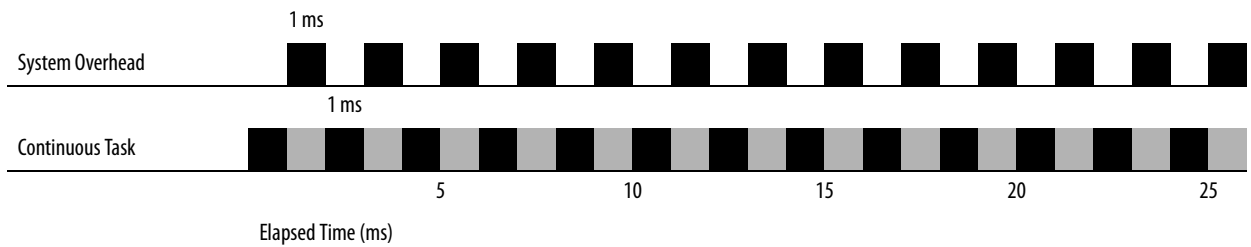
The interruption of a periodic task increases the elapsed time (clock time) between the execution of system overhead functions.



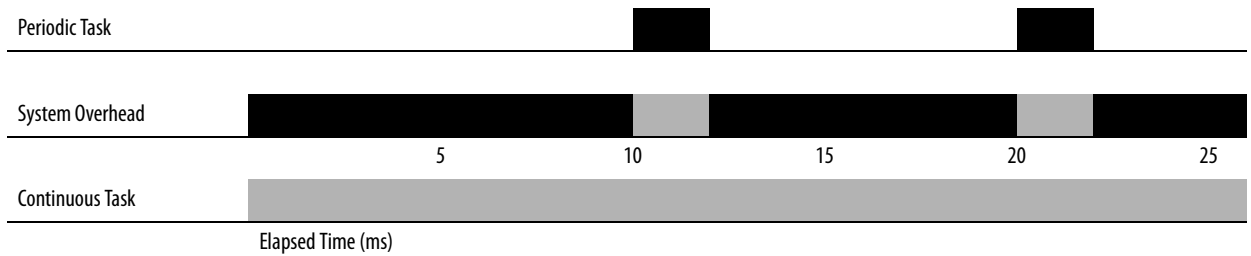
If you use the default time slice of 20%, the system overhead interrupts the continuous task every 4 ms.



If you increase the time slice to 50%, the system overhead interrupts the continuous task every 1 ms.



If the controller contains only a periodic task(s), the system overhead time slice value has no effect. System overhead runs whenever a periodic task is not running.





## Configure PhaseManager

This chapter explains how to configure PhaseManager™.

The PhaseManager option of RSLogix 5000 programming software gives you a state model for your equipment.

Topic	Page
PhaseManager Overview	113
State Model Overview	115
Compare PhaseManager to Other State Models	117
Minimum System Requirements	118
Equipment Phase Instructions	118

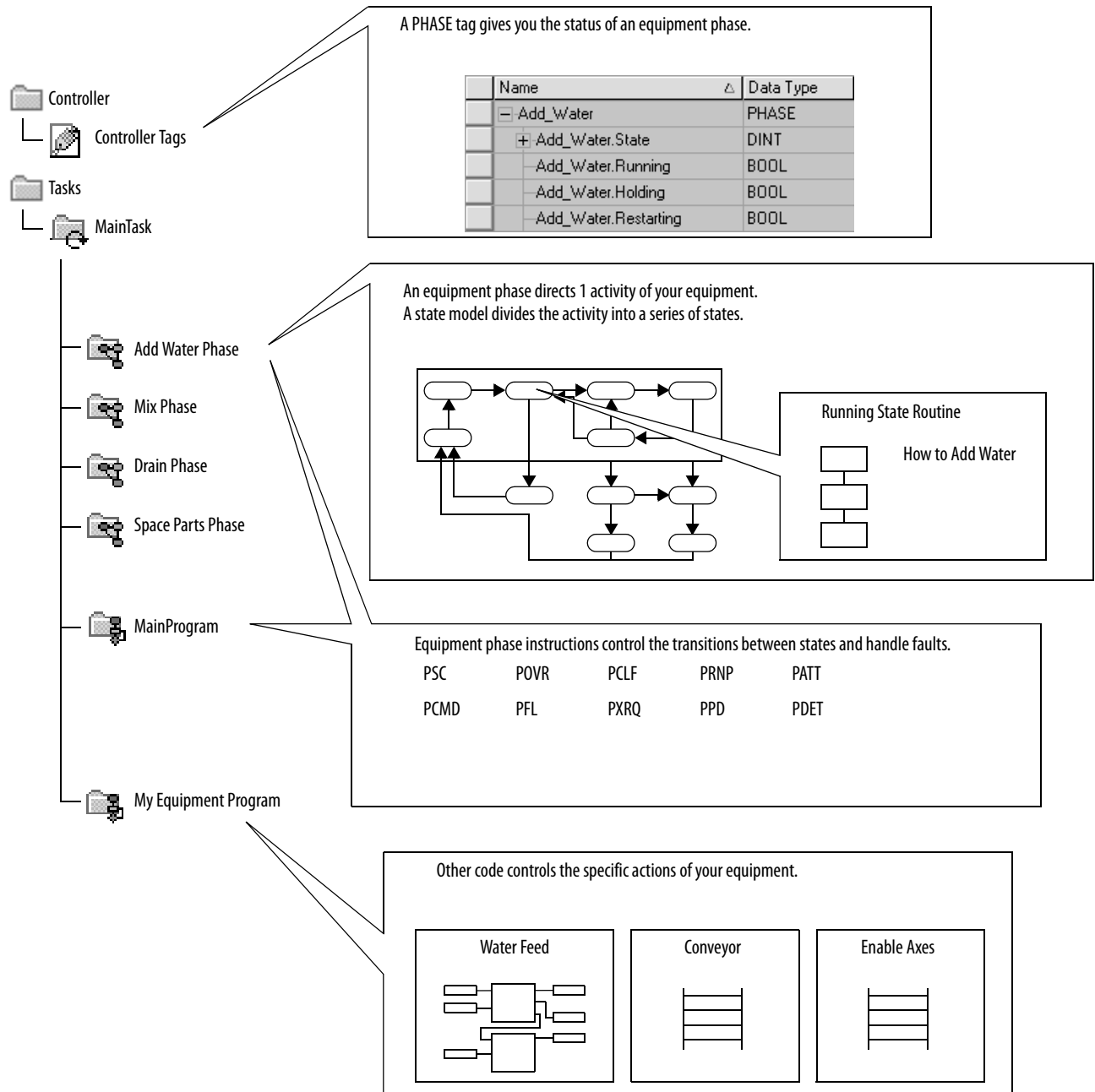
For additional information, consult PhaseManager User Manual, publication [LOGIX-UM001](#).

### PhaseManager Overview

PhaseManager lets you add equipment phases to your controller. An equipment phase helps you lay out your code in sections that are easier to write, find, follow, and change.

Term	Description
Equipment phase	<ul style="list-style-type: none"> <li>As with a program, an equipment phase is run in a task and is given a set of routines and tags.</li> <li>Unlike a program, an equipment phase runs by a state model and lets you do one activity.</li> </ul>
State model	<p>A state model divides the operating cycle of your equipment into a series of states. Each state is an instant in the operation of the equipment. It's the actions or conditions of the equipment at a given time.</p> <p>The state model of an equipment phase is similar to the S88 and PackML state models.</p>
State machine	<ul style="list-style-type: none"> <li>An equipment phase includes an embedded state machine that:</li> <li>calls the main routine (state routine) for an acting state.</li> <li>manages the transitions between states with minimal coding.</li> <li>makes sure that the equipment goes from state to state along an allowable path.</li> </ul>
PHASE tag	When you add an equipment phase, RSLogix 5000 programming software makes a tag, using the PHASE data type.

**Figure 21 - PhaseManager Overview**



## State Model Overview

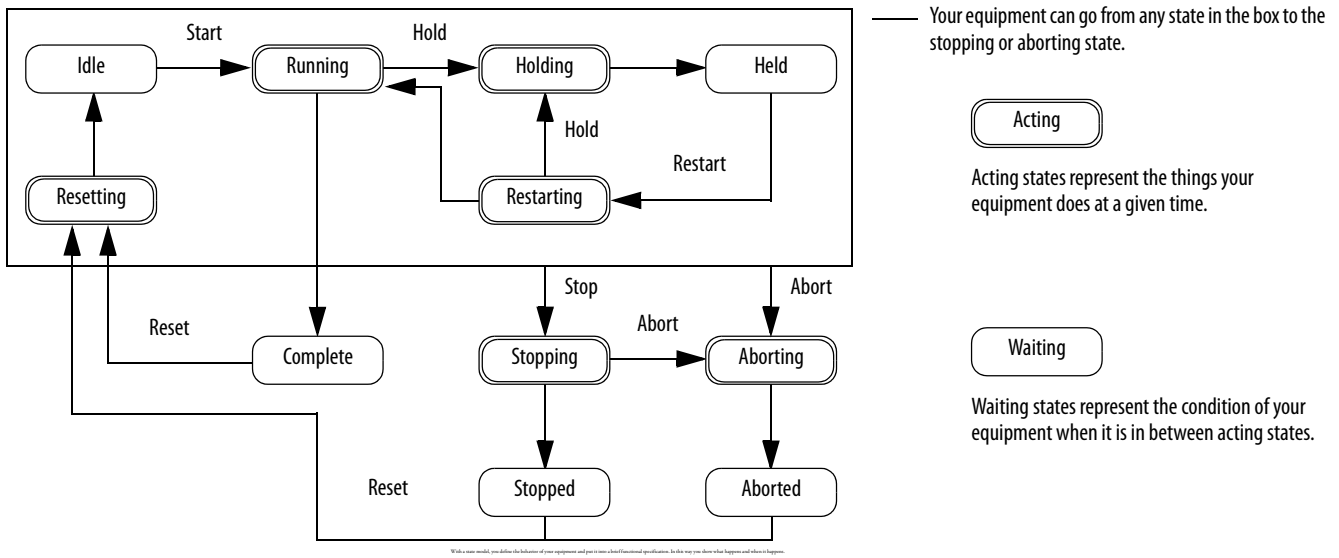
A state model divides the operating cycle of your equipment into a series of states. Each state is an instant in the operation of the equipment, an action or condition at a given time.

In a state model, you define what your equipment does under different conditions, such as run, hold, and stop. You don't need to use all the states for your equipment. Use only needed states.

**Table 28 - Types of States**

State	Description
Acting	Does something or several things for a certain time or until certain conditions are met. An acting state runs one time or repeatedly.
Waiting	Shows that certain conditions are met and the equipment is waiting for the signal to go to the next state.

**Figure 22 - PhaseManager States**



State	Question To Be Asked
Stopped	What happens when you turn on power?
Resetting	How does the equipment get ready to run?
Idle	How do you tell that the equipment is ready to run?
Running	What does the equipment do to make product?
Holding	How does the equipment temporarily stop making product without making scrap?
Held	How do you tell if the equipment is safely holding?
Restarting	How does the equipment resume production after holding?
Complete	How do you tell when the equipment has finished what it had to do?
Stopping	What happens during a normal shutdown?
Aborting	How does the equipment shut down if a fault or failure happens?
Aborted	How do you tell if the equipment is safely shut down?

## How Equipment Changes States

The arrows in the state model show how your equipment can transition from one state to another.

- Each arrow is called a transition.
- A state model lets the equipment make only certain transitions. This transition restriction standardizes equipment behavior so that another piece of equipment using the same model will behave the same way.

Figure 23 - PhaseManager Transitions Overview

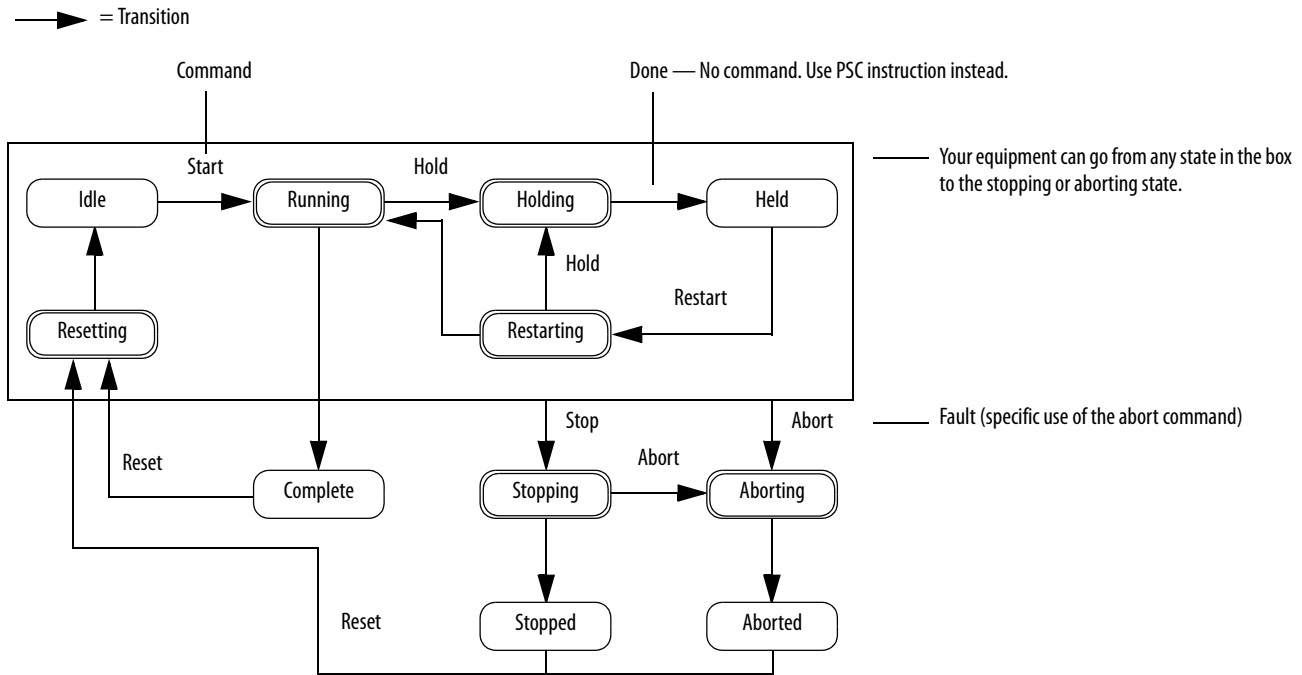


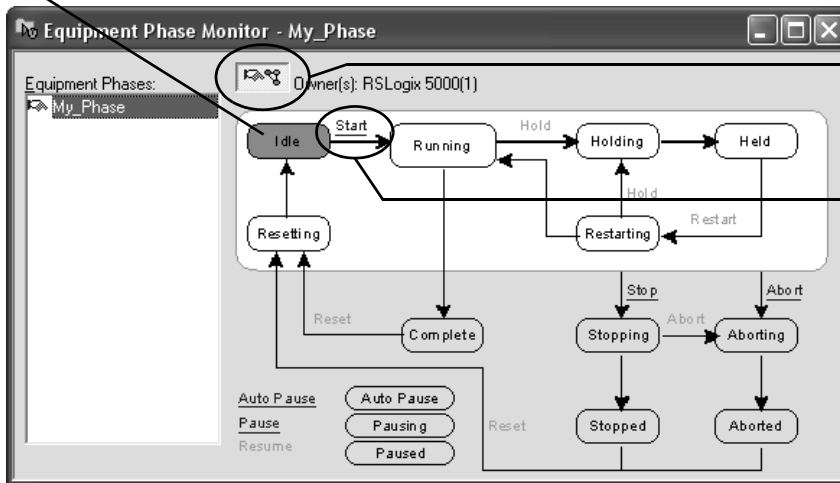
Table 29 - PhaseManager Transition Types

Transition Type	Description
Command	A command tells the equipment to start doing something or do something different. For example the operator pushes the start button to start production and the stop button to halt production. PhaseManager uses these commands: <ul style="list-style-type: none"> <li>• Reset</li> <li>• Start</li> <li>• Stop</li> <li>• Hold</li> <li>• Restart</li> <li>• Abort</li> </ul>
Done	Equipment goes to a waiting state when it has completed a task. You don't have to command equipment to stop. Instead, set up your code to signal when a task is complete.
Fault	A fault tells you that something unusual has occurred. Set up your code to find and take action for faults. Suppose you want your equipment to shut down as fast as possible in case of a certain fault. In that case, set up your code to look for that fault and give the abort command if it finds it.

## Manually Change States

With RSLogix 5000 programming software, you can monitor and command an equipment phase. To manually change states, perform this procedure.

Current State of Equipment Phase



Take ownership of the equipment phase. Give a command.

## Compare PhaseManager to Other State Models

You can compare PhaseManager’s state models to other common state models.

Table 30 - State Model Comparisons

S88	PackML	PhaseManager
Idle	Starting ? Ready	Resetting ? Idle
Running ? Complete	Producing	Running ? Complete
Pausing ? Paused	Standby	Subroutines and/or breakpoints
Holding ? Held	Holding ? Held	Holding ? Held
Restarting	None	Restarting
Stopping ? Stopped	Stopping ? Stopped	Stopping ? Stopped
Aborting ? Aborted	Aborting ? Aborted	Aborting ? Aborted

## Minimum System Requirements

To develop PhaseManager programs, you need:

- a CompactLogix controller with firmware revision 16.0 or later.
- a communication path to the controller.
- RSLogix 5000 programming software, version 15.0 or later.

To enable PhaseManager support, you need the full or professional editions of RSLogix 5000 programming software or the optional PhaseManager add-on (9324-RLDPMENE) to your RSLogix 5000 programming software package.

## Equipment Phase Instructions

With CompactLogix controllers, you can issue many ladder diagram (LD) and structured text (ST) instructions to begin various equipment phases.

Instruction Code	Instruction
PSC	Signal a phase that the state routine is complete so go to the next state
PCMD	Change the state or substate of a phase
PFL	Signal a failure for a phase
PCLF	Clear the failure code of a phase
PXRQ	Initiate communication with RSBizWare Batch software
PRNP	Clear the NewInputParameters bit of a phase
PPD	Set up breakpoints within the logic of a phase
PATT	Take ownership of a phase to either: <ul style="list-style-type: none"> <li>• prevent another program or RSBizWare Batch software from commanding a phase</li> </ul> or <ul style="list-style-type: none"> <li>• make sure another program or RSBizWare Batch software does not already own a phase</li> </ul>
PDET	Relinquish ownership of a phase
POVR	Override a command

## Use a CompactFlash Card

This chapter explains how to use a CompactFlash card for nonvolatile memory or data storage.

Topic	Page
Use a CompactFlash Card to Load/Store a User Application	122
Use a CompactFlash Card for Data Storage	125
Read and Write User Data to the CompactFlash Card	125

CompactLogix controllers only support nonvolatile storage through CompactFlash removable media. CompactLogix controllers support the 1784-CF64 or 1784-CF128 Industrial CompactFlash memory cards for nonvolatile memory.

CompactLogix controllers 1769-L31, 1769-L32E, 1769-L32C, 1769-L35E, and 1769-L35CR can save and restore user applications to CompactFlash memory.

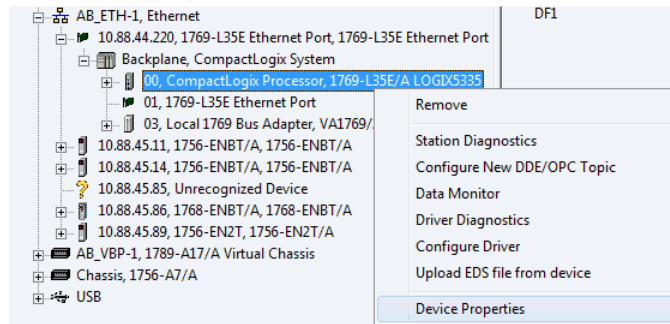
Of the 1769 CompactLogix controllers, only the 1769-L32E and 1769-L35E can store user data (for example, a recipe) to the CompactFlash card during runtime. This feature is supported on 1769-L35E controllers with serial numbers starting with SS0OR9GE, or greater, and 1769-L32E controllers with serial numbers starting with SS0QZ000, or greater. To find the controller's serial number, look on the label on the outside of the controller, or access it electronically in RSLinx software or RSLogix 5000 programming software. You must use firmware version V16, or greater.

### Locate the Controller Serial Number in RSLinx Software

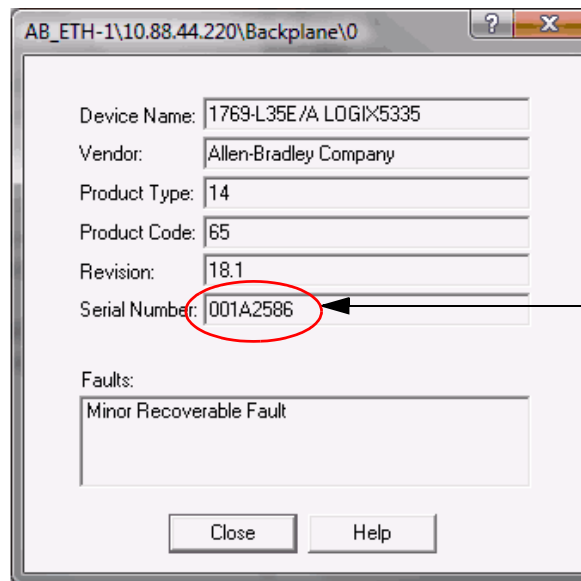
To find the controller's serial number in RSLinx software, follow these steps.

1. Open RSLinx software and from the Communication pull-down menu, choose RSWho.

2. Right-click on the controller in the RSWWho browse window and select Device Properties.



The Device Properties dialog box displays, showing the serial number.



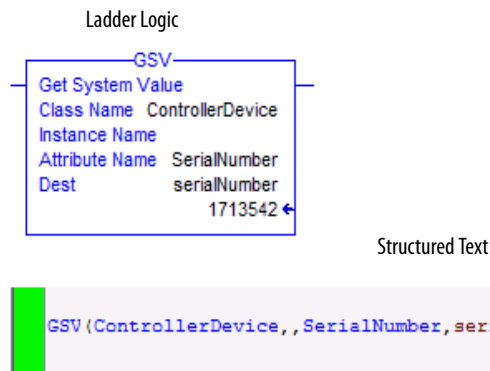
The serial number shown in this example is in hexadecimal format.



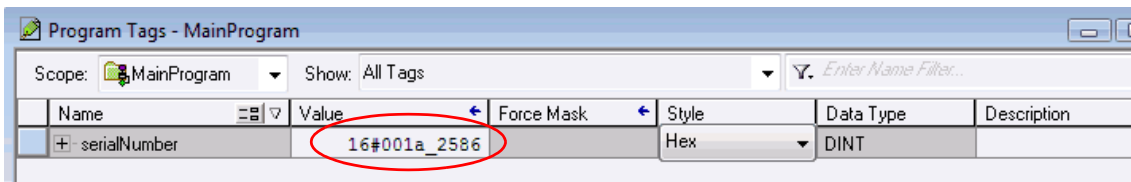
## Locate the Controller Serial Number

### Via the RSLogix 5000 Project

To find the controller's serial number in your RSLogix 5000 project when using ladder logic or structured text, use the Get System Value (GSV) instruction to obtain the value of the Serial Number attribute of the ControllerDevice object.



The value can be shown in RSLogix 5000 programming software's data monitor. When the style is set to Hex, the displayed value is the same as shown in RSLinx software.



Name	Value	Force Mask	Style	Data Type	Description
serialNumber	16#001a_2586		Hex	DINT	

**TIP** If the user wants to access the serial number programmatically, additional logic is needed to obtain the serial number's value.

### Via RSLogix 5000 Programming Software

To find the controller's serial number in RSLogix programming software, follow these steps.

1. In the controller organizer, right-click on the controller and select Properties from the pull-down menu.

The Controller Properties dialog box displays.

2. Click the Advanced tab to see the serial number.

## Use a CompactFlash Card to Load/Store a User Application

You can load the user application/project from nonvolatile memory/ CompactFlash to the user memory of the controller:

- on every power-up.
- on corrupt memory.
- anytime through RSLogix 5000 programming software..



**ATTENTION:** Fault conditions can occur if the controller types do not match. For example, if the CompactFlash user program and controller firmware were created for a 1769-L35E controller, and then an attempt was made to load that program and/or firmware into a 1769-L32E controller.

---

### IMPORTANT

The user application and firmware version on the CompactFlash card is loaded into the controller. If the contents of the CompactFlash card are a different revision than the revision that is on the controller, then the controller will be updated to the revision on the CompactFlash card.

---



**ATTENTION:** Do not remove the CompactFlash card while the controller is reading from or writing to the card, as indicated by a flashing green CF status indicator. Doing so could corrupt the data on the card or in the controller, as well as corrupt the latest firmware in the controller.

---

### IMPORTANT

CompactFlash card memory stores the contents of the user memory when you store the project.

- Changes made after you store the project are not reflected in CompactFlash card memory.
  - If you change the project but do not store those changes, you overwrite them when you load the project from the CompactFlash card. If this occurs, you have to upload or download the project to go online.
  - If you want to store changes such as online edits, tag values, or a ControlNet network schedule, store the project again after you make the changes.
- 

When you store a project to a CompactFlash memory card, the controller formats the card, if required.

## Manually Change Which Project Loads

A CompactFlash card stores multiple projects. By default, the controller loads the project that you most recently stored, according to the load options of that project.

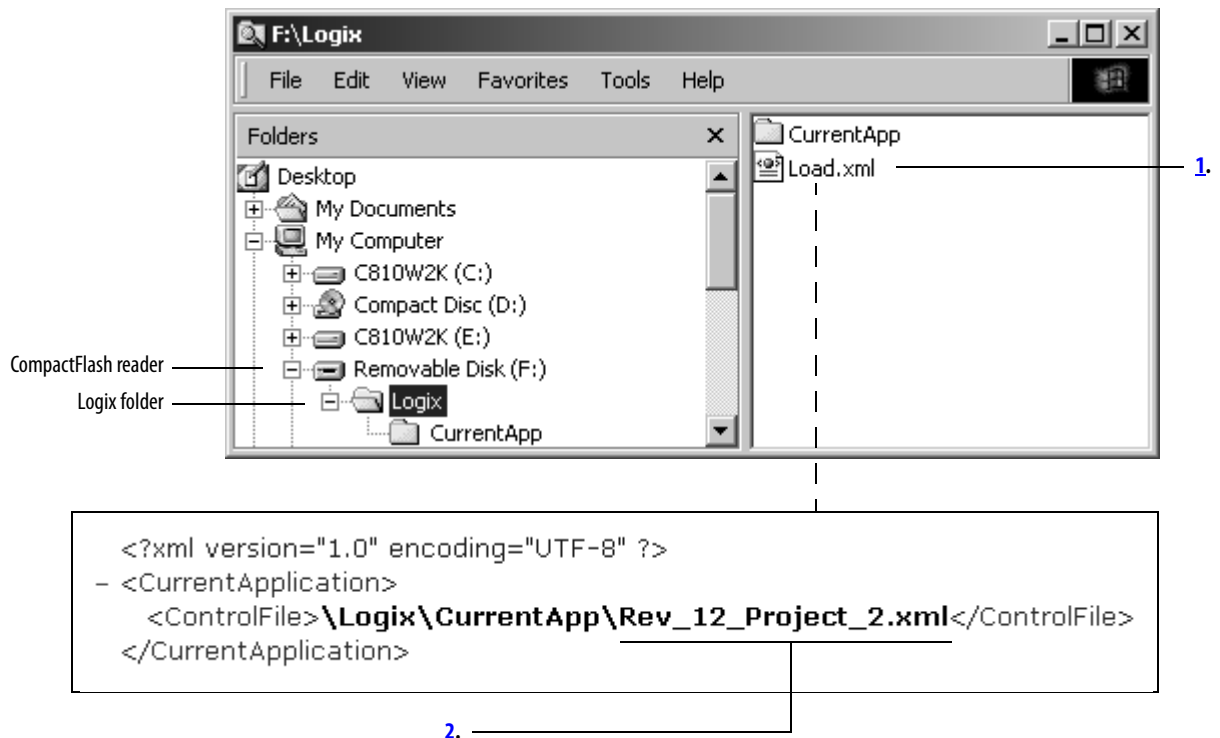
---

### IMPORTANT

Be aware that when loading a different project, the firmware revisions must be the same.

---

To assign a different project to load from the CompactFlash card, edit the *Load.xml* file on the card.



1. To change which project loads from the card, open *Load.xml*. Use a text editor to open the file.
2. Edit the name of the project that you want to load.
  - Use the name of an XML file that is in the *CurrentApp* folder.
  - In the *CurrentApp* folder, a project is comprised of an XML file and a P5K file.

## Manually Change the Load Parameters

When you store a project to a CompactFlash card, you define:

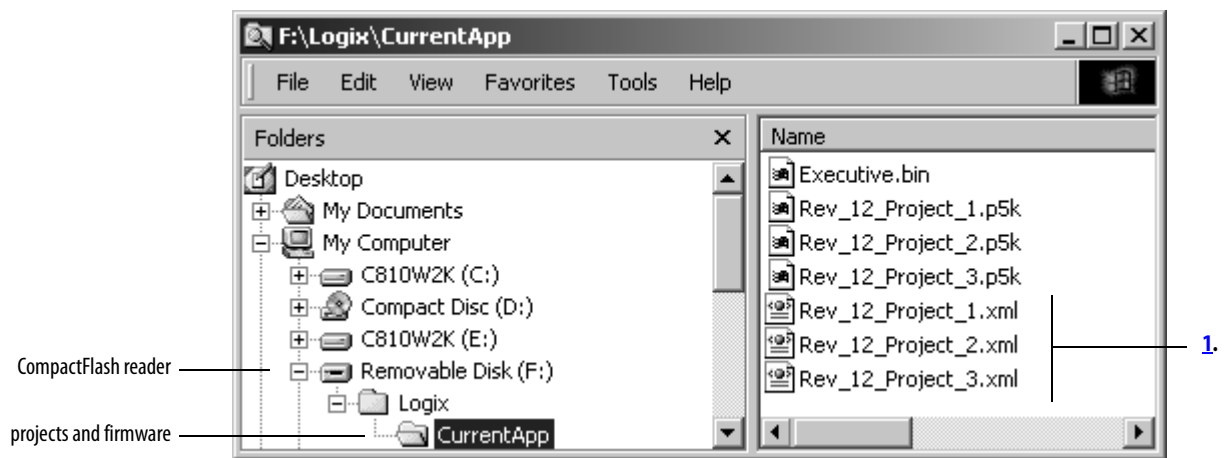
- when the project is to load (On Power Up, On Corrupt Memory, User Initiated).
- mode to which to set the controller (if the keyswitch is in REM and the load mode is not User Initiated).

---

**IMPORTANT** Be aware that when loading a different project, the firmware revisions must be the same.

---

To assign a different project to load from the CompactFlash card, edit the Load.xml file on the card.



1. To change the load parameters for a project, open the XML file with the same name as the project. Use a text editor to open the file.

```

<?xml version="1.0" encoding="UTF-8" ?>
- <Controller>
  - <ExecutiveLoadOption>
    <ExecFile>\Logix\CurrentApp\Executive.bin</ExecFile>
  </ExecutiveLoadOption>
  - <ProgramLoadOption>
    <ProgramLoadMode>CORRUPT_RAM</ProgramLoadMode>
    <LoadFile>\Logix\CurrentApp\Rev_12_Project_2.p5k</LoadFile>
  </ProgramLoadOption>
  - <ControllerModeOption>
    <ControllerMode>RUN</ControllerMode>
  </ControllerModeOption>
</Controller>

```

2. points to the `<ProgramLoadMode>CORRUPT_RAM</ProgramLoadMode>` line.

3. points to the `<ControllerMode>RUN</ControllerMode>` line.

2. Edit the Load Image option of the project.

If you want to set the Load Image option to	Then enter
On Power Up	ALWAYS
On Corrupt Memory	CORRUPT_RAM
User Initiated	USER_INITIATED

3. Edit the Load Mode option of the project (doesn't apply if the Load Image option is *User Initiated*).

If you want to set the Load Mode option to	Then enter
Program (Remote Only)	PROGRAM
Run (Remote Only)	RUN

## Use a CompactFlash Card for Data Storage

You can also store data to the CompactFlash memory card.

For example:

- A PanelView terminal changes tag values in a controller project. If power to the controller is lost (and the controller is not battery backed up), the program running in the controller, along with any values that were changed by the PanelView terminal, will be lost. Use the CompactFlash file system and logic in the project to store tag values as they change. When the project reloads from the CompactFlash card, it can check the CompactFlash card for any saved tag values and reload those into the project.
- Store a collection of recipes on the CompactFlash card. When you need to change a recipe, program the controller to read data for the new recipe from a CompactFlash card.
- Program the controller to write data logs at specific time intervals.

## Read and Write User Data to the CompactFlash Card

A sample controller project that reads and writes from a CompactFlash card is available with RSLogix 5000 Enterprise programming software. To display a list of sample projects from a CompactFlash card, [see Sample Controller Projects on page 102](#).

## Additional Resources

For additional information, consult these publications.

Resource	Description
Logix 5000 Controllers Memory Card Programming Manual, publication <a href="#">1756-PM017</a>	Explains the use of nonvolatile memory, or CompactFlash card memory, with Logix controller, and how to read/write data to a CompactFlash card.
Logix5000 Controllers Common Procedures Manual, publication <a href="#">1756-PM001</a>	Information about using Logix5000 controllers

## Maintain the Battery

This chapter explains how to maintain your battery.

Topic	Page
Battery Handling	127
Check If the Battery Is Low	128
Estimate 1769-BA Battery Life	128
Store Lithium Batteries	129
Battery Removal	129

CompactLogix controllers support the 1769-BA battery.



**ATTENTION:** The 1769-BA battery is the only battery you can use with the CompactLogix controllers. The 1747-BA battery is not compatible with the CompactLogix controllers and may cause problems.

## Battery Handling

Lithium batteries are primary (not rechargeable) cells that give extended memory support for Rockwell Automation products.



**ATTENTION:** This product contains a sealed lithium battery that may need to be replaced during the life of the product.

At the end of its life, the battery contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

## Check If the Battery Is Low

The battery indicator (BAT) warns when the battery is low. Once the controller is powered down, the battery retains controller memory as long as the BAT indicator remains on. Temperature dictates how long the BAT indicator remains on.

Figure 24 - Battery Status Indicator

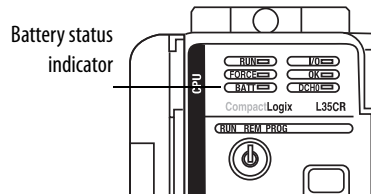


Table 31 - BAT Indicator Duration

Temperature	Duration
60 °C (140 °F)	8 days
25 °C (77 °F)	25 days

## Estimate 1769-BA Battery Life

Certain conditions affect typical battery life.

Table 32 - Battery Life Estimations

Time On/Off	At 25 °C (77 °F)	At 40 °C (104 °F)	At 60 °C (140 °F)
Always on	14 months	12 months	9 months
On 8 hours per day 5 days per week	18 months	15 months	12 months
On 16 hours per day 5 days per week	26 months	22 months	16 months
Always On	There is almost no drain on the battery when the controller is always on.		



## Store Lithium Batteries



**ATTENTION:** Follow these general rules to store your batteries.

- Store batteries in a cool, dry environment. We recommend 25 °C (77 °F) with 40 . . .60% relative humidity.
- Regularly monitor the temperature and humidity of the storage area.
- Use a first-in/first-out system for handling stored batteries.
- Store in the original containers away from flammable materials.
- Keep track of storage time. Reference storage time to the date of manufacture.
- Do not store batteries longer than 10 years.
- Do not store used batteries longer than 3 months before disposal.
- Clearly mark the contents of the storage area.
- Place a Lith-X or Class D Powder fire extinguisher in a readily accessible area in or around the storage area.
- Ventilate and protect the storage area against fire. You must have a system that automatically detects and extinguishes fires and automatically activates an alarm signal.
- Do not smoke in the storage area.

**Table 33 - Storage Temperatures for 1769-BA Lithium Batteries**

Storage Temperature	Capacity Loss
40 °C (104 °F) for 5 years	Loses up to 4% of original capacity
60 °C (140 °F)	Loses 2.5 % of capacity each year

- You may store batteries for up to 30 days between -45...85 °C (-49...185 °F) such as during transportation. Do not store in temperatures above 85° C (185 °F).
- To avoid leakage or other hazards, do not store batteries above 60° C for more than 30 days.
- The rate of capacity loss increases as storage temperature increases.

## Battery Removal



**WARNING:** When you connect or disconnect the battery, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

## Additional Resources

For additional information, consult this publication.

Resource	Description
Guidelines for Handling Batteries, publication <a href="#">AG 5-4</a>	Detailed information on battery-handling procedures for the 1769-BA lithium battery.

## Status Indicators

### Introduction

This appendix explains how to interpret the status indicators on your CompactLogix controllers.

Topic	Page
1769-L3xx Controllers Status Indicators	131
RS-232 Serial Port Status Indicators	133
ControlNet Indicators	134
EtherNet/IP Indicators	136

### 1769-L3xx Controllers Status Indicators

These are the 1769-L3xx CompactLogix controller status indicators.

Indicator	Condition	Interpretation
RUN	Off	The controller is in program or test mode.
	Steady green	The controller is in run mode.
FORCE	Off	<ul style="list-style-type: none"> <li>No tags contain I/O force values.</li> <li>I/O forces are inactive (disabled).</li> </ul>
	Steady amber	<ul style="list-style-type: none"> <li>I/O forces are active (enabled).</li> <li>I/O force values may or may not exist.</li> </ul>
	Flashing amber	One or more input or output addresses have been forced to an On or Off condition, but the forces have not been enabled.
BAT	Off	The battery supports memory.
	Steady red	<ul style="list-style-type: none"> <li>The battery is:</li> <li>not installed.</li> <li>95% discharged and should be replaced.</li> </ul>
I/O	Off	<ul style="list-style-type: none"> <li>There are no devices in the I/O configuration of the controller.</li> <li>The controller does not contain a project.</li> </ul>
	Steady green	The controller is communicating with all the devices in its I/O configuration.
	Flashing green	One or more devices in the I/O configuration of the controller are not responding.
	Flashing red	<ul style="list-style-type: none"> <li>The controller is not communicating with any devices.</li> <li>The controller is faulted.</li> </ul>

Indicator	Condition	Interpretation									
OK	Off	No power is applied.									
	Flashing red	<ul style="list-style-type: none"> <li>The controller requires a firmware update.</li> <li>A major recoverable fault occurred on the controller. To clear the fault, perform this procedure.                             <ol style="list-style-type: none"> <li>Turn the controller keyswitch from PROG to RUN to PROG.</li> <li>Go online with RSLogix 5000 programming software.</li> </ol> </li> <li>A nonrecoverable major fault occurred on the controller. In this case, the controller:                             <ol style="list-style-type: none"> <li>initially displays a steady red status indicator.</li> <li>resets itself.</li> <li>clears the project from its memory.</li> <li>sets the status indicator to flashing red.</li> <li>produces a major recoverable fault.</li> <li>generates a fault code in the RSLogix 5000 project.</li> </ol> </li> </ul> <p>The fault code displayed in RSLogix 5000 programming software, and the subsequent fault recovery method, depends on whether you have installed a CompactFlash card in the controller.</p> <table border="1"> <thead> <tr> <th>Code</th> <th>Condition</th> <th>Fault recovery method</th> </tr> </thead> <tbody> <tr> <td>60</td> <td>CompactFlash card is not installed.</td> <td>                             A. Clear the fault.                              B. Download the project.                              C. Change to Remote Run/Run mode.                               If the problem persists:                              A. Before you cycle power to the controller, record the state of the OK and RS232 status indicators.                              B. Contact Rockwell Automation support. See the back cover.                         </td> </tr> <tr> <td>61</td> <td>CompactFlash is installed.</td> <td>                             A. Clear the fault.                              B. Download the project.                              C. Change to Remote Run/Run mode.                               If the problem persists, contact Rockwell Automation support. See the back cover.                         </td> </tr> </tbody> </table>	Code	Condition	Fault recovery method	60	CompactFlash card is not installed.	A. Clear the fault. B. Download the project. C. Change to Remote Run/Run mode.  If the problem persists: A. Before you cycle power to the controller, record the state of the OK and RS232 status indicators. B. Contact Rockwell Automation support. See the back cover.	61	CompactFlash is installed.	A. Clear the fault. B. Download the project. C. Change to Remote Run/Run mode.  If the problem persists, contact Rockwell Automation support. See the back cover.
	Code	Condition	Fault recovery method								
	60	CompactFlash card is not installed.	A. Clear the fault. B. Download the project. C. Change to Remote Run/Run mode.  If the problem persists: A. Before you cycle power to the controller, record the state of the OK and RS232 status indicators. B. Contact Rockwell Automation support. See the back cover.								
	61	CompactFlash is installed.	A. Clear the fault. B. Download the project. C. Change to Remote Run/Run mode.  If the problem persists, contact Rockwell Automation support. See the back cover.								
Steady red	<p>The controller detected a nonrecoverable major fault, so it cleared the project from memory. To recover from a major fault, perform this procedure.</p> <ol style="list-style-type: none"> <li>Cycle power to the chassis.</li> <li>Download the project.</li> <li>Change to Run mode.</li> </ol> <p>If the OK status indicator remains steady red, contact your Rockwell Automation representative or local distributor.</p>										
Steady green	Controller is OK.										
Flashing green	The controller is storing or loading a project to or from nonvolatile memory.										

## CompactFlash Indicator

This is the CompactFlash card status indicator present on all CompactLogix controllers.



**ATTENTION:** Do not remove the CompactFlash card while the controller is reading from or writing to the card, as indicated by a flashing green CF status indicator. This could corrupt the data on the card or in the controller, as well as corrupt the latest firmware in the controller.

Indicator	Condition	Interpretation
CF	Off	There is no activity.
	Flashing green	The controller is reading from or writing to the CompactFlash card.
	Flashing red	CompactFlash card does not have a valid file system.

## RS-232 Serial Port Status Indicators

These are the RS-232 serial port status indicators present on all CompactLogix controllers.

Indicator	Condition	Interpretation
DCH0	Off	Channel 0 configuration differs from the default serial configuration.
	Steady green	Channel 0 has the default serial configuration.
CH0	Off	No RS-232 activity.
	Flashing green	RS-232 activity.
CH1 (1769-L31 only)	Off	No RS-232 activity.
	Flashing green	RS-232 activity.

## ControlNet Indicators

The ControlNet indicators are only on the 1769-L32C and 1769-L35CR controllers.

Use these indicators to determine how your CompactLogix 1769-L32C or 1769-L35CR controller is operating on the ControlNet network:

- Module Status
- Network Status

These indicators provide information about the controller and network when the controller is connected to ControlNet via the BNC connectors.

**Table 34 - ControlNet Network Status Indicator States**

Status Indicator State	Interpretation
Steady	The indicator is on continuously in the defined state.
Alternating	When viewed together, two indicators alternate between two defined states; the two indicators are always in opposite states, out of phase.
Flashing	When viewed independent of another, an indicator alternates between the two defined states; if both indicators are flashing, they flash together, in phase.

### IMPORTANT

Keep in mind that the Module Status indicator reflects the module state (for example, self-test, firmware update, normal operation but no connection established). The network status indicators, A and B, reflect network status. Remember that the host is able to engage in local messaging with the card although it is detached from the network. Therefore, the Module Status indicator is flashing green if the host has successfully started the card. Note, however, that until the host removes reset, all communication port status indicators.

When you view the indicators, always view the Module Status indicator first to determine the state of the communication port. This information may help you to interpret the network indicators. As a general practice, view all indicators (Module Status and Network Status) together to gain a full understanding of the daughtercard's status.

## Module Status (MS) Indicator

Indicator	Condition	Recommended Action
Off	The controller has no power.	Apply power.
	The controller is faulted.	Make sure that the controller is firmly seated in the slot.
Steady red	A major fault has occurred on the controller.	1. Cycle power. 2. If the problem persists, replace the controller.
Flashing red	A minor fault has occurred because a firmware update is in progress.	Normal operation - No action is required.
	A node address switch change has occurred. The controller's node address switches may have been changed since power-up.	Change the node address switches back to the original setting. The module will continue to operate properly.
	The controller uses invalid firmware.	Update the controller firmware with the ControlFlash Update utility.
	The controller's node address duplicates that of another device.	1. Remove power. 2. Change the node address to a unique setting. 3. Reapply power.
Steady green	Connections are established.	Normal operation - No action is required.
Flashing green	No connections are established.	Establish connections, if necessary.
Flashing red/green	The controller is diagnosing a problem.	Wait briefly to see if problem corrects itself. If problem persists, check the host. If the daughtercard cannot communicate with the host, the card may remain in self-test mode.

## Network Channel Indicators

Channel B is only labelled on the 1769-L35CR controller. The 1769-L32C controller only has channel A but uses the second indicator in some status indicator patterns as described below.

Indicator	Condition	Recommended Action
Off	A channel is disabled.	Program network for redundant media, if necessary.
Steady green	Normal operation is occurring.	Normal operation - No action is required.
Flashing green/off	Temporary network errors have occurred.	1. Check media for broken cables, loose connectors, and missing terminators. 2. If condition persists, refer to the ControlNet Planning and Installation Manual, publication 1786-6.2.1.
	The node is not configured to go online.	Make sure the network keeper is present and working and the selected address is less or equal to the UMAX <sup>(1)</sup> .
Flashing red/off	Media fault has occurred.	1. Check media for broken cables, loose connectors, and missing terminators. 2. If condition persists, refer to the ControlNet Planning and Installation Manual, publication 1786-6.2.1.
	No other nodes are present on the network.	Add other nodes to the network.
Flashing red/green	The network is configured incorrectly.	Reconfigure the ControlNet network so that UMAX is greater than or equal to the card's node address.
Off	You should check the MS indicators.	Check the MS indicators.
Steady red	The controller is faulted.	1. Cycle power. 2. If the fault persists, contact your Rockwell Automation representative or distributor.
Alternating red/green	The controller is performing a self test.	Normal operation - No action is required.
Alternating red/off	The node is configured incorrectly.	Check the card's network address and other ControlNet configuration parameters.

(1) UMAX is the highest node address on a ControlNet network that can transmit data.

## EtherNet/IP Indicators

The EtherNet/IP indicators are only on 1769-L32E and 1769-L35E controllers.

### Module Status (MS) Indicator

Indicator	Condition	Recommended Action
Off	The controller does not have power.	Check the controller power supply.
Flashing green	The port is in standby mode; it does not have an IP address and is operating in BOOTP mode.	Verify that the BOOTP server is running.
Steady green	The port is operating correctly.	Normal operation - No action is required.
Steady red	The controller is holding the port in reset or the controller has faulted.	1. Clear the controller fault. 2. If the fault will not clear, replace the controller.
	The port is performing its power-up self test.	Normal operation - No action is required.
	A nonrecoverable fault has occurred.	1. Cycle power to the controller. 2. If the fault will not clear, replace the controller.
Flashing red	The port firmware is being updated.	Normal operation - No action is required.

### Network Status (NS) Indicator

Indicator	Condition	Recommended Action
Off	The port is not initialized; it does not have an IP address and is operating in BOOTP mode.	Verify that the BOOTP server is running.
Flashing green	The port has an IP address, but no CIP connections are established.	<ul style="list-style-type: none"> <li>If no connections are configured, no action is required.</li> <li>If connections are configured, check connection originator for connection error code.</li> </ul>
Steady green	The port has an IP address and CIP connections (Class 1 or Class 3) are established.	Normal operation - No action is required.
Steady red	The port has detected that the assigned IP address is already in use.	Verify that all IP addresses are unique.
Flashing red/green	The port is performing its power-up self test.	Normal operation - No action is required.

### Link Status (LNK) Indicator

Indicator	Condition	Recommended Action
Off	The port is not connected to a powered Ethernet device. Therefore, the port cannot communicate on Ethernet.	1. Verify that all Ethernet cables are connected. 2. Verify that Ethernet switch is powered.
Flashing green	The port is performing its power-up self-test.	Normal operation - No action is required.
	The port is communicating on Ethernet.	
Steady green	The port is connected to a powered Ethernet device. Therefore, the port can communicate on Ethernet.	



---

## Dynamic Memory Allocation in CompactLogix Controllers

### Introduction

This appendix explains the dynamic allocation of memory in CompactLogix controllers.

Topic	Page
Messages	138
RSLinx Tag Optimization	138
Trends	138
DDE/OPC Topics	139

Certain operations cause the controller to dynamically allocate and remove user-available memory, affecting the space available for program logic. As these functions become active, memory is allocated. Memory is then removed when these functions become inactive.

Operations that dynamically allocate memory are:

- messages.
- connections to processors with RSLogix 5000 programming software.
- RSLinx tag optimization.
- trends.
- DDE/OPC topics.

## Messages

Messages come in and go out of the controller via the Ethernet, ControlNet, and serial ports, causing memory allocation. The memory allocations for messages destined to I/O are accounted for in these allocations. To prevent message instructions from using too much memory, do not send messages simultaneously.

**Table 35 - Message Types**

Message Path		Connection Established?	Memory Allocated
ControlNet Port	Incoming	Yes - The message is connected.	1200 bytes
		No - The message is unconnected.	1200 bytes
	Outgoing	All outgoing messages whether connected or unconnected	1200 bytes
Ethernet Port	Incoming	Yes - The message is connected.	1200 bytes
		No - The message is unconnected.	1200 bytes
	Outgoing	All outgoing messages whether connected or unconnected	1200 bytes
Serial Port	Incoming	All incoming messages whether connected or unconnected	1200 bytes
	Outgoing	All outgoing messages whether connected or unconnected	1200 bytes

## RSLinx Tag Optimization

With tag optimization, trend objects, trend drivers, and connections allocate memory.

**Table 36 - Tag Functions**

Item	Description	Memory Allocated
Trend Object	Object is created in the controller to group the requested tags. One trend object can handle approximately 100 tags.	80 bytes
Trend Driver	Drive is created to communicate with the trend object.	36 bytes
Connection	Connection is created between the controller and RSLinx.	1200 bytes

**EXAMPLE** To monitor 100 points:  
 100 points x 36 bytes = 3600 bytes (Trend Driver)  
 3600 (Trend Driver) + 80 (Trend Object) + 1200 (Connection)  
 = approximately 4000 bytes  
 We estimate that one tag consumes about 40 bytes of memory.

## Trends

Each trend created in a controller creates a trend object and allocates a buffer for logging.

**Table 10.A Controller Trends**

Item	Memory Allocated
Trend Object	80 bytes
Log Buffer	4000 bytes

## DDE/OPC Topics

A DDE/OPC topic uses connections based on these variables:

- Maximum number of messaging connections per controller configured in RSLinx
- Number of connections needed to optimize throughput
- Configuration of RSLinx to use connections for writing to a ControlLogix controller

---

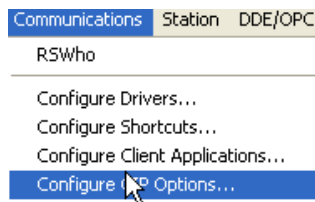
**IMPORTANT** These variables are per path. For example, if you set up two different DDE/OPC topics, with different paths to the same controller, the variables limit the connections for each path. Therefore, if you have a limit of 5 connections, it is possible to have 10 connections, with 5 over each path.

---

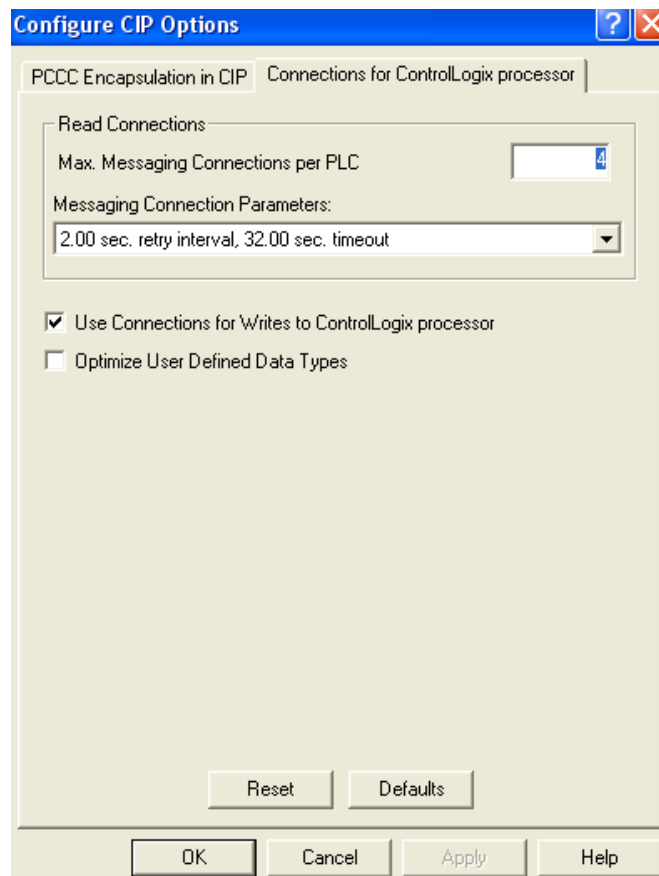
## Specify Connections per Controller

To specify the maximum messaging connections per controller, perform this procedure.

1. In RSLinx programming software, from the Communication pull-down menu, choose Configure CIP Options.



The Configure CIP Options dialog box appears.



2. In the Max. Messaging Connections per PLC field, enter the maximum number of read connections you want a particular workstation to make to a ControlLogix controller.
3. Click OK.

### *Specify Number of Connections Needed to Optimize Throughput*

To specify the number of connections needed to optimize throughput, perform this procedure.

1. Repeat step 1 from the previous procedure.
2. In the Configure CIP Options dialog box, click the Use Connections for Writes to ControlLogix processor checkbox.

---

**IMPORTANT** Once you have selected this feature, you cannot limit the number of connections established.

---

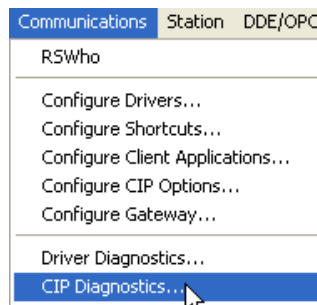
## Number of Connections Needed to Optimize Throughput

RSLinx software only opens the number of connections required to optimize throughput. For example, if you have one tag on scan, but have configured RSLinx software to allow five connections as the maximum number of connections, RSLinx software only opens one connection for the tag. Conversely, if you have thousands of tags on scan and limit the maximum number of CIP connections to five, RSLinx software cannot establish more than five connections to the CompactLogix controller. RSLinx software then funnels all of the tags through those five available connections.

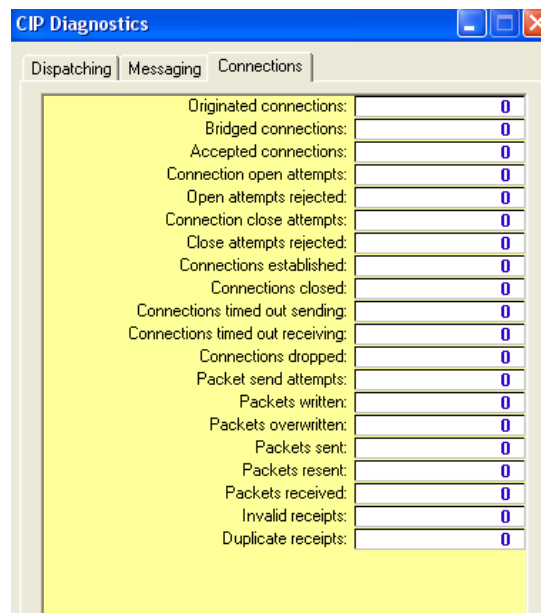
## View the Number of Open Connections

To view the number of open connections made from your workstation to the CompactLogix controller, perform this procedure.

1. In RSLinx programming software, from the Communication pull-down menu, choose CIP Diagnostics.



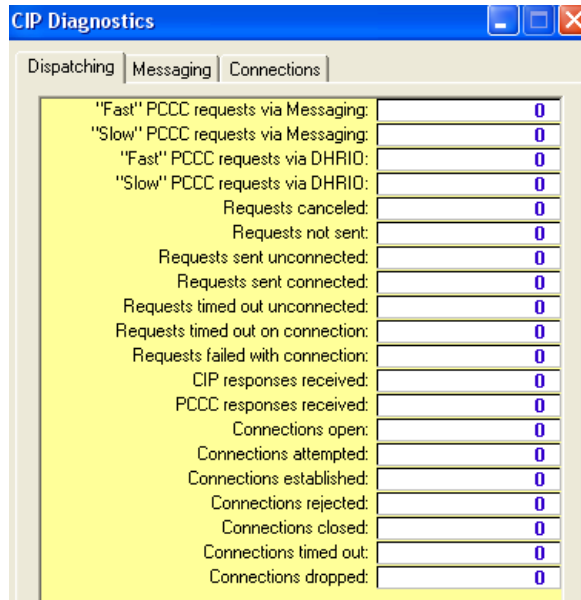
The CIP Diagnostics dialog box appears.



2. Click the Connections tab.

Here you see an itemized list of open connections.

3. Click the Dispatching tab.



In the Connections Established box you see the total number of connections open to the CompactLogix controller.

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## Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.

At <http://www.rockwellautomation.com/support>, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at <http://www.rockwellautomation.com/knowledgebase> for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

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

## Installation Assistance

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

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

## New Product Satisfaction Return

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

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication [RA-DU002](#), available at <http://www.rockwellautomation.com/literature/>.

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