User Manual

Allen-Bradley

1768 CompactLogix Controllers

Catalog Numbers 1768-L43, 1768-L45

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

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

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.

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.

Topic	Page
Updated software and firmware compatibility	13, 17
Added the History of Changes appendix	139

For specifications, see the 1769 CompactLogix Controllers Specifications Technical Data, publication 1769-TD005.

Notes:

Chapter 4

Communicate over Networks

Chapter 5

Manage Controller Communication

Chapter 6

Place 1768 and 1769 Modules

Chapter 7

Configure and Monitor I/O Modules

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Appendix B

History of Changes

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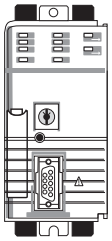


This manual describes how to install, configure, program, and operate a CompactLogix™ system. This manual is for automation engineers and control system developers who design, program, and commission 1768 CompactLogix control systems.

CompactLogix 1768-L43 and 1768-L45 controllers are designed to provide a solution for medium-sized applications.

Additional Resources

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

Resource	Description
1769 CompactLogix Controllers Specifications Technical Data, publication 1769-TD005	Contains technical specifications and certifications for all CompactLogix controllers.
1769-L4*x* CompactLogix System Quick Start, publication IASIMP-QS003	Provides examples of using a 1769-L3*x* CompactLogix controller to connect to multiple devices over various networks.
Logix5000 Controller Design Considerations Reference Manual, publication 1756-RM094	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 1756-PM001	Guides the development of projects for Logix5000 controllers. It provides links to individual guides.
Logix5000 Controllers General Instruction Set Reference Manual, publication 1756-RM003	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 1756-RM006	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.
Logix5000 Controllers Motion Instructions Reference Manual, publication 1756-RM007	Provides details on how to program the controllers for motion applications.
EtherNet/IP Communication Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Describes how to install and configure EtherNet/IP modules in Logix5000 control systems.
ControlNet Communication Modules in Logix5000 Control Systems User Manual, publication CNET-UM001	Describes how to install and configure ControlNet modules in a Logix5000 control system.

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

1768 CompactLogix Overview

About the 1768 CompactLogix Controllers

The CompactLogix system is designed to provide a solution for machine-level control applications with I/O, motion, and network requirements.

The 1768-L43 and 1768-L45 controllers offer one built-in serial port and have a key on the front panel so that you can change controller modes.

TIP If you need replacement keys, use part number 1768-KY1.

Table 1 - CompactLogix Chassis

CompactLogix Controller	Available 1768 Slots	Number of 1768 Communication Modules, Max	Type of Communication Modules	Number of 1768-M04SE Modules, Max	Number of Connections Supported, Max
1768-L43	2	2	1768-ENBT 1768-EWEB 1768-CNB 1768-CNBR	2	250
1768-L45	4	2		4	

Table 2 - CompactLogix Communication Modules

Communication Module	Function
1768-ENBT	Module for Ethernet/IP communication
1768-EWEB	Web server module for the remote monitoring and modification of data via an XML web page raw socket
1768-CNB and 1768-CNBR	Modules for ControlNet communication

Figure 1 - Example of Standalone CompactLogix Controller with I/O and DeviceNet Communication

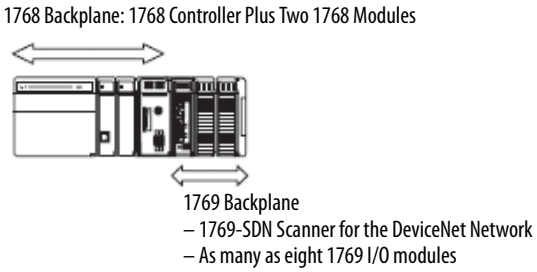
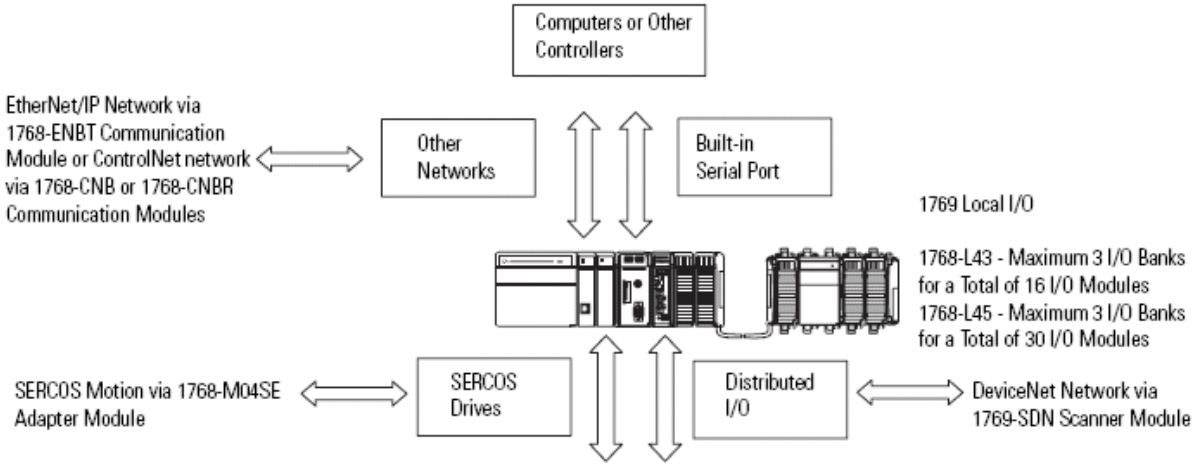


Figure 2 - Complex CompactLogix System



ATTENTION: Install the remaining modules in one or two additional I/O banks attached to the 1768/1769 system.

See 1769 Module Placement for more information.

The additional banks are powered by any standard 1769 power supply and connect to the main rack by using standard 1769-CRL*x* extension cables.

Software and Firmware Compatibility

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

- An inability to connect to the controller
- Unsuccessful firmware upgrades in ControlFLASH™ or AutoFlash utilities

This table shows the compatible pairs of software versions and controller firmware revisions.

Controller	RSLogix 5000 Software Version or Later	Controller Firmware Revision or Later
1768-L43	16.00.00	16.025
1768-L45	16.03.00	16.025
1768-L43 or 1768-L45	17.01.02	17.012
	19.01.00	19.015
	20.01.00	20.013

Design a System

When designing a CompactLogix system, determine the network configuration and the placement of components in each location. You need to do the following:

- Select I/O devices for your DIN-rail or panel-mounted system.
- Establish motion control and drives requirements.
- Select communication modules.
- Select controllers.
- Select power supplies.
- Mount the system.
- Select software.

Notes:

Install the 1768-L4*x* Controllers

ATTENTION: Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 m (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 difficulties with electromagnetic compatibility in residential and other environments due to conducted as well as radiated disturbances.

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:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation 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.

North American Hazardous Location Approval

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

European Hazardous Location Approval

The following applies when the product bears the Ex Marking.
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 Zone 2 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.

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.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- This equipment is not resistant to sunlight or other sources of UV radiation.
- 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: Prevent Electrostatic Discharge

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

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

Verify Compatibility

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

- An inability to connect to the controller
- Unsuccessful firmware upgrades in ControlFLASH or AutoFlash utilities

This table shows the compatible pairs of software versions and controller firmware revisions.

Controller	RSLogix 5000 Software Version or Later	Controller Firmware Revision or Later
1768-L43	16.00.00	16.025
1768-L45	16.03.00	16.025
1768-L43 or 1768-L45	17.01.02	17.012
	19.01.00	19.015
	20.01.00	20.013

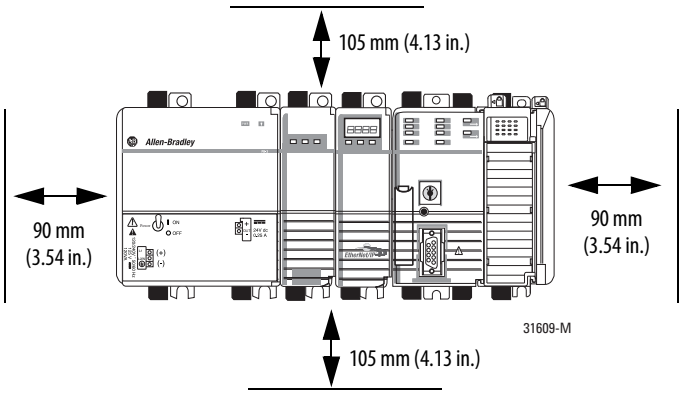
Required System Components

You need these parts when installing your controller:

- 1768-L43 or 1768-L45CompactLogix controller
- 1768-PA3 or 1768-PB3 power supply
- 1769-ECR end cap
- Mounting screws (M4 or #8 panhead) or one of these EN 50 022 DIN rails:
  - 35 x 7.5 mm (1.38 x 0.30 in.)
  - 35 x 15 mm (1.38 x 0.59 in.)
- 1756-CP3 serial cable (or make your own)

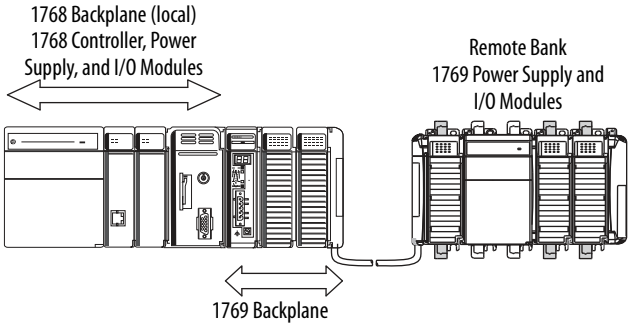
Clearance Requirements

Allow for the minimum clearance from enclosure walls, wireways, and other equipment.



IMPORTANT These minimum clearances keep the modules cool enough in most situations.

Module Placement



IMPORTANT **CompactLogix System Distance Ratings**

Because the 1768 CompactLogix power supply works with the controller to power a 1768 system, the distance rating in a 1768 CompactLogix system differs from that in a 1769 CompactLogix system.

In the 1768 system, the distance rating is the distance between 1769 I/O modules and the controller. In the 1769 system, the distance rating is the distance between 1769 I/O modules and the power supply.

Follow these requirements to determine proper placement of your 1768 controller, power supply, 1768 I/O modules, and 1769 I/O modules:

- Place the 1768-L4*xx* controller so that it is the last module (furthest away from the power supply) in the 1768 backplane.
- The 1768 CompactLogix power supply distributes power from the right side of the supply and must be the leftmost module in the system.
- Up to eight 1769 I/O modules can reside in the local bank.
- The local bank is powered by a 1768 power supply.
- Up to two remote banks of 1769 I/O modules may be connected by using 1769-CRL*x* extension cables.
- Remote banks are powered by a standard 1769 power supply.
- Up to eight 1769 Compact I/O modules can reside on each side of a 1769 power supply in a remote bank. Consult the module's specifications for its distance rating.

IMPORTANT Never place a 1769 power supply in a local bank with a 1768 controller or a major fault will occur.

- The type of controller determines the maximum number of 1768 modules that can reside in the local bank and the maximum number of 1769 I/O modules that can reside in one local and up to two remote banks.

Controller	Max Local 1768 Modules	Max 1769 I/O Modules (local and remote)
1768-L43	2	16
1768-L45	4	30

Installation Summary

Follow these steps to install your controller.

1. Mount the controller to a panel or on a DIN rail.

IMPORTANT Do not use screws if using a DIN rail to mount the controller. You can break the mounting tabs if you screw the controller to a panel while it is on a DIN rail.

2. Confirm the installation.
3. Connect the controller.
4. Configure a serial or Ethernet driver.
5. Install a CompactFlash card (optional).
6. Download and install controller firmware.

Panel Mount the Controller

Follow these steps to mount your controller by using the panhead screws.

1. Connect the CompactLogix modules together as shown in Mount the Controller on a DIN Rail on page 20.
2. Use the controller as a template and mark pilot holes on your panel.
3. Drill the pilot holes for M4 or #8 screws.

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

4. Use M4 or #8 screws to mount the controller to your panel with 1.16 N•m (10 lb•in) of torque.
5. Ground the module on a ground bus with a dedicated earth ground stake.
6. Connect the ground bus to a functional earth ground on the panel or a DIN rail.

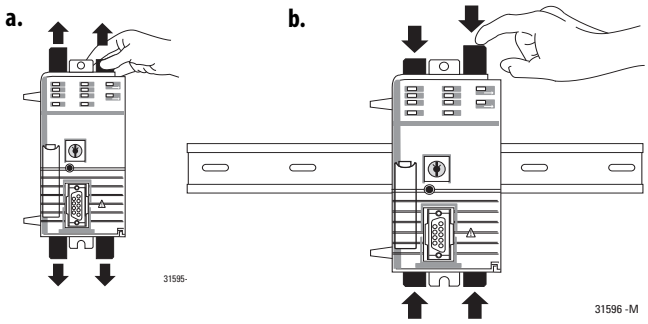
Mount the Controller on a DIN Rail

> **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 and plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to the mounting surface approximately every 200 mm (7.87 in.) and use end anchors appropriately.

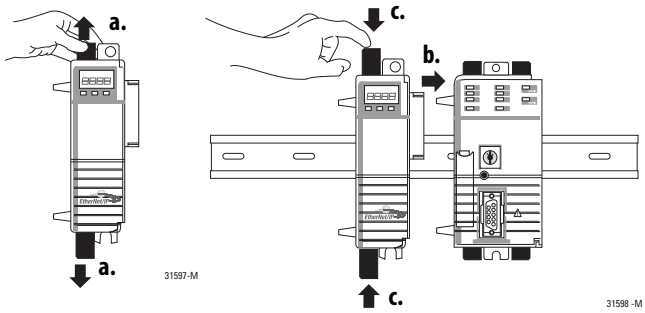
Mount 1768 Components

Follow these steps to mount the controller.

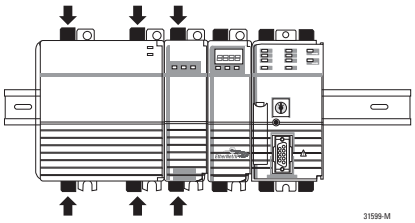
1. Mount the controller on the DIN rail.



2. Mount additional 1768 modules to the left of the controller.



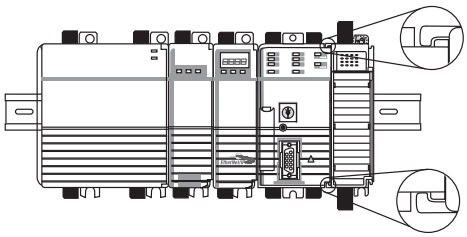
3. Mount the 1768 power supply and other 1768 modules.



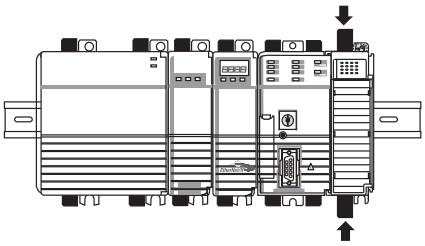
4. Mount 1769 I/O Modules

Follow these steps to mount 1769 I/O modules to the right of the controller.

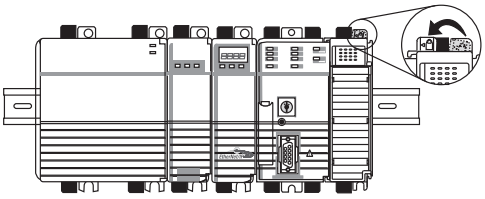
1. Align the upper and lower tongue-and-groove slots and slide the module back toward the DIN rail until the bus levers line up.



2. Close the DIN rail latches.

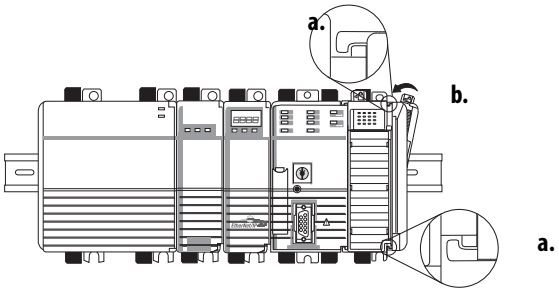


3. Slide the bus lever to the left to lock the modules together.



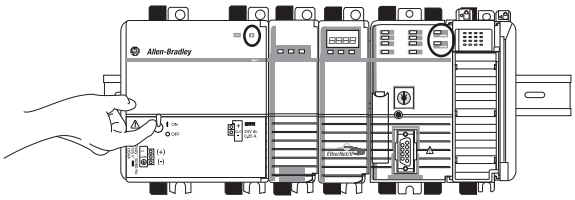
ATTENTION: When attaching I/O modules, it is very important that the bus connectors are securely locked together for proper electrical connection.

4. Attach the end cap by using the tongue and groove slots (a) and locking the bus lever (b).



Confirm the Installation

After you have installed the controller and applied power, check that the PWR and I/O PWR status indicators are solid green.



If the indicators are in any other state, see Troubleshoot System Power on page 29.

Connect to the Controller

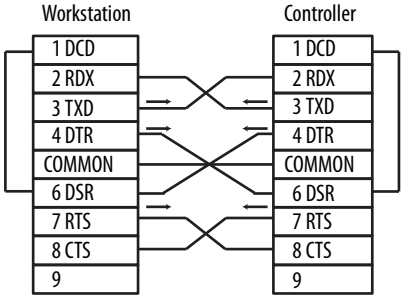
WARNING: If you connect or disconnect the serial cable with power applied to this module or the serial device on the other end of the cable, an electrical arc can occur. This could cause an explosion in hazardous location installations.

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

Connect the 1756-CP3 serial cable to the controller's serial port and to your workstation.

If you make your own cable, follow these guidelines.

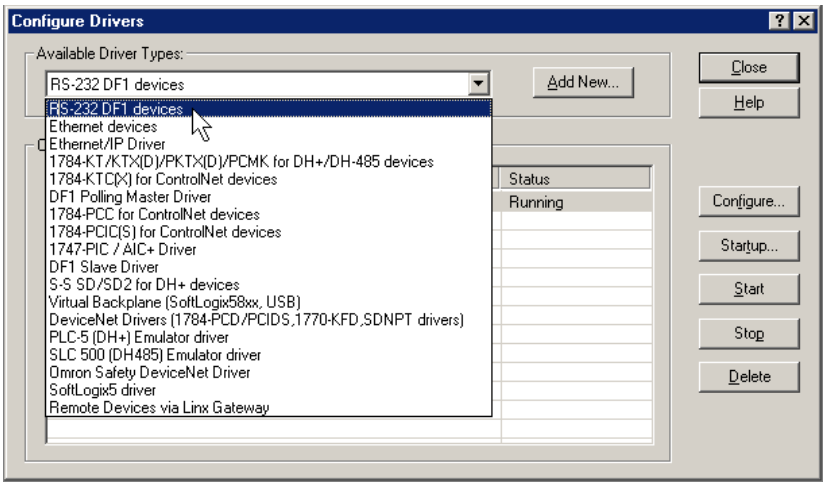
- Wire the connectors as shown below.
- Limit the cable length to 15.2 m (50 ft).
- Attach the shield to both connectors.



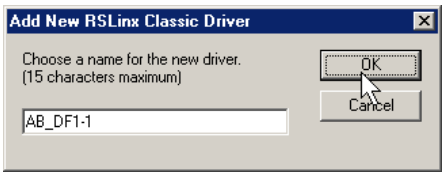
Configure a Serial Driver

Use RSLinx® software to configure the driver for serial communication.

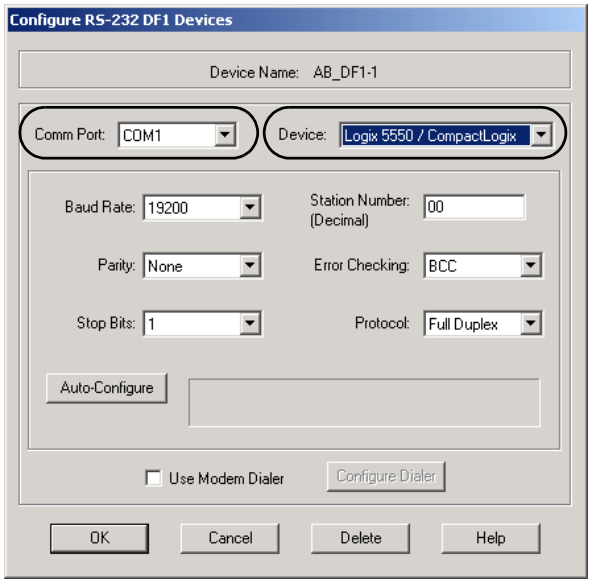
1. From the Communications menu, choose Configure Drivers.
2. From the Available Driver Types pull-down menu, choose the RS-232 DF1 devices driver.



3. Click Add New.
4. Type a name for the driver and click OK.



5. From the Comm Port pull-down menu on the Configure Devices dialog box, choose the serial port on the workstation to which your cable is connected.



6. From the Device pull-down menu, choose Logix5550/CompactLogix.
7. Click Auto-Configure.
   a. Click OK if the Auto Configuration Successful dialog box appears.
   b. If the dialog box does not appear, go back to step 5 and verify that you selected the correct communication port.
8. Click Close.

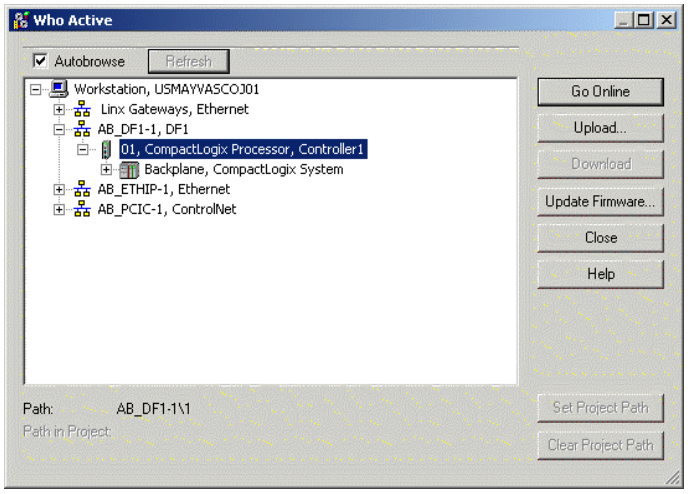
Configure an EtherNet/IP Driver

For EtherNet/IP communication, you must use a 1768-ENBT or 1768-EWEB module. You can install up to two of these modules to the left of the controller in the 1768 backplane. Before you can load controller firmware via the EtherNet/IP network, you must set the EtherNet/IP module's IP address. You can set the IP address by using the BOOTP-DHCP utility.

For more information, refer to the EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

Set the Communication Path to the Controller

1. Open a controller project.
2. From the Communications menu, choose Who Active.
3. Expand the communication driver to the level of the controller.
4. Select the controller



5. Complete the desired action.

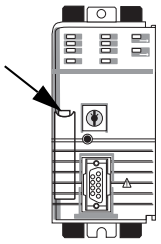
To	Click
Monitor the project in the controller	Go Online
Transfer a copy of the project from the controller to the software	Upload
Transfer the open project to the controller	Download

Insert or Remove a CompactFlash Card

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.

Follow these steps to insert or remove a CompactFlash card.



1. Press the memory-card door latch on the controller front panel and pivot the door down toward you.
2. Insert or remove the card from the slot.
3. Close the memory card door.

Install Controller Firmware

The controller ships without functioning firmware, so you must obtain and install the firmware before you can use your controller.

IMPORTANT When installing or updating controller firmware, do not interrupt the update process in any way. Interrupting the firmware update may result in an inoperable controller.

Inoperable controllers must be returned to Rockwell Automation.

Firmware revisions are available with RSLogix 5000 software, or you can download them from the support website at: http://www.rockwellautomation.com/support. Be prepared to enter a serial number.

To install firmware, you can use any of the following.

Method	Page
ControlFLASH software, version 8 or later, that ships with the Studio5000 environment	27
AutoFlash software that runs within the Studio5000 environment	27
A memory card with valid firmware already loaded	28

Updating your controller firmware via ControlFLASH or AutoFlash software requires either a serial or other network connection to the controller.

Updating via an Ethernet connection is faster, but you must first install a 1768-ENBT Ethernet module to connect to the controller via the Ethernet network.

For information on installing, configuring, and operating a 1768-ENBT module, refer to the EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

Install Firmware via ControlFLASH Software

1. Make sure the network is connected.
2. Start ControlFLASH software.
3. When the Welcome dialog box appears, click Next.
4. Select the catalog number of the controller and click Next.
5. Expand the network until you see the controller.

   TIP If the required network is not shown, first configure a driver for that network in RSLinx software.

6. Select the controller and click OK.
7. Select the desired revision level and click Next.
8. To start the update, click Finish and then Yes.

   The OK status indicator flashes red to show that the update is in progress. The status box indicates when the update is complete and the OK status indicator is solid green.
9. Click OK.
10. Click Cancel and then Yes to close ControlFLASH software.

Install Firmware via AutoFlash Software

1. Make sure the network is connected.
2. Download to a controller project.

   AutoFlash software launches if the required firmware is not loaded on the controller.
3. Select the catalog number of the controller and click Next.
4. Expand the network until you see the controller.

   TIP If the required network is not shown, first configure a driver for that network in RSLinx software.

5. Select the controller and click OK.
6. Select the desired revision level and click Next.
7. To start the update, click Finish and then Yes.

   The OK status indicator flashes red to show that the update is in progress. The status box indicates when the update is complete and the OK status indicator is solid green.
8. Click OK.
9. Click Cancel and then Yes to close AutoFlash software.

Install Firmware via a CompactFlash Card

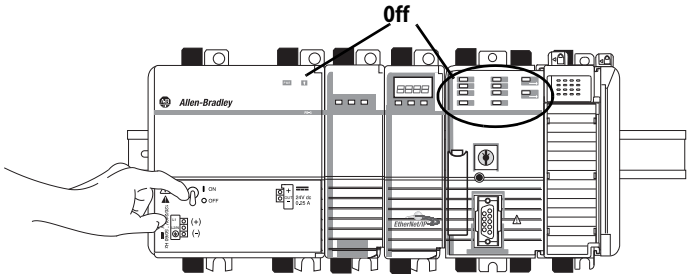
Follow these steps in RSLogix 5000 software to store the controller program and firmware of a configured controller to the CompactFlash card. The firmware is automatically stored on your CompactFlash card when you store the program.

1. With the CompactFlash card installed on the configured controller, on the Controller Properties dialog box, click the Nonvolatile Memory tab.
2. Click Load Image On Powerup to save to the card.
3. Remove the card and insert it into the controller onto which you want to load the firmware and user program.
4. Start the controller and the image stored on the CompactFlash card loads.

Remove a 1768 or 1769 Module from the DIN Rail

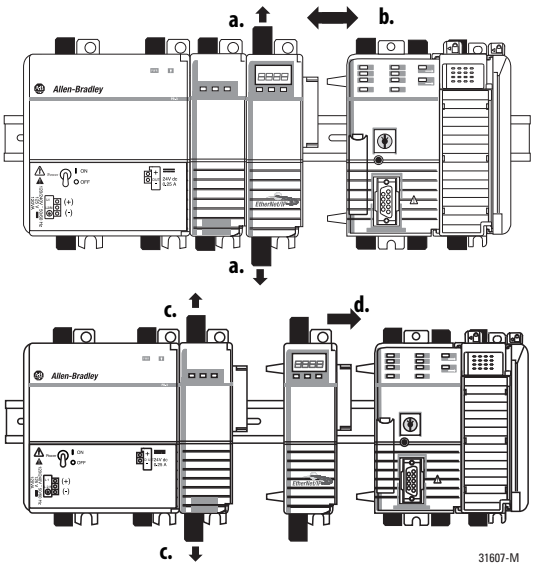
If you need to remove a module from the DIN rail, follow these steps.

1. Remove power from the controller and wait for all status indicators on the power supply and controller to turn off.

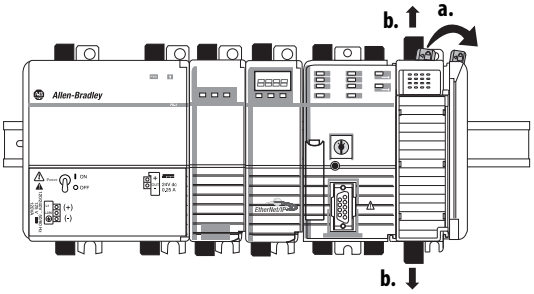


IMPORTANT If you disconnect any part of the system while the controller is still writing its program to memory, you will lose your program.

2. Remove the 1768 module.



3. Remove the 1769 module by unlocking the bus lever (a) and DIN rail latches (b).



4. Slide the module away from the DIN rail along the tongue and groove slots.

Troubleshoot a Nonresponsive Module

Follow these steps to determine why a device may not be responding.

1. Verify that all I/O modules in your project are installed in the same order.
2. Verify that all devices have been updated to the latest major and minor firmware revisions.
3. Use the online Help in the software to determine which module is not responding.

Troubleshoot System Power

The CompactLogix power supply works with the CompactLogix controller to provide power to the system. You must consider both when attempting to troubleshoot system power.

IMPORTANT Before you disconnect, reconnect, or replace any component, make sure you have turned off power and allowed all system status indicators to turn off.

To troubleshoot system power issues, use the CompactLogix power supply PWR status indicator and the CompactLogix controller PWR and I/O PWR indicators. If the power supply is not operating properly, the controller will not operate properly either. You must first diagnose and correct any issues with the power supply before troubleshooting the controller.

1. Examine the power supply PWR status indicator.
2. If the power supply is operating properly and the power supply PWR status indicator is green, examine the controller PWR indicator.
3. If the controller PWR status indicator is green, examine the I/O PWR status indicator.

Examine the Power Supply PWR Status Indicator

Power Supply PWR Indicator Status	Recommended Action
Off	Verify that the power supply is turned on and that adequate input power is properly connected. Replace the power supply.
Green	The power supply is operating properly. Check the controller PWR and I/O PWR status indicators to make sure the entire system is operating properly.
Red	The power supply is not producing valid 24V power to the 1768 modules. Follow the corrective action below.

1. Remove power and wait for all status indicators to turn off.
2. Disconnect all modules from the system, including the controller.
3. Reapply power.
4. Check the PWR status indicator on the power supply.
   a. If the status indicator remains red, replace the power supply.
   b. If the status indicator is green, one of the other modules in the system is causing the red indicator.
5. Remove power and wait for all status indicators to turn off.
6. Reinstall the controller and check the power supply's PWR indicator.
   a. If green, remove power, wait for all status indicators to turn off and reinstall 1768 modules one at a time until you identify the module causing the red indicator.
   b. If red, replace the controller.

Examine the Controller PWR Indicator

This task assumes that the power supply PWR indicator is green.

Controller PWR Indicator Status	Recommended Action
Off	Make sure all of the modules in the system are installed properly and are fully engaged with one another. If the indicator remains off, follow the corrective action below.
Green	The controller is providing power to 1768 modules in the system. Check the controller I/O PWR status indicator to make sure the entire system is operating properly.
Red	Either the controller or 1768 modules in the system need to be replaced. Follow the corrective action below.

1. Remove power and wait for all status indicators to turn off.
2. Disconnect all 1768 modules from the system, except for the controller.
3. Reapply power.

4. Check the controller PWR indicator.
   a. If the status indicator remains red, replace the controller.
   b. If the status indicator is green, one of the 1768 modules is causing the red indicator.
5. Remove power.
6. Reinstall the 1768 modules one at a time, removing and reapplying power and checking the controller PWR indicator each time.
7. If the controller PWR indicator turns red, the most-recently installed module is causing the red indicator.

   To troubleshoot 1768 modules, see their respective installation instructions.

Examine the I/O PWR Indicator

This task assumes that the power supply and controller PWR indicators are green and that you have 1769 I/O modules in your system.

Controller I/O PWR Indicator Status(1)	Recommended Action
Off	Replace the controller.
Green	The controller is operating properly. No action required.
Flashing red and green	Make sure the 1769 I/O modules or end cap are properly attached and cycle power.
Red	A 1769 power supply may be installed in the local bank, or there may be an issue with the controller or 1769 I/O in the system. Follow the corrective action below.

(1) When the controller powers up, the I/O PWR status indicator is momentarily red and then changes to green if there are no issues. If the indicator remains red, use the table above to troubleshoot the issue.

1. If there is a 1769 power supply installed in the local bank, remove it and reapply power.

   If the I/O PWR indicator remains red, go to the next step.
2. Remove power and wait for all status indicators to turn off.
3. Disconnect the 1769 I/O modules from the system.
4. Reapply power.
5. Check the controller I/O PWR indicator.
   a. If the indicator is red, replace the controller.
   b. If the indicator is green, one of the 1769 I/O modules is causing the red indicator.

   To troubleshoot 1769 I/O modules, see their respective installation instructions.

Notes:

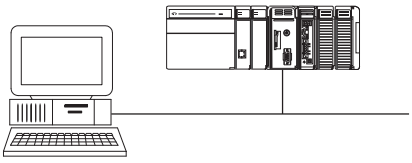
Connect to the Controller via the Serial Port

This chapter explains how to establish a serial connection to a controller via the serial port. This enables you to configure a controller and upload and download a project to it.

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

- A workstation with a serial port
- RSLinx software to configure the serial communication driver
- RSLogix 5000 software to configure the serial port of the controller

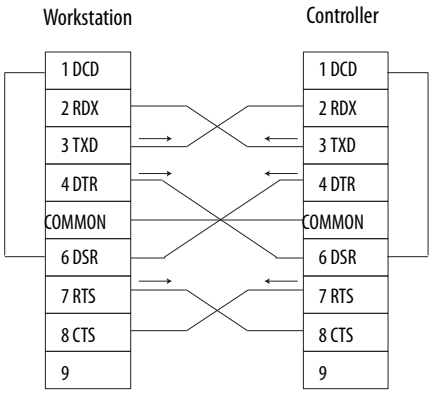
Connect a Controller via the Serial Port



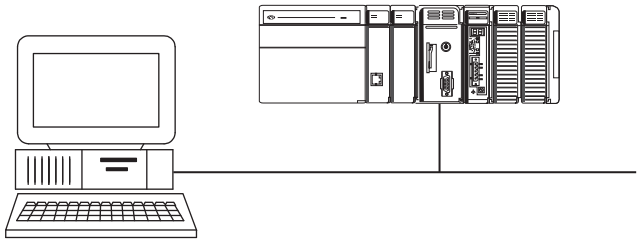
Channel 0 on a CompactLogix controller is fully isolated and does not need a separate isolation device.

To connect a serial cable, perform this procedure.

1. Obtain a serial cable.

If you	Then
Make your own cable	1. Limit the length to 15.2 m (50 ft). 2. Wire the connectors.  3. Attach the shield to both connectors.
Do not make your own cable	Obtain one of these serial cables: • 1747-CP3 • 1756-CP3

2. Connect the cable to your controller and workstation.

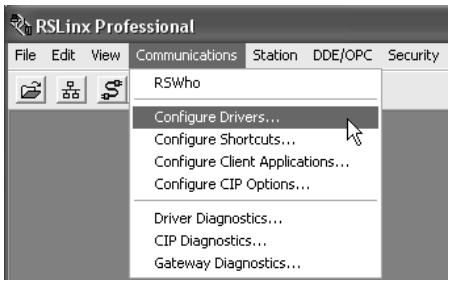


Configure the Serial Driver

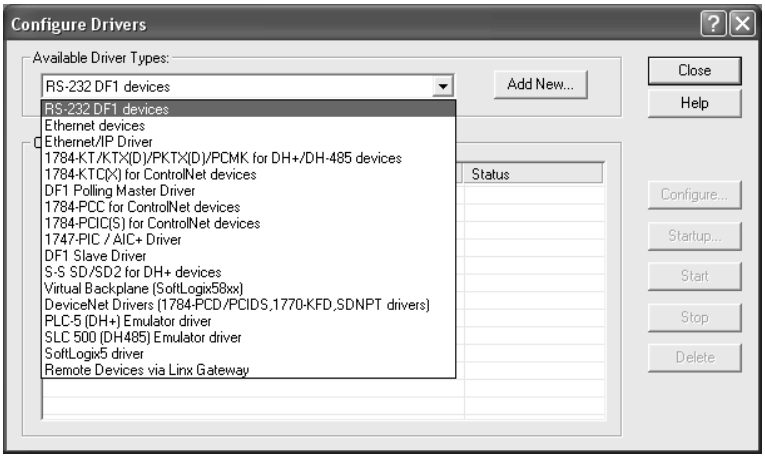
Use RSLinx software to configure the RS-232 DF1 device driver for serial communication.

To configure the driver, perform this procedure.

1. In RSLinx software, from the Communications menu, choose Configure Drivers

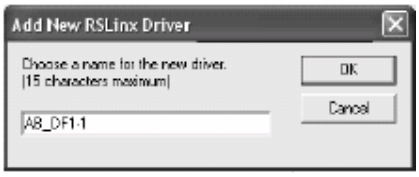


   The Configure Drivers dialog box appears.



2. From the Available Driver Types pull-down menu, choose RS-232 DF1 devices.
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. From the Comm Port pull-down menu, choose the serial port on the workstation to which the cable is connected.
6. From the Device pull-down menu, choose Logix 5550/CompactLogix.
7. Click Auto-Configure.
8. Verify that the auto configuration was successful.

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

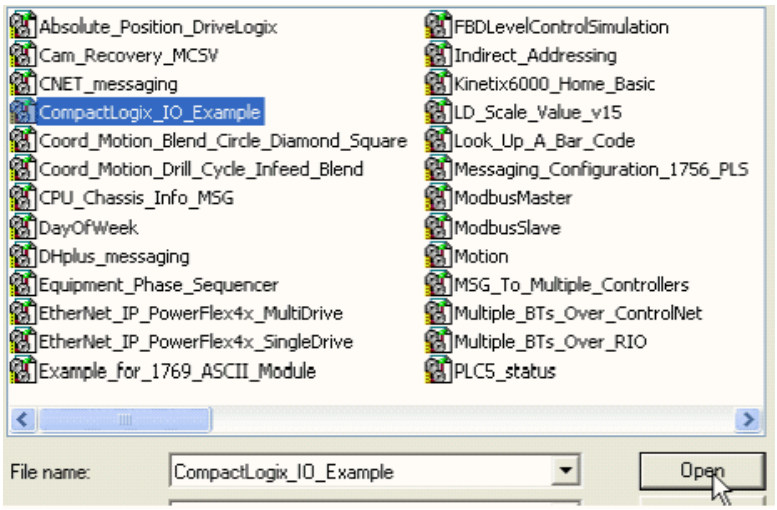
9. In the Configure Drivers dialog box, click Close.

Select the Controller Path

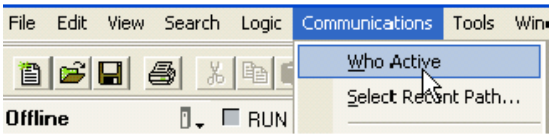
IMPORTANT Remember to update your controller's firmware prior to establishing communication and downloading a program.

To select the controller path, perform this procedure.

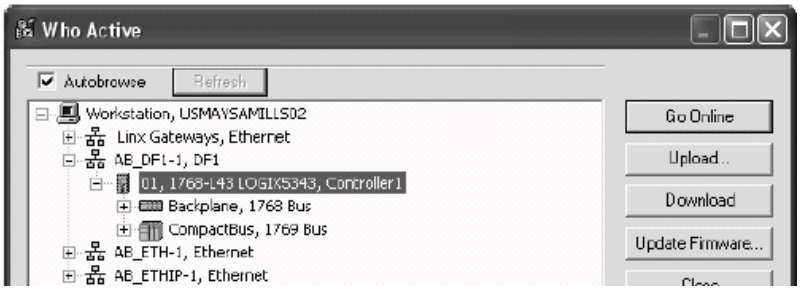
1. In RSLogix 5000 software, open a controller project.



2. From the Communications menu, choose Who Active.



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



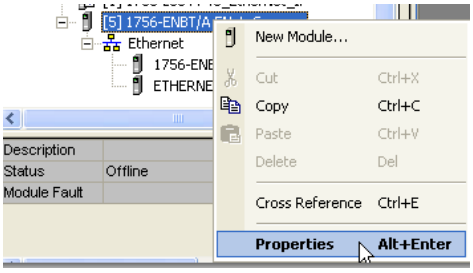
4. Select the controller.

To	Click
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

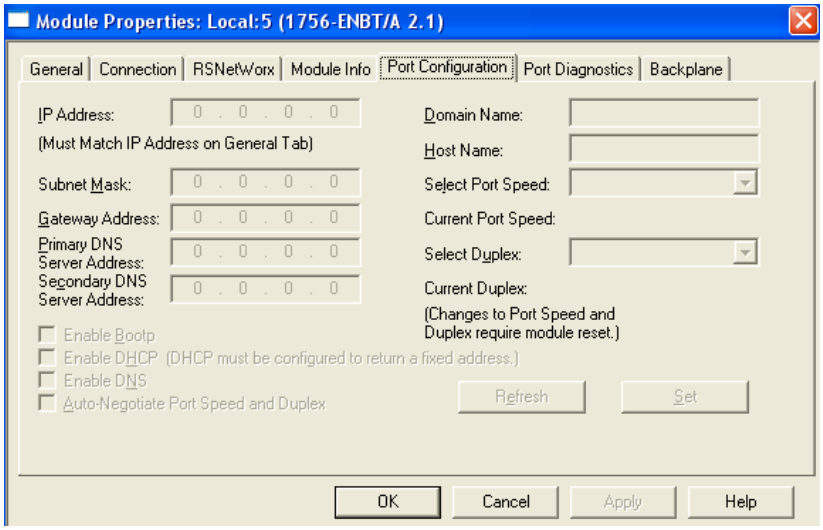
Set the IP Address via a Serial Port

To set the IP address via a serial port, perform this procedure.

1. Make sure the module is installed, started, and connected to the controller via a serial connection.
2. In the Controller Organizer, right-click the module and choose Properties.



The Module Properties dialog box appears.



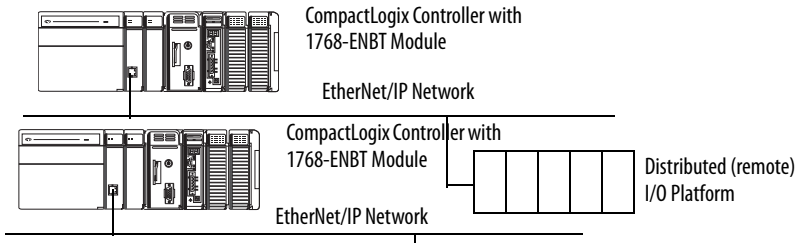
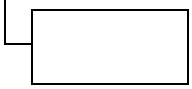
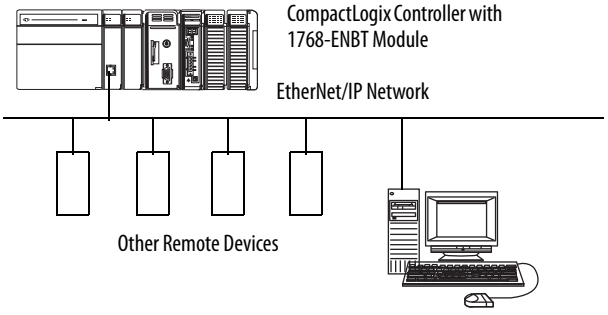
3. Click the Port Configuration tab.
4. In the IP Address box, type the IP address.
5. In the other boxes, type the other network parameters, if needed.

IMPORTANT The boxes that appear vary from one module to another.

6. Click Apply.
7. Click OK.

Communicate over Networks

CompactLogix controllers support multiple network types.

Network Support	Example
Control distributed (remote) I/O with these networks: • EtherNet/IP network • ControlNet network • DeviceNet network	
Produce and consume data between controllers with these networks: • EtherNet/IP network • ControlNet network	
Send and receive messages to and from other devices, including access to the controller via RSLogix 5000 software, with these networks: • EtherNet/IP network • DeviceNet network (to devices only) • ControlNet network • Serial networks • DH-485 networks	

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. With this combination of well-accepted standards, the EtherNet/IP network supports 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, the controller needs a 1768-ENBT or 1768-EWEB module. You can install up to two of these modules in the 1768 backplane for each controller.

Use these software products for EtherNet/IP communication.

Table 3 - Required Software for EtherNet/IP Communication

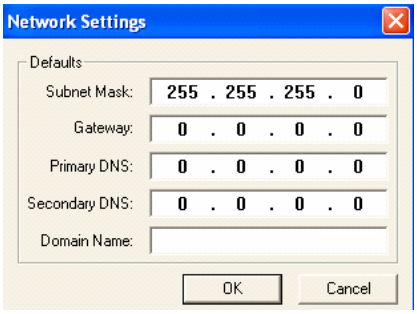
Software	Functions	Requirement
RSLogix 5000	• Configure CompactLogix projects. • Define EtherNet/IP communication.	Yes
BOOTP/DHCP utility	Assign IP addresses to devices on an EtherNet/IP network.	No
RSNetWorx™ for EtherNet/IP	• Configure EtherNet/IP devices by IP addresses or host names. • Provide bandwidth status.	
RSLinx	• Configure communication devices. • Provide diagnostics. • Establish communication between devices.	Yes

Set the IP Address By Using the BOOTP/DHCP Utility

To set the IP address using the BOOTP/DHCP utility, perform this procedure.

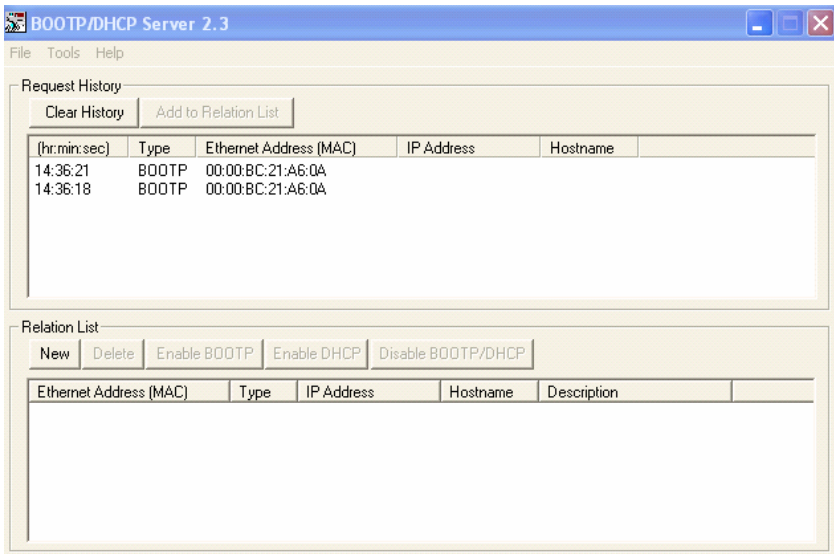
1. Open the BOOTP-DHCP utility.

   The Network Settings dialog box appears.

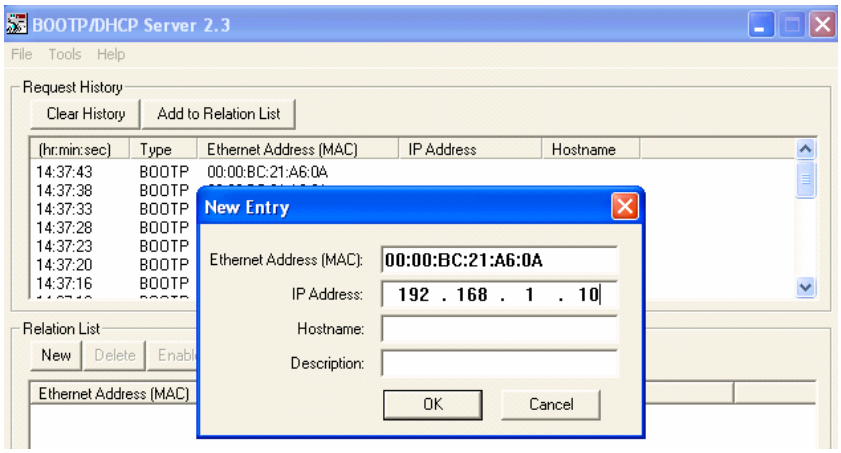


2. Enter at least one subnet mask setting and click OK.

   The BOOTP/DHCP Server dialog box appears. BOOTP requests fill the upper portion of the dialog box.



3. Select one of the requests and click Add to Relation List.



The New Entry dialog box appears, showing the Ethernet address (MAC).

4. In the IP Address box, type the IP address and click OK.

1768-ENBT EtherNet/IP Communication Module

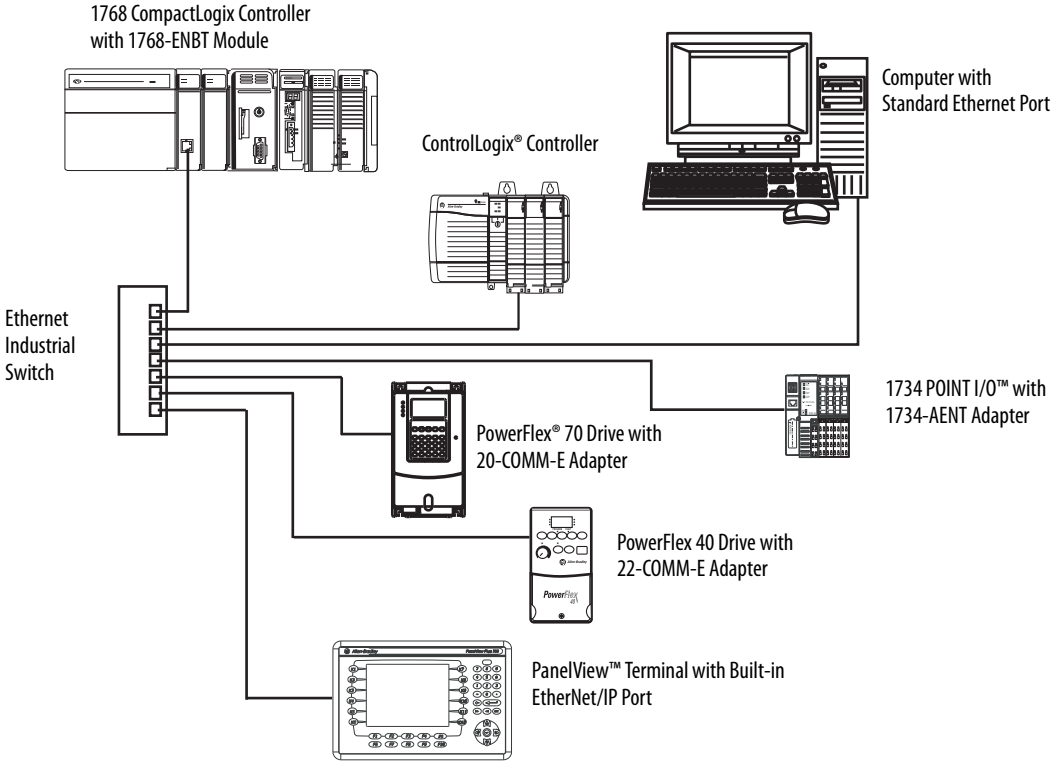
The 1768-ENBT EtherNet/IP communication module does the following:

- Supports messaging, produced and consumed tags, HMI, and distributed I/O
- Encapsulates messages within standard TCP/UDP/IP protocol
- Shares a common application layer with ControlNet and DeviceNet networks
- Connects via an RJ45 connector
- Supports half- and full-duplex 10 MB or 100 MB operation
- Supports standard switches

Figure 3 shows the following:

- Controllers produce and consume tags.
- Controllers initiate MSG instructions that send and receive data or configure devices.
- A computer uploads and downloads projects to the controllers.
- A computer configures devices on an EtherNet/IP network.
- Controllers establish I/O and drive control over an EtherNet/IP network.

Figure 3 - CompactLogix EtherNet/IP Network Overview



1768-EWEB Web Server Module

The 1768-EWEB EtherNet/IP web server module supports the following:

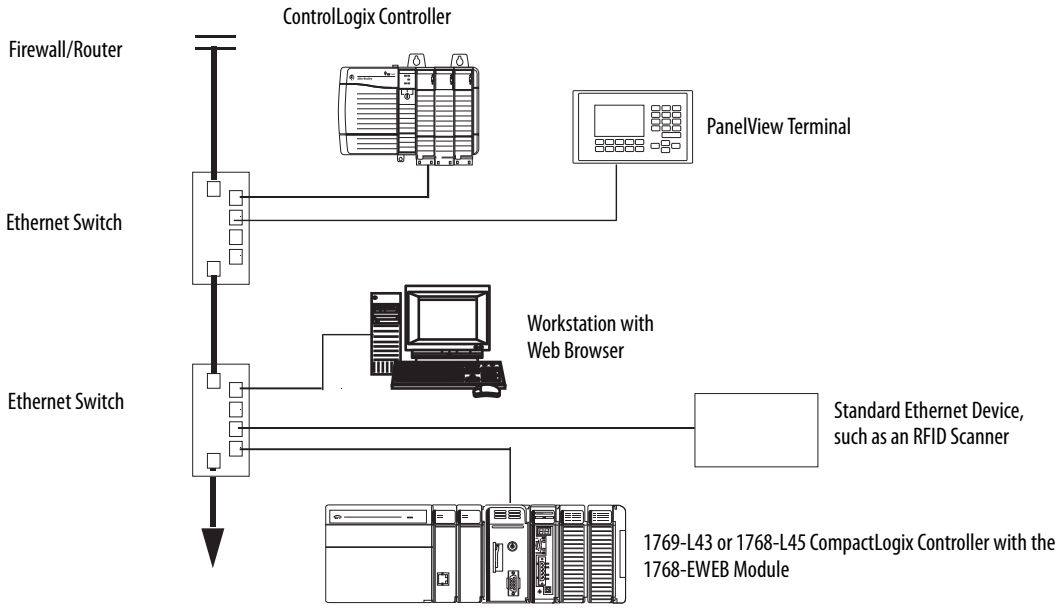
- Bridging and routing of messages, but not I/O control
- Data access (read and write) to controllers via a standard web browser
- Custom web pages
- Email
- Raw, open-socket interfaces

Figure 4 shows how the web server module enables you to do the following:

- Route messages, upload/download programs, and flash upgrade modules by using the web server module as part of the communication path to access the target device.
- View and modify data that resides in a 1768 CompactLogix controller via a standard web browser.
- Create custom web pages that are tailored to your application.

  Use ASP functions to populate your web pages with live controller data.
- Send an email initiated by a Logix controller via a MSG instruction.
- Open TCP or UDP communication links to other standard Ethernet devices via open sockets.

Figure 4 - CompactLogix EtherNet/IP Web Network



Connections over an EtherNet/IP Network

Each 1768-ENBT or 1768-EWEB module in an EtherNet/IP network can provide messaging support for 64 CIP connections and 32 TCP/IP connections.

For more information, see the EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

ControlNet Network Communication

The ControlNet network 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 efficient data transfer capability significantly enhances I/O performance and peer-to-peer communication in any system or application.

The ControlNet network is 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 following:

- 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

Table 4 - Required Software for ControlNet Communication

Software	Functions	Requirement
RSLogix 5000	• Configure CompactLogix projects. • Define ControlNet communication.	Yes
RSNetWorx for ControlNet	• Configure ControlNet devices by IP addresses and/or host names. • Schedule a network.	
RSLinx	• Configure communication devices. • Provide diagnostics. • Establish communication between devices.	

1768-CNB and 1768-CNBR ControlNet Modules

CompactLogix ControlNet communication modules bridge ControlNet links to route messages to devices on other networks. The modules also monitor and control I/O modules located remotely from CompactLogix controllers.

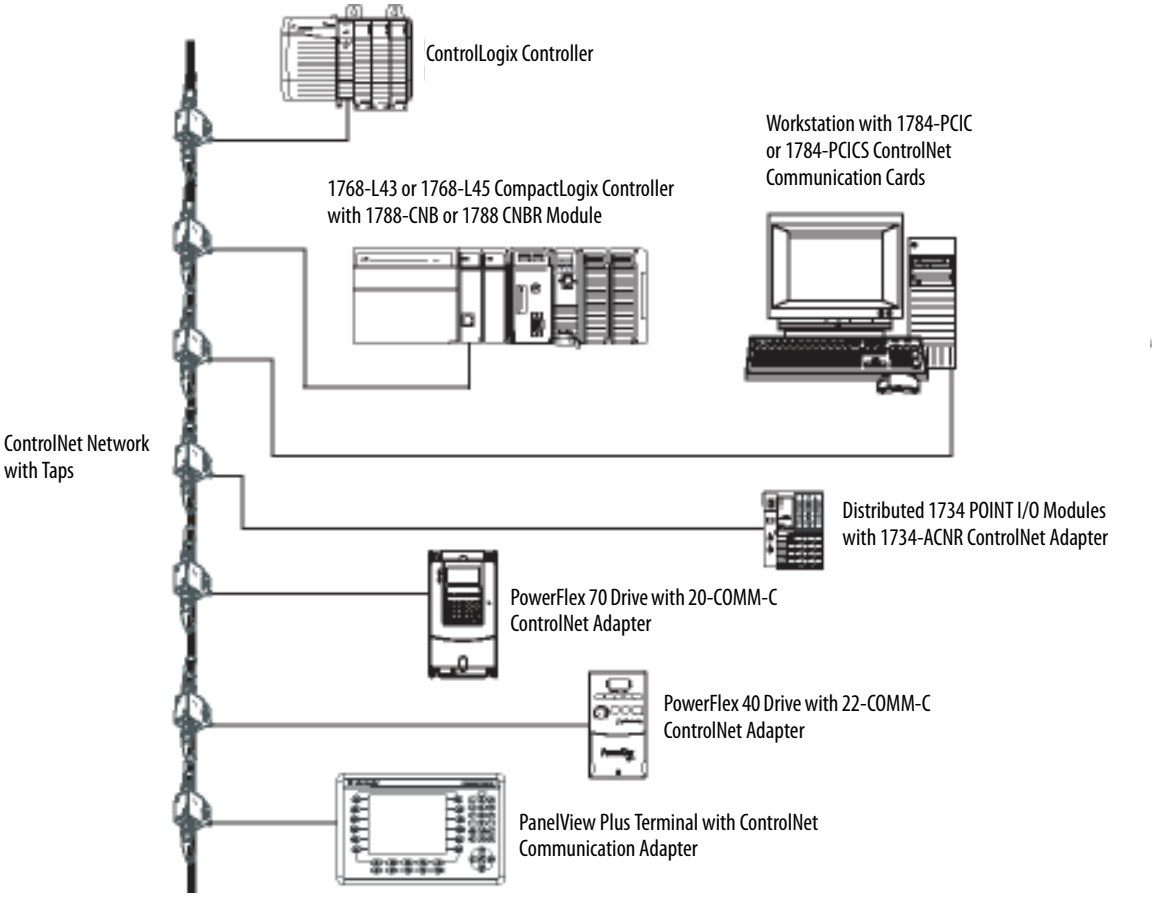
The 1768-CNB and 1768-CNBR ControlNet modules support the following:

- Messaging data for configuration and programming
- Operator interfaces and uploading and downloading
- I/O bridging
- The transfer of scheduled data via produced/consumed tags
- Unscheduled MSG instruction communication with other ControlNet nodes
- Local communication network access through the network access port (NAP)
- Redundant media (1768-CNBR module only)

Figure 5 shows the following:

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

Figure 5 - CompactLogix ControlNet Network Overview



Connections over a ControlNet Network

Each 1768-CNB or 1768-CNBR module in a ControlNet network can provide a certain amount of connected messaging support.

Table 5 - ControlNet Connected Messaging Support

Each	Supports
1768-CNB module	Supports 64 connections: • Five controllers can have a rack-optimized connection to the module. • Five controllers can have a rack-optimized, listen-only connection to the module.
1768-CNBR module	

DeviceNet Network 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 6 - DeviceNet Interfaces

Application	Required Interface
• Communicates with other DeviceNet devices • Uses the controller as a master on a DeviceNet network	1769-SDN DeviceNet scanner
• Accesses remote Compact I/O modules over a DeviceNet network • Sends remote I/O data for as many as 30 modules back to a scanner or controller	1769-ADN DeviceNet adapter(1)

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

DeviceNet I/O Modules and Adapters

Table 7 lists the communication I/O modules available for use with the DeviceNet network.

Table 7 - DeviceNet Network Communication Modules

Cat. No.	Adapter	Specifications
Distributed Block I/O		
1791D CompactBlock I/O	1791D CompactBlock I/O contains a built-in adapter in the base block	• Removable terminal block • 50% smaller than FLEX I/O • 24V DC and selectable combination analog block • 4...16 points • DeviceLogix-enabled • Expandable up to 32 digital points
1790 CompactBlock LDX I/O	CompactBlock LDX I/O contains a built-in adapter in the base block	• Lowest price-per-point I/O • Digital: 24V DC, 120V AC • Analog: current, voltage, RTD and thermocouple • 4...16 points • Expandable up to 64 points
1732 ArmorBlock I/O	ArmorBlock I/O contains a built-in adapter in the base block	• 8 points • 8 in, 8 out, or 8 self-configuring • Front or side mount • M12 or M8 I/O connector
1792 ArmorBlock MaXum I/O	ArmorBlock MaXum I/O contains a built-in adapter in the base block	• Maximum value IP67 I/O • Lowest overall installed cost on KwikLink • Point-level diagnostics • 4...16 points • DeviceLogix-enabled • Input-only, output-only, or combos

Table 7 - DeviceNet Network Communication Modules (Continued)

Cat. No.	Adapter	Specifications
Distributed Modular I/O		
1734 POINT I/O	1734D POINTBlock I/O 1734-ADN 1734-ADNX (with subnet connectivity) 1734-PDN (DeviceNet power supply)	• Highly granular (2, 4, or 8 points) • Digital, analog, relay outputs, isolated temperature, RTD thermocouple, counter, and ASCII modules • Channel-level Logix diagnostics: wire off, short circuit, OR, UR, CALIB, fault, and more • Removal and insertion under power (RIUP) • Expansion power supply and a POINT Power Bus Isolation Module available • Removable terminal blocks • A total of 63 POINT I/O modules can be assembled on a single DeviceNet node • 1734-ADNX increases the reach of DeviceNet from 500...1500 m (1640...4921 ft) • 1734-ADNX allows an expansion power supply for additional Pinatubo backplane current • Up to 504 points maximum using 8-point digital I/O modules
1738 ArmorPOINT® I/O	1738-ADN12 1738-ADN18 1738-ADN18P 1738-ADNX	• DIN rail mounting • 1P67 and NEMA 4 rated • Highly granular (mix and match to your exact needs) • Removal and insertion under power (RIUP) • Full range of digital, analog, specialty, and temperature modules • Up to 252 points per adapter
1794 FLEX I/O	1794-ADN	• I/O can be removed and inserted under power (RIUP) • Digital: 24/48V DC, 120/230V AC, relay contact, protected, diagnostic, isolated • Analog: current/voltage selectable, temperature, isolated • Specialty: counters and frequency modules • 4...32 points per module, 8 modules per adapter • Conformally coating versions on selected modules
1797 FLEX Ex I/O	1794-ADN To be used with 1797-BIC and 1797-CEC for connecting to hazardous areas	• Intrinsically-Safe FLEX I/O for hazardous areas • I/O can be removed and inserted under power (RIUP) • Digital (NAMUR), 0...20 mA analog, temperature, frequency • All modules conformally coated • 4...32 points per module, 8 modules per adapter
1798 FLEX Armor I/O	1798-ADN Also order either of the following: • 1798-DFTP1 (Terminator for 12mm DeviceNet cable plugs) • 1798-DFTP2 (Terminator for 18mm DeviceNet cable plugs)	• On-machine mounting • IP67 and NEMA 4X rated • Outdoor applications • 24V DC analog and digital • 4 and 8 points per module; up to 64 per node

In addition to communication hardware for DeviceNet networks, the software products in Table 8 are available.

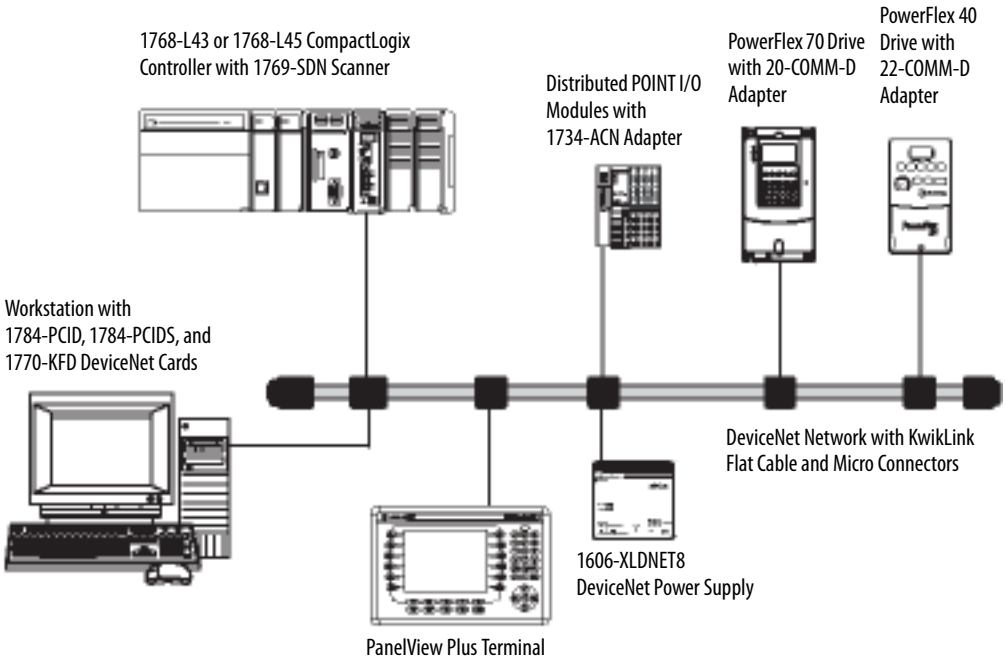
Table 8 - Required Software for DeviceNet Communication

Software	Functions	Requirement
RSLogix 5000	• Configure CompactLogix projects. • Define EtherNet/IP communication.	Yes
RSNetWorx for DeviceNet	• Configure DeviceNet devices. • Define the scan list for those devices.	
RSLinx	• Configure communication devices. • Provide diagnostics. • Establish communication between devices.	

The DeviceNet communication modules offer the following:

- Messaging to a device, not controller to controller
- A common application layer with ControlNet and EtherNet/IP networks
- Diagnostics for improved data collection and fault detection
- Less wiring than traditional, hardwired systems

Figure 6 - CompactLogix DeviceNet Network Overview



Serial Network Communication

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

Table 9 - DF1 Modes for Logix5000 Controllers

Mode	Functions
DF1 Point-to-Point	Communication between a controller and one other DF1-protocol-compatible device. This is the default mode with these parameters: • Communication Rate: 19,200 bps • Data Bits: 8 • Parity: None • Stop Bits: 1 • Control Line: No Handshake • RTS send Delay: 0 • RTS Off Delay: 0 This mode is typically used to program a controller through its serial port.
DF1 Master	• Control of polling and message transmission between the master and slave nodes. • The master/slave network includes one controller configured as the master node and up to 254 slave nodes. Link slave nodes using modems or line drivers. • A master/slave network can have node numbers from 0…254. Each node must have a unique node address. Also, for your link to be a network, it must consist of one master and one slave station.
DF1 Slave	• A controller to operate as a slave station in a master/slave serial communication network. • When there are multiple slave stations on the network, link slave stations by 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. • One node is designated as the master and controls who has access to the link. All of the other nodes are slave stations and must wait for permission from the master before transmitting.
DF1 Radio Modem	• Compatible with SLC™ 500 and MicroLogix™ 1500 controllers. • This mode supports Master and Slave, and Store and Forward modes.
User (channel 0 only)	• Communication with ASCII devices. • This requires your program to use ASCII instructions to read and write data from and to an ASCII device.
DH-485	• Communication with other DH-485 devices. • This multi-master, token-passing network permits programming and peer-to-peer messaging.

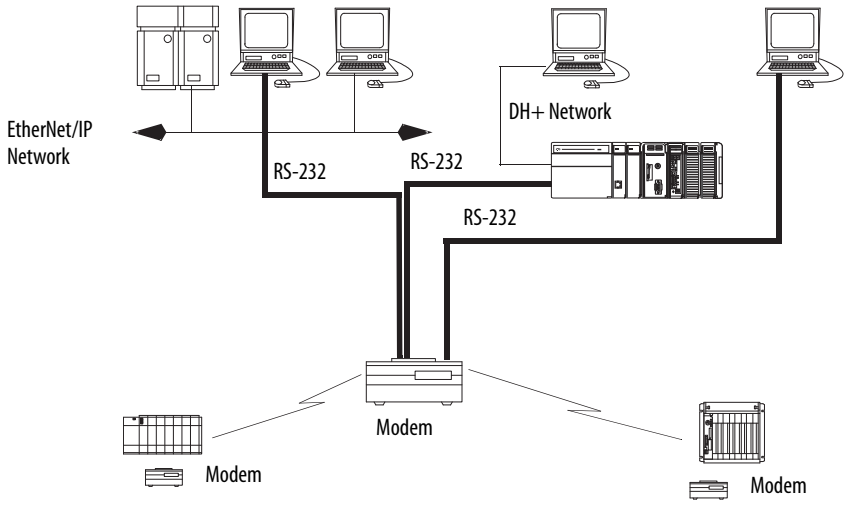
Master and Slave Communication

You can establish Modbus RTU Master and Slave communication via Application 129 provided in the samples directory of RSLogix 5000 software.

Communicate with DF1 Devices

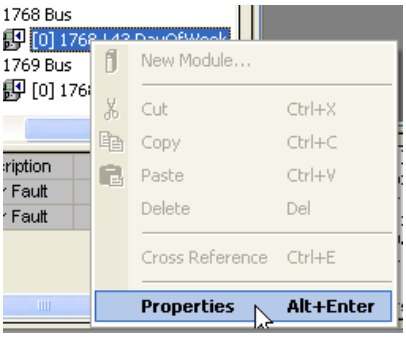
You can configure a controller as a master or slave on a serial network. Use serial communication to get information to and from remote controllers (stations) in these scenarios:

- The system contains three or more stations.
- Communication occurs on a regular basis and requires leased-line, radio, or power-line modems.

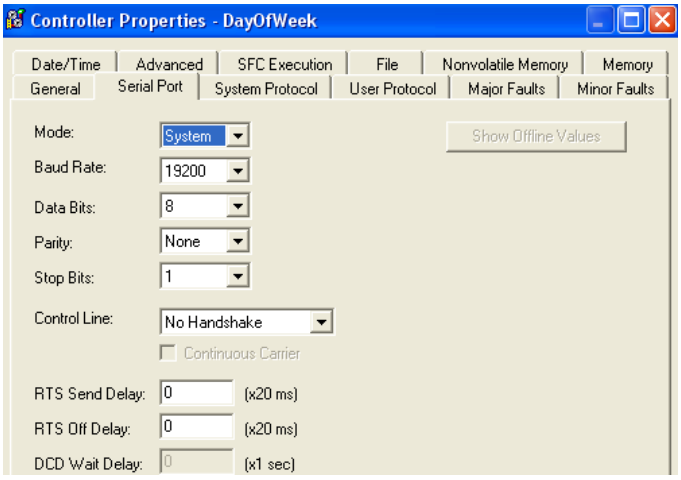


To configure your controller for DF1 communication, perform this procedure.

1. In the Controller Organizer, right-click your controller and choose Properties.

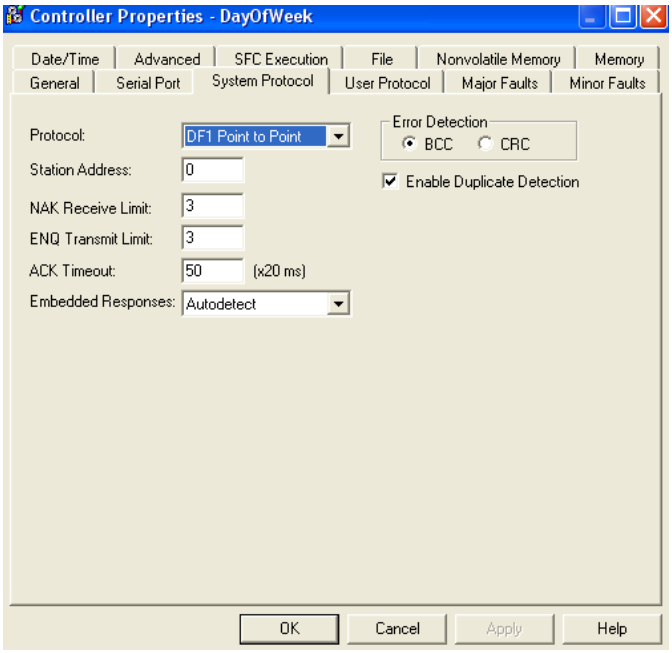


   The Controller Properties dialog box appears.



2. Click the Serial Port tab.
3. From the Mode pull-down menu, choose System.
4. Specify DF1 communication settings.

5. Click the System Protocol tab.

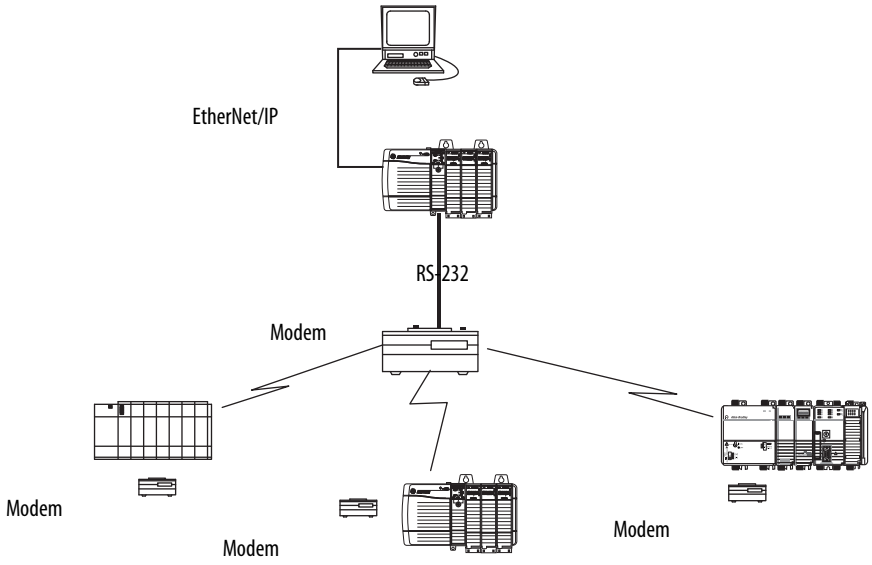


6. From the Protocol pull-down menu, choose DF1 Point-to-Point.
7. Specify DF1 system protocol settings.
8. Click OK.

DF1 Radio Modem Support

Your CompactLogix controller includes a driver that allows 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. The driver is not compatible with either of these protocols.

IMPORTANT	The DF1 radio modem driver should only be used 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 allows any node to initiate 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 passthru packets.

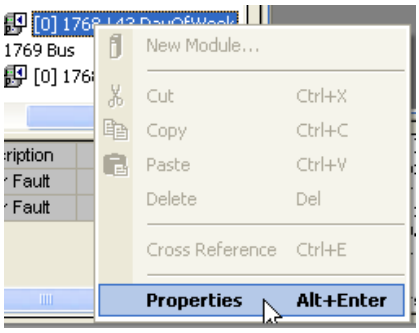
Unlike either DF1 full-duplex or DF1 half-duplex protocols, DF1 radio modem protocol does not include ACKs, NAKs, ENQs, or poll packets. Data integrity is ensured by the CRC checksum.

Using the DF1 Radio Modem

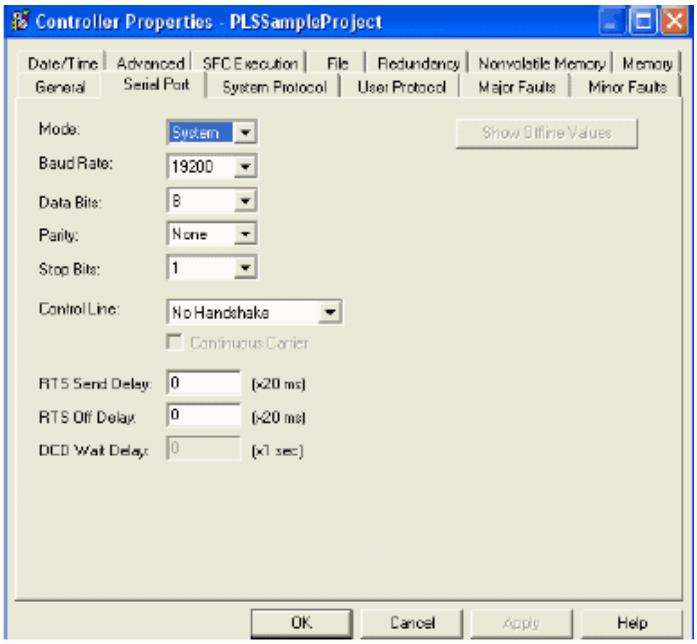
The DF1 radio modem driver can be configured as the system mode driver by using RSLogix 5000 software, version 17.01.02 or later.

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

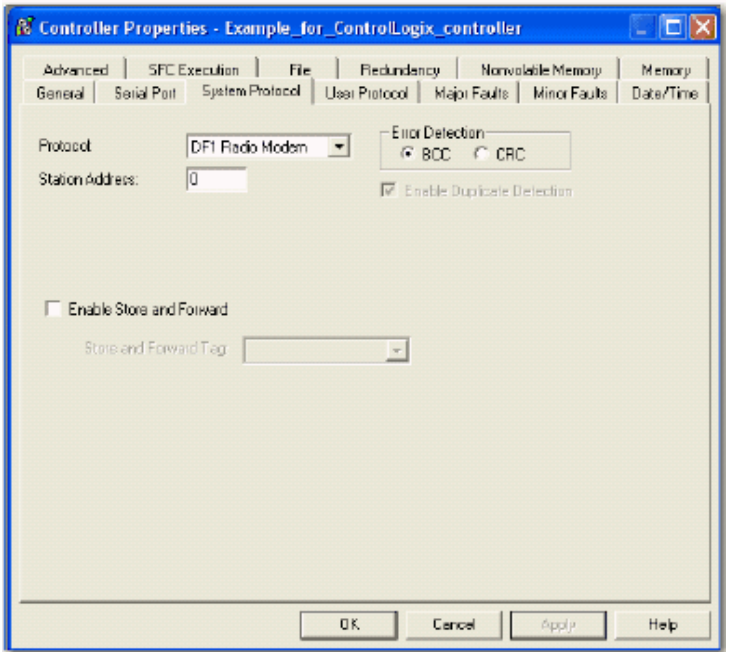
1. In the Controller Organizer, right-click your controller and choose Properties.



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 and click OK.

Setting	Description
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. • BCC—The processor sends and accepts messages that end with a BCC byte. • CRC—The processor sends and accepts messages with a 2-byte CRC.
Enable Store and Forward	Check the Enable Store and Forward check box 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) out 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.

Advantage of Using DF1 Radio Modem

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, where 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 can help you determine how to 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 using RSLogix 5000 software, version 17.01.02 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 passthru to remotely program the other nodes using RSLinx software and RSLogix 5000 software running on a personal computer connected to a local ControlLogix controller via a DH-485, DH+, or Ethernet network.

Additional Resources

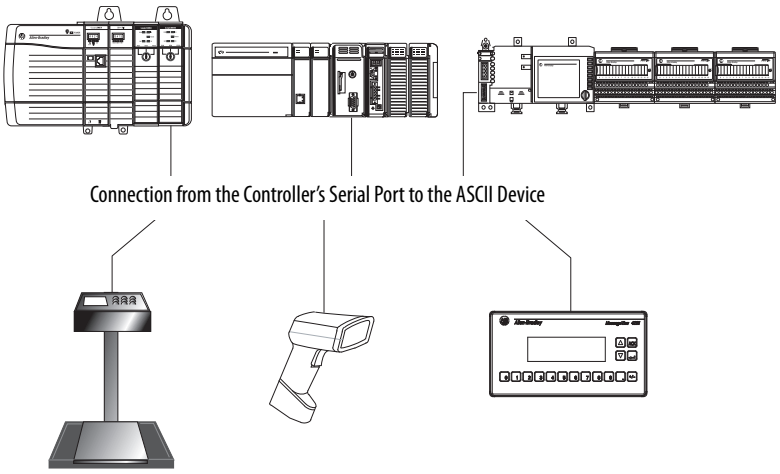
For additional information, consult these publications:

- Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003
- SCADA System Application Guide, publication AG-UM008.

Communicate with ASCII Devices

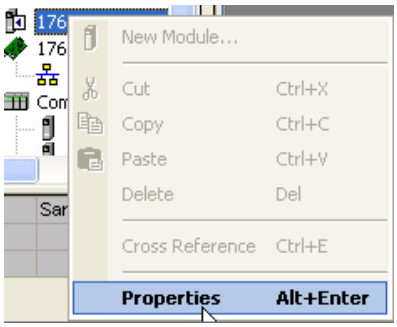
When you configure the serial port for User mode, you do the following:

- Read ASCII characters from a weigh scale module or bar code reader.
- Send and receive messages from an ASCII triggered device.

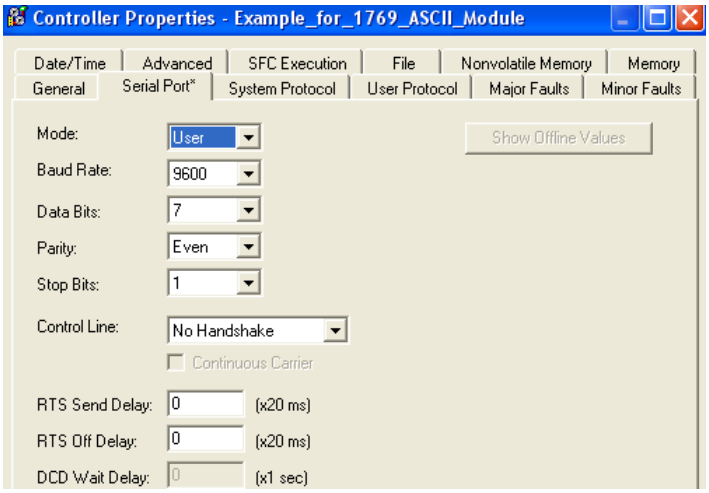


To communicate with ASCII devices, perform this procedure.

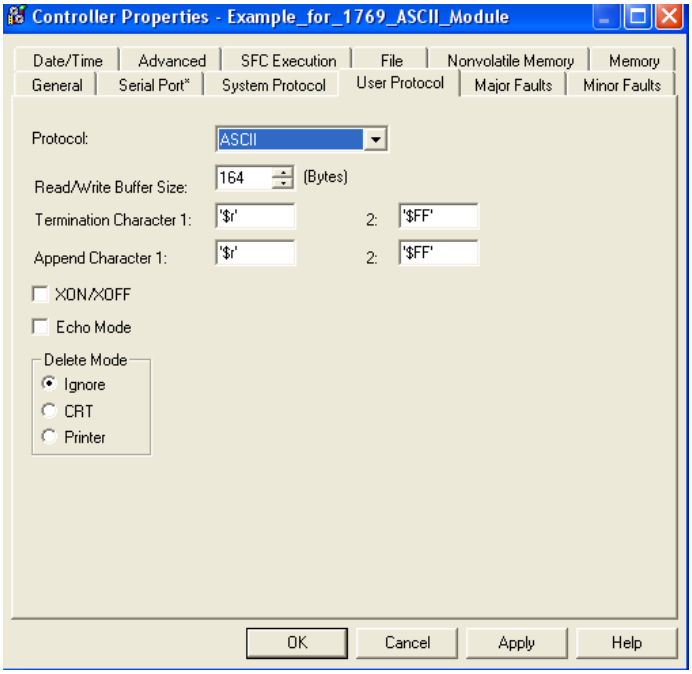
1. In the Controller Organizer, right-click your controller and choose Properties.



The Controller Properties dialog box appears.



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



6. Specify ASCII user protocol settings.
7. Click OK.

Each controller supports several ladder diagram (LD) and structured text (ST) instructions to manipulate ASCII characters.

Table 10 - Read and Write ASCII Characters

Instruction	Command
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 the DTR signal on or off.
	Turn the RTS signal on or off.
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.

Table 11 - Create and Modify Strings of ASCII Characters

Instruction	Command
CONCAT	Add characters to the end of a string.
DELETE	Delete characters from a string.
FIND	Determine the starting character of a sub-string.
INSERT	Insert characters into a string.
MID	Extract characters from a string.

Table 12 - Convert Data To or From ASCII Characters

Instruction	Command
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 the Modbus protocol, you will need to access two example programs in the samples directory of RSLogix 5000 software that emulate the Modbus protocol. These programs are entitled ModbusMaster and ModbusSlave. To execute these programs, you will need to use the CH0 serial port.

For more information on these applications, see the Using Logix5000 Controllers as Masters and Slaves on Modbus Application Solution, publication CIG-AP129.

Broadcast Messages over Serial

You can broadcast messages over a serial port connection from a master controller to all of its slave controllers using these communication protocols:

- DF1 master
- DF1 radio modem
- DF1 slave

Broadcasting over serial is achieved using the Message tag. Because messages are sent to receiving controllers, only Write messages can be used for broadcasting.

The broadcast feature can be set up using Ladder Logic software or Structured Text software.

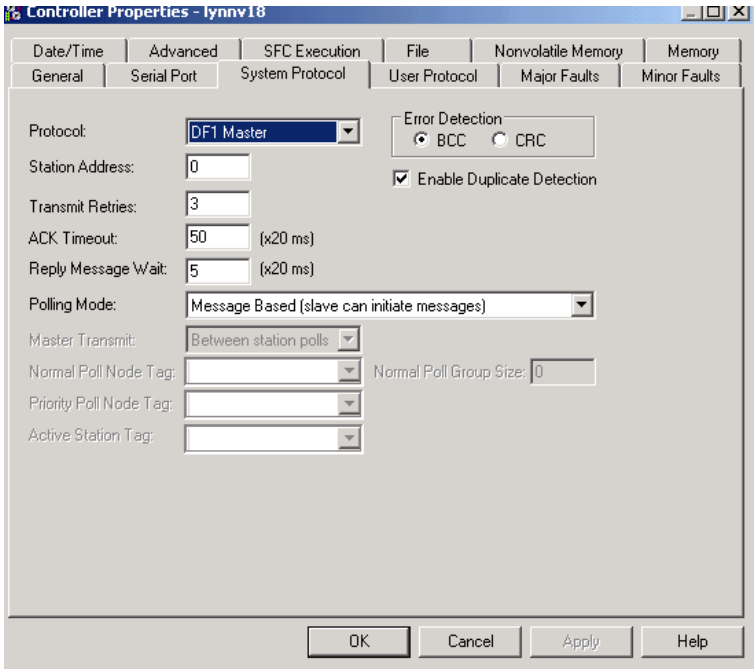
Broadcast can also be set by modifying the path value of a message tag in the tag editor.

The following example uses Ladder Logic software.

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. On the Controller Properties dialog box, click the System Protocol tab.



3. Complete the fields as described in the table below and click OK.

Field	DF-1 Master Protocol	DF1 Slave Protocol	DF1 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	1. Choose Message based on if you want to poll the slave using the Message instruction. 2. Choose Slave initiates messages for slave-to-slave broadcast. 3. Choose Standard if you want to have the schedule poll for the slave.	N/A	N/A
EOT Suppression	N/A	Disable	N/A
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 store and forward tag

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 the Controller Tags folder and choose New Tag.
2. Name the tag and choose the Message data type.
3. Click OK.

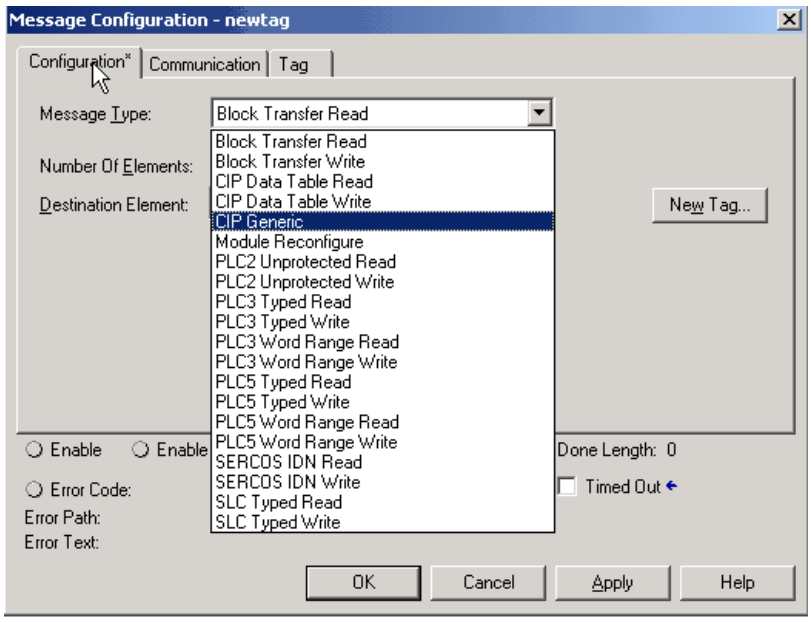
   The Message tag in the Controller Scope's Controller Tags folder will look similar to the following.

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.EX	16#0000_0000		Hex	DINT

Step 3: Ladder Logic Programming Software

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

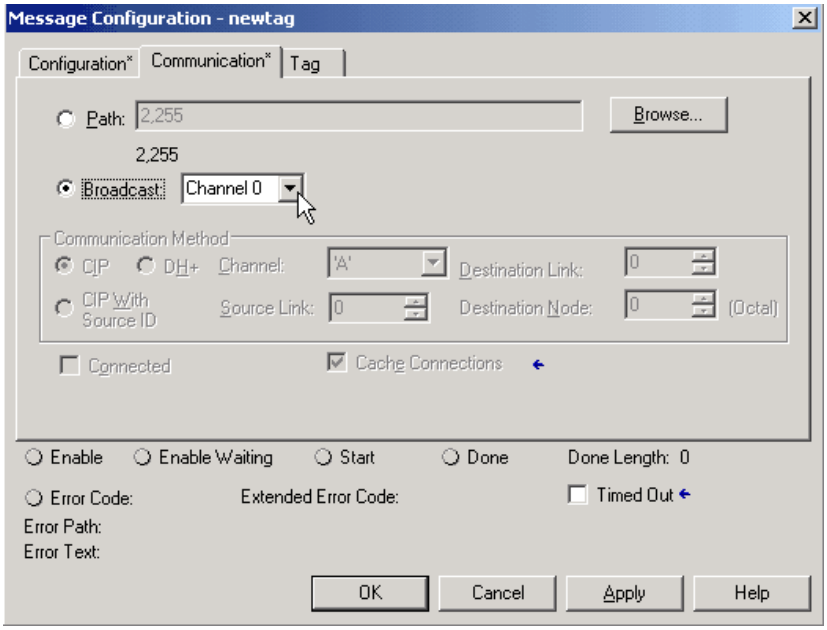
1. In the Controller Organizer, from the Tasks folder, click Main Routine to display the Ladder Logic interface.
2. Open a MSG instruction from the Input/Output tab.
3. Double-click in the Message Control field to enable the pull-down menu and choose the tag you created.
4. Open the Message Configuration dialog box.
5. On the Configuration tab, choose the message type from the Message Type pull-down menu and complete in any other fields needed.



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. On the Communication tab, click Broadcast, choose Channel from the pull-down menu, and click 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.

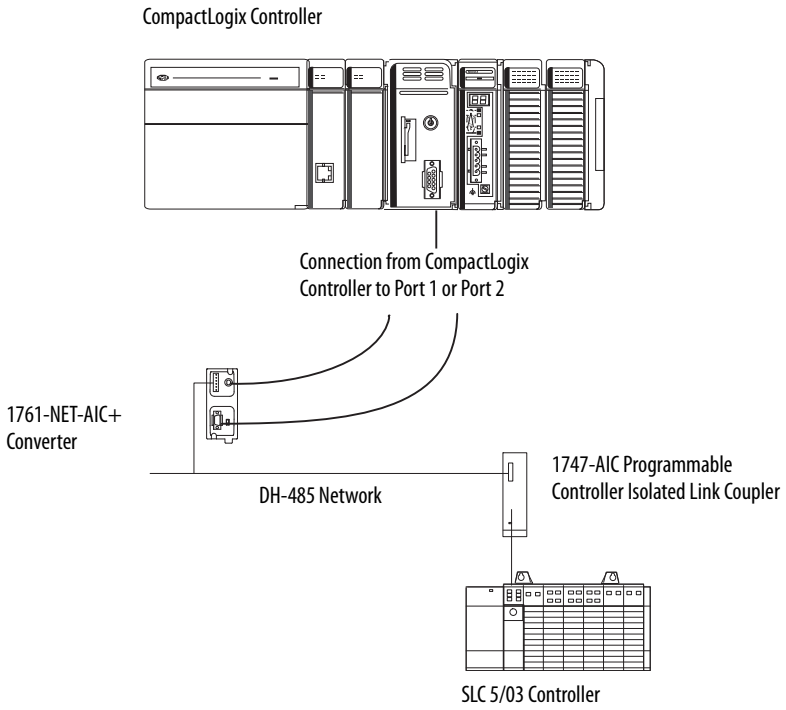
DH-485 Network Communication

For DH-485 communication, use the serial port of the controller. 1768 CompactLogix controllers can send and receive messages to and from other controllers on a DH-485 network. The DH-485 connection supports remote programming and monitoring. However, excessive traffic over a DH-485 connection can adversely affect overall performance and lead to time-outs and decreased configuration performance.

IMPORTANT Use Logix5000 controllers on DH-485 networks only when you want to add controllers to an existing DH-485 network. For new applications with Logix5000 controllers, we recommend you use networks in the NetLinx open architecture.

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 RS-232 port of a CompactLogix controller to act as a DH-485 interface. By using a 1761-NET-AIC converter and the appropriate RS-232 cable (Cat. No. 1756-CP3 or 1747-CP3), a CompactLogix controller can send and receive data on a DH-485 network.

Table 13 - CompactLogix DH-485 Network Communication Overview



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

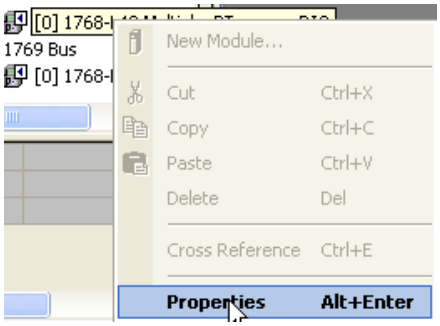
You can have two controllers for each 1761-NET-AIC converter, but you need a separate cable for each controller. Connect the serial port of the controller to either port 1 or port 2 of the 1761-NET-AIC converter. Use the RS-485 port to connect the converter to the DH-485 network.

Table 14 - Cable Selection

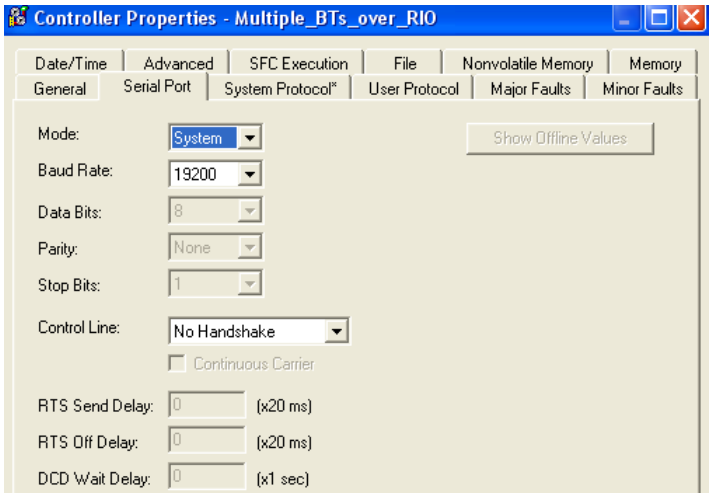
Connection	Required Cable
Port 1 DB-9 RS-232, DTE connection	1747-CP3 or 1761-CBL-AC00
Port 2 Mini-DIN 8 RS-232 connection	1761-CBL-AP00 or 1761-CBL-PM02

To communicate with DH-485 devices, perform this procedure.

1. In the Controller Organizer, right-click your controller and choose Properties.



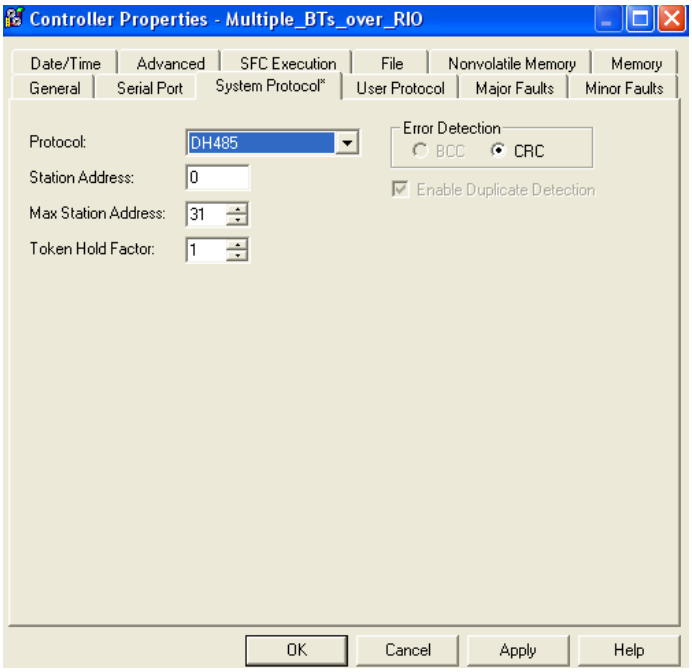
The Controller Properties dialog box appears.



2. Click the Serial Port tab.
   a. From the Mode pull-down menu, choose System.
   b. From the Baud Rate pull-down menu, choose 9600 or 19200 bps.

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.

3. Click the System Protocol tab.



a. From the Station Address pull-down menu, choose a station address number from 1...31, decimal.

IMPORTANT	The station address specifies the node address of the controller on the DH-485 network. To optimize network performance, assign station addresses in sequential order. Assign initiators, such as workstations, the lowest station address numbers to minimize the time required to initialize the network. The maximum station address specifies the maximum node address of all the devices on the DH-485 network.

b. From the Max Station Address pull-down menu, choose a maximum station address number from 1...31, decimal.

IMPORTANT	To optimize network performance, make sure of the following: • The maximum station address is the highest node number being used on the network. • All the devices on the same DH-485 network have the same selection for the maximum station address.

c. In the Token Hold Factor box, type a token hold factor value from 1...4.

IMPORTANT	The token hold factor is the number of transmissions (plus retries) that an address holding a token can send onto the data link each time that it receives the token. The default is 1.

4. Click OK.

Additional Resources

These documents contain additional information pertinent to communicating over networks.

Resource	Description
EtherNet/IP Web Server Module User Manual, publication ENET-UM527	Explains how to use and troubleshoot the 1768-EWEB Web Server Module.
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Explains how to use EtherNet/IP modules with Logix5000 controllers.
EtherNet/IP Performance Application Solution, publication ENET-AP001	Explains how to plan an EtherNet/IP network and improve overall network performance.
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Provides information pertinent to the design of Logix5000 systems.
ControlNet Modules in the Logix5000 Control Systems User Manual, publication CNET-UM001	Explains how to use ControlNet modules with Logix5000 controllers and provides technical specifications.
DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004	Explains how to use EtherNet/IP modules with Logix5000 controllers.
SCADA System Application Guide, publication AG-UM008	Explains how to configure a SCADA system.
Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003	Explains how to program Logix5000 controllers for sequential applications.
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides guidelines for the development of programs for Logix5000 controllers.
Using Logix5000 Controllers as Masters or Slaves on Modbus Application Solution, publication CIG-AP129	Details how to use Logix5000 controllers as Modbus RTU masters or slaves.
Data Highway/Data Highway Plus/Data Highway II/Data Highway-485 Cable Installation Manual, publication 1770-6.2.2	Explains how to plan and construct a Data Highway cable system.

Manage Controller Communication

Connection Overview

A Logix5000 system uses a connection to establish a communication link between two devices. There are several types of connections:

- Controller to local I/O modules or local communication modules
- Controller to remote I/O or remote communication modules
- Controller to remote I/O (rack-optimized) modules
- Produced and consumed tags
- Messages
- Controller access via RSLogix 5000 software
- Controller access via RSLinx software for HMI or other applications

Produce and Consume (interlock) Data

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

Table 15 - Produced and Consumed Tags

Tag Type	Description
Produced	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 one connection for each consumer. The controller's communication device uses one connection for each consumer. 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, such as communication and I/O.
Consumed	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.

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

The number of available connections limits the 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 other controllers or operator interfaces. Some messages use connections to send or receive data. These connected messages can leave the connection open (cache) or close the connection when the message is done transmitting. Each message uses one connection, regardless of how many devices are in the message path.

Table 16 - Message Types

Message Type	Communication Method	Connected Message	Message Can Be Cached
CIP data table read or write	N/A	Yes(1)	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	N/A	Optional (2)	Yes(3)
Block-transfer read or write	N/A	Yes	Yes

(1) Starting with version 16.03.00 of RSLogix 5000 software, you can initiate these messages as unconnected.
(2) You can connect CIP generic messages. However, for most applications we recommend you leave CIP generic messages unconnected.
(3) Consider caching only if the target module requires a connection.

To conserve connections, configure one message to read from or write to multiple devices. You can programmatically change the target of a MSG instruction to optimize program size.

Determining Whether to Cache Message Connections

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

Table 17 - Caching Message Connections

Message Execution	Function
Repeatedly	Cache the connection. This keeps the connection open and optimizes execution time. Opening and closing 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, which frees up that connection for other uses.

Calculate Connection Use

The total connection requirements for a 1768 CompactLogix system include both local and remote (distributed) connections. You do not have to tally local controller connections because the controllers support all of the connections required for the maximum number of I/O modules and 1769-SDN modules in one system.

Table 18 - Tallying Remote Connection Use

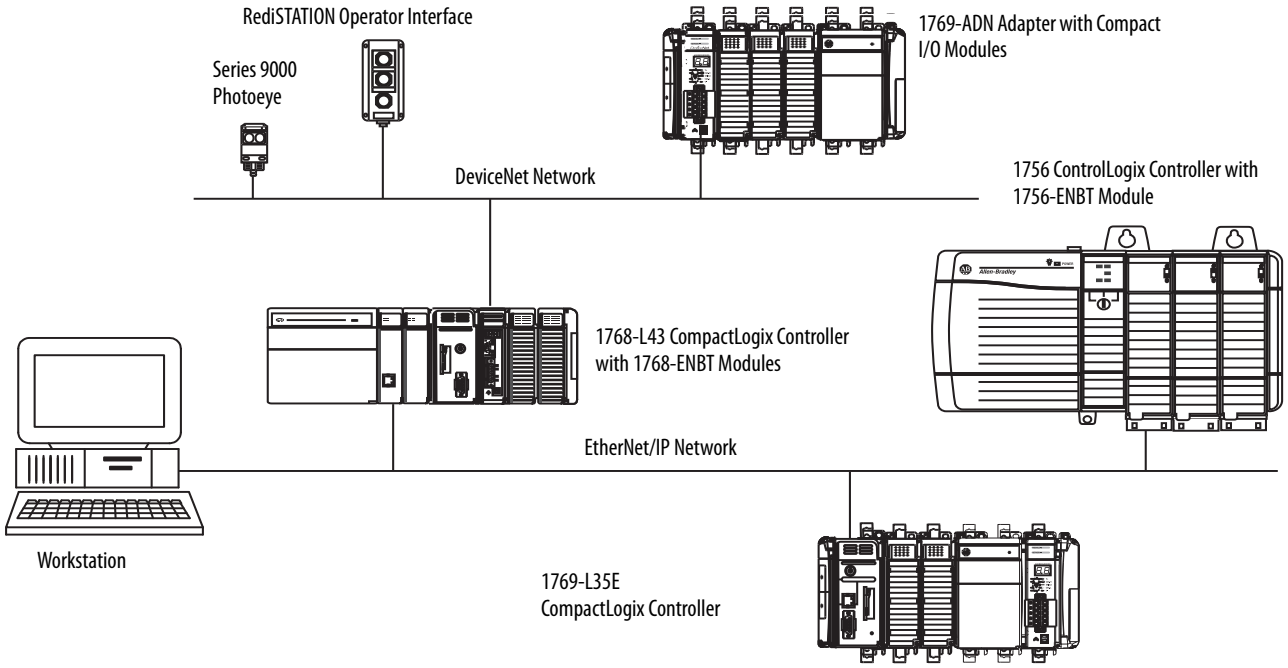
Remote Connection Type	Device Quantity	Connections per Device	Total Connections
Remote EtherNet/IP communication module I/O configured as direct connection (none) I/O configured as rack-optimized connection		 0 **or** 1	
Remote I/O module over an EtherNet/IP network (direct connection)		1	
Produced tag Each consumer		1 1	
Consumed tag		1	
Message (depending on type)		1	
Block-transfer message		1	
		Total	

Connections Example

In this example system, the 1768-L43 or 1768-L45 CompactLogix controller does the following:

- Monitors input or status data via the 1769-L35E CompactLogix controller.
- Sends and receives messages to and from a ControlLogix controller on an EtherNet/IP network.
- Produces a tag for the 1769-L35E CompactLogix controller, which the controller consumes.

Figure 7 - Example CompactLogix System



The 1756-ENBT and 1768-ENBT modules in this system use these connections.

Table 19 - Example Connection Types

Connection Type	Device Quantity	Connections per Device	Total Connections
Controller to RSLogix 5000 software	1	1	1
Message to 1756 ControlLogix controller	1	1	1
Message to 1769-L35E controller	1	1	1
Tag produced for the 1769-L35E CompactLogix controller	1	1	1
Tag consumed by the 1769-L35E CompactLogix controller	1	1	1
		Total	5

Place 1768 and 1769 Modules

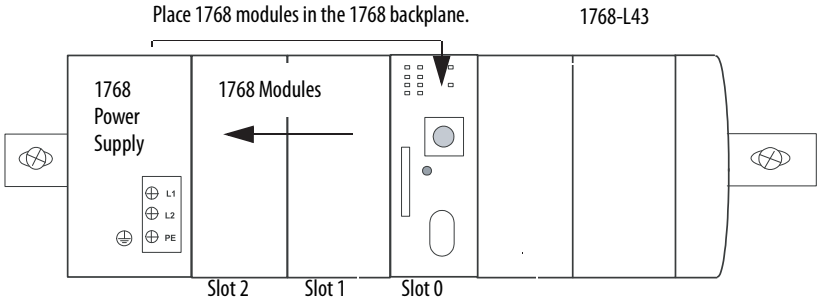
The 1768 CompactLogix controllers combine a 1768 backplane with a 1769 backplane. This combination includes the advantages of the 1768 architecture while retaining the advantages of 1769 I/O support.

1768 Module Placement

Follow these guidelines as you place modules in the 1768 backplane.

1768 CompactLogix Controller	Guidelines
1768-L43 and 1768-L45	The 1768 power supply must be the leftmost module in the 1768 backplane.
	The controller must be the rightmost module in the 1768 backplane.
	Up to two 1768 communication modules can reside between the controller and power supply in any one of these combinations: • 1768-ENBT or 1768-EWEB for EtherNet/IP communication (maximum of two) • 1768-CNB or 1768-CNBR for ControlNet communication (maximum of two)
1768-L43	Two chassis slots are available.
	The controller supports a maximum of 3 banks for a total of 16 modules.
1768-L45	Four chassis slots are available.
	The controller supports a maximum of 3 banks for a maximum of 30 modules.
	Up to four 1768-M04SE for SERCOS motion control modules can be used.

Figure 8 - 1768 Module Placement Overview

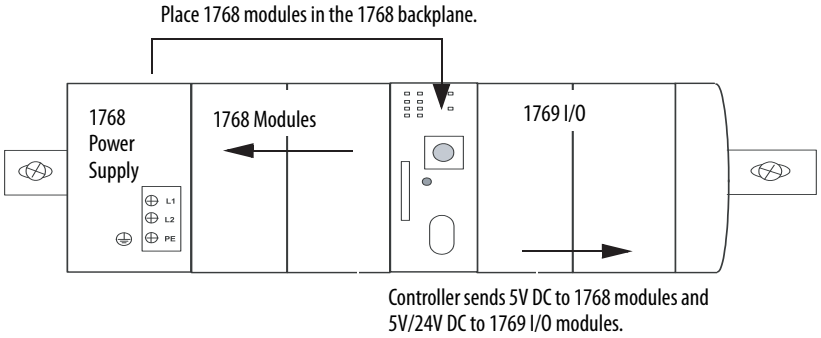


Note the following:

- The 1768 slots are numbered right to left, starting with the controller in slot 0.
- The 1768 backplane requires one 1768 power supply.
- The 1768-PA3 power supply is a dual input supply that operates in these ranges:
  - 86...265V AC
  - 108...132V DC

The 1768-PB3 power supply is a single-input power supply whose power supply range is 16.8...31.2V DC.

Figure 9 - 1768 Power Supply



The 1768-PA3 and 1768-PB3 power supplies also offer a 24V DC external power source. These power supplies require that a 1768 CompactLogix controller be installed:

- The power supply sends 24V DC to the controller in slot 0.
- The controller converts the 24V DC to 5V DC and 24V DC, and distributes the power as needed.
  - 5V/24V power to 1769 I/O modules on the right side of the controller
  - 5V power to communication or motion modules on the left side of the controller

The 1768 modules do not have a distance rating to the 1768 power supply.

1769 Module Placement

The CompactLogix controllers support the following:

- 1768-L43, a maximum of 16 local 1769 I/O modules
- 1768-L45, a maximum of 30 local 1769 I/O modules

Follow these guidelines as you place 1769 modules to the right of the 1768 controller:

- Up to eight 1769 modules can be attached to the right of the 1768 system.
- The 1769 I/O modules connected directly to the 1768 controller do not need a 1769 power supply.

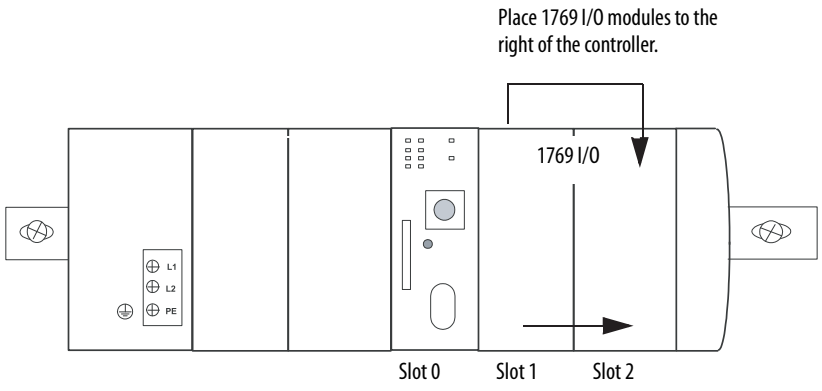
IMPORTANT	Never put a 1769 power supply in the 1768 backplane. A 1769 power supply in the 1768 backplane causes the controller to generate a major fault that cannot be cleared until you remove the 1769 power supply.

- Additional 1769 modules must be in additional I/O banks.
- Each additional I/O bank must have its own power supply. Use any 1769 power supply.
- Each 1769 module also has a power supply distance rating, which is the number of modules from the power supply.

IMPORTANT	Each module must be within its distance rating. See the specifications for the module to determine its distance rating.

- Place up to eight 1769 I/O modules to the left or the right of the 1769 power supply.
- Each additional I/O bank must connect to the main rack by using standard 1769-CRL*x* extension cables.

Figure 10 - 1769 Module Placement Overview



The 1769 slots are numbered left to right, starting with the controller as slot 0.

Notes:

Configure and Monitor I/O Modules

Select I/O Modules

When selecting 1769 I/O modules, choose the following:

- Specialty I/O modules as needed
- A1492 wiring system for each I/O module as an alternative to the terminal block that comes with the module

Each 1769 I/O module includes a built-in removable terminal block with finger-safe cover for connections to I/O sensors and actuators. The terminal block is behind a door at the front of the module. I/O wiring can be routed from beneath the module to the I/O terminals.

When planning I/O communication, consider these factors:

- Which CompactLogix I/O modules to use
- Where to place CompactLogix I/O modules
- How CompactLogix I/O modules operate

Local I/O Performance

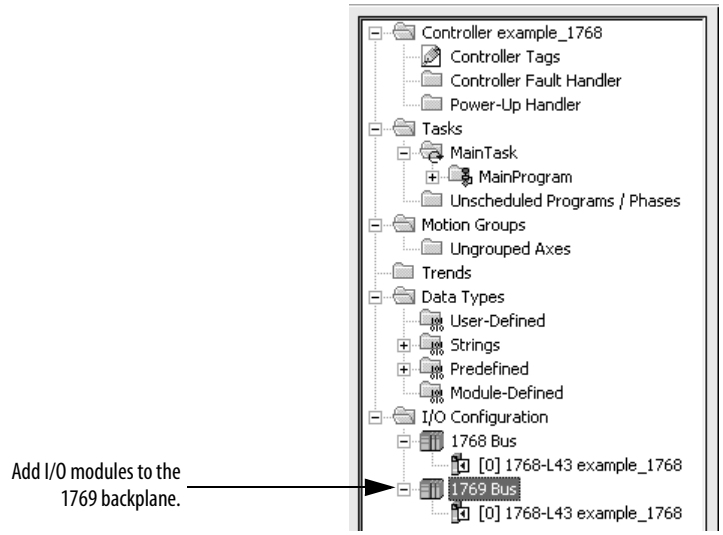
For the best local I/O performance in a 1768 CompactLogix system, follow these guidelines:

- Set an individual requested packet interval (RPI) for each local 1769 I/O module.
- Use a faster RPI for time critical I/O without impacting overall 1769 I/O performance.

I/O update times do not affect overall 1768 bus performance, such as motion performance or controller performance.

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



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 20 - Configuration Options for I/O Modules

Configuration Option	Description
RPI (local 1769 I/O and distributed I/O only)	The RPI specifies the period at which data updates over a connection. For example, an input module sends data to a controller at the RPI that you assign to the module. Note the following: • Typically, you configure an RPI in milliseconds (ms). The minimum RPI for 1769 I/O is 1 ms. • 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.
Change of State (COS) (distributed I/O only)	Digital I/O modules use COS to determine when to send data to the controller. If a COS does not occur within the RPI time frame, the module multicasts data at the specified RPI. 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.
Communication format (distributed I/O only)	Many I/O modules support different formats. The communication format determines the following: • Data structure of tags • Connections • Network use • Ownership • Whether the module returns diagnostic information
Electronic keying (local 1769 I/O and distributed I/O only)	When you configure a module, you specify the slot number for the module. However, it is possible to place a different module in that slot. 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 will open a connection to the module. Keying options differ depending on your application needs.

IMPORTANT The configuration dialog boxes for 1769 I/O modules offer a Hold Last State option for how to react when the controller faults.

Although the 1768-L43 an 1768-L45 controllers do not support the Hold Last State option for 1769 I/O modules when they are configured locally, this feature is available when they are connected on DeviceNet using a 1769-ADN adapter.

I/O Connections

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

Table 21 - Logix5000 Connection Types

Connection	Description
Direct (applies to all 1769 I/O)	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 (applies to distributed I/O only)	For digital I/O modules, you can select rack-optimized communication. A rack-optimized connection consolidates connection usage between the controller and all of 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).

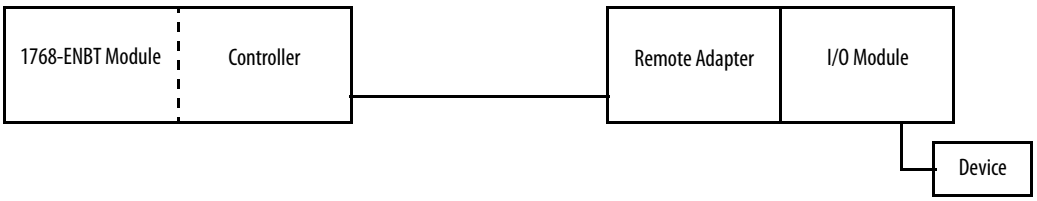
Configure Distributed I/O on an EtherNet/IP Network

To communicate with distributed I/O modules over an EtherNet/IP network, add an EtherNet/IP adapter and I/O modules to the controller's I/O Configuration folder.

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

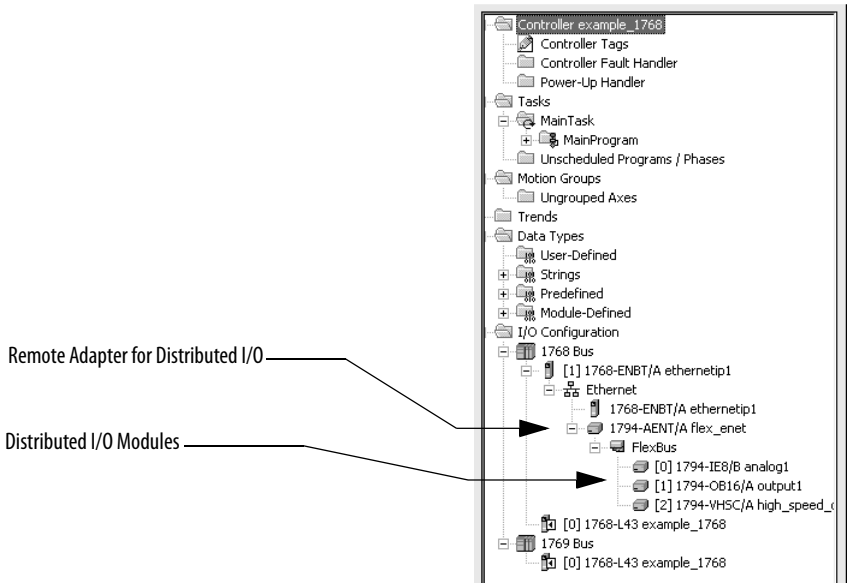
Figure 11 - Configuring I/O on EtherNet/IP Network

Typical Distributed I/O on an EtherNet /IP Network



To build the I/O Configuration, follow these steps.

1. In the Controller Organizer, under the I/O Configuration folder, add the remote adapter for the distributed I/O chassis or DIN rail.
2. Add the distributed I/O modules.

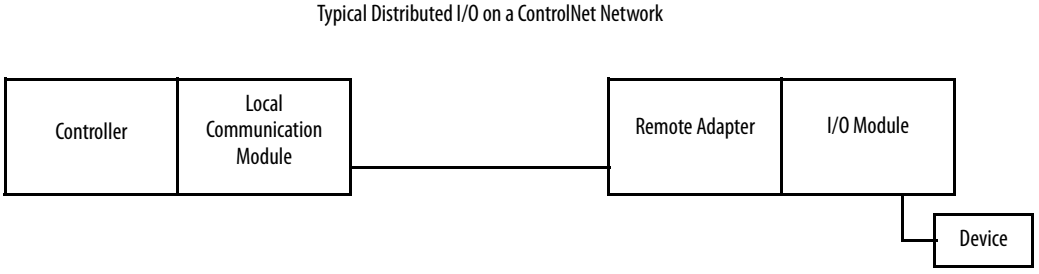


Configure Distributed I/O on a ControlNet Network

To communicate with distributed I/O modules over a ControlNet network, add a ControlNet bridge, followed by an adapter, and I/O modules to the I/O Configuration folder of the controller.

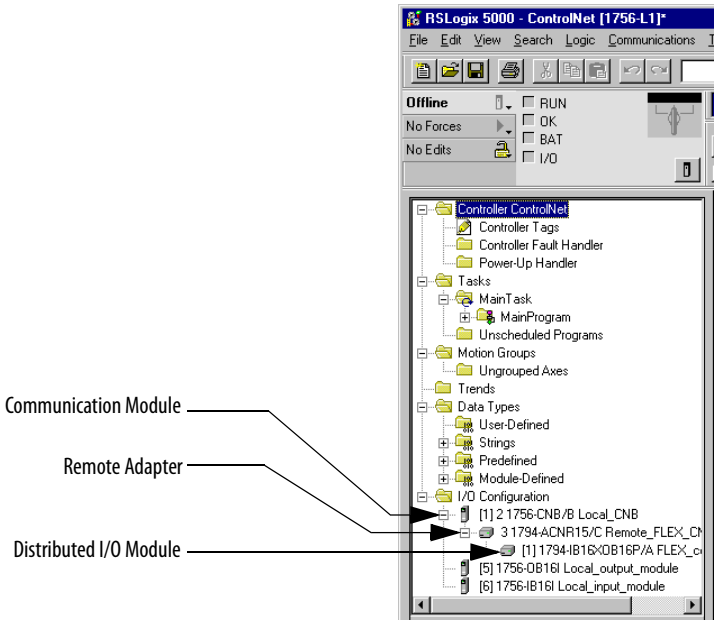
Within the I/O Configuration folder, organize the modules into a hierarchy of tree/branch and parent/child.

Figure 12 - Configuring I/O on a ControlNet Network



To build the I/O Configuration, follow these steps.

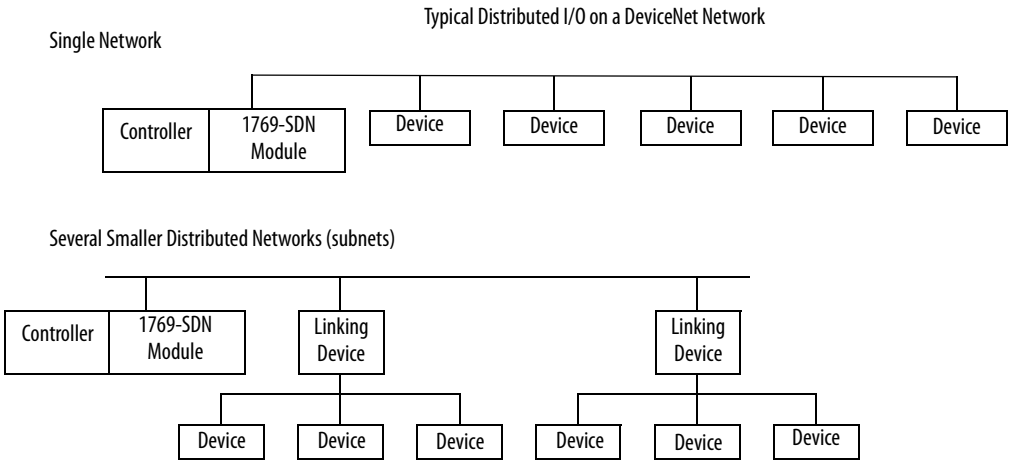
1. On the Controller Organizer, under the I/O Configuration folder, add the local communication module.
2. Add the remote adapter for the distributed I/O chassis or DIN rail.
3. Add the distributed I/O module.



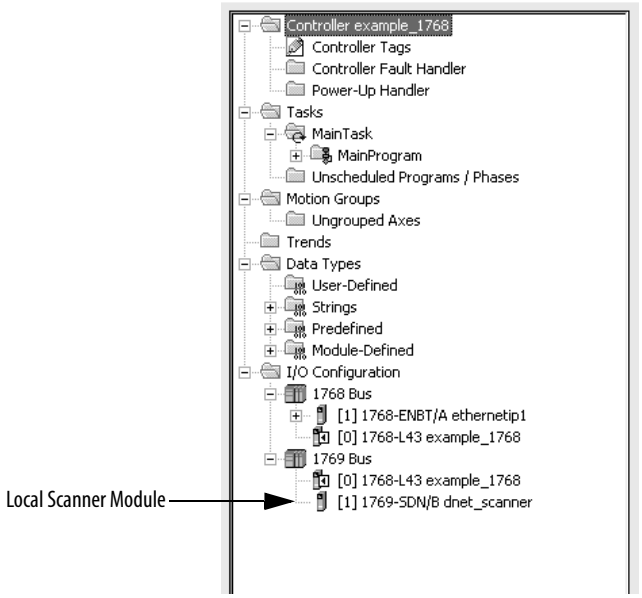
Configure Distributed I/O on a DeviceNet Network

To communicate with the I/O modules over a DeviceNet network, add the 1769-SDN DeviceNet scanner to the I/O Configuration folder of the controller. You define a scanlist within the DeviceNet scanner to communicate data between devices and the controller.

Figure 13 - Configuring I/O on a DeviceNet Network



To build the I/O Configuration, on the Controller Organizer, in the I/O Configuration folder, 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. The structure depends 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.

An I/O address follows this format.

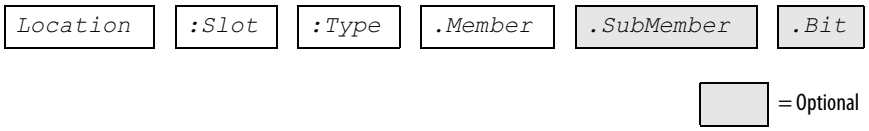


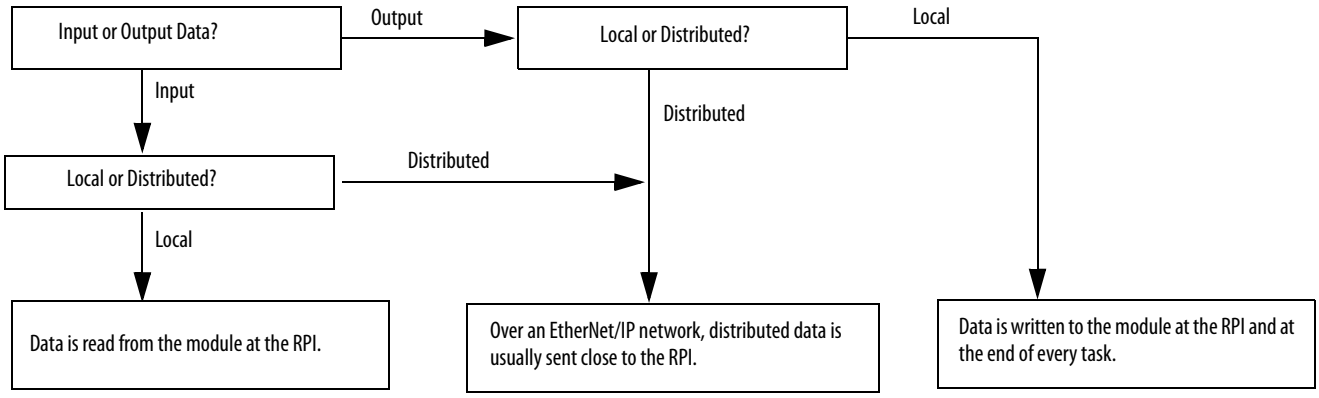
Table 22 - I/O Address Components

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 S = status
Member	Specific data from the I/O module, depending on what type of data the module can store • For a digital module, a data member usually stores the input or output bit values • For an analog module, a channel member (CH#) usually stores the data for a channel
Submember	Specific data related to a member
Bit	Specific point on a digital I/O module; depends 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. Use the flowchart to determine when a producer, such as a controller, input module, or bridge module, will send data.

Figure 14 - Overview - Updating Data



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

Monitor I/O Modules

To monitor I/O modules, you can do the following:

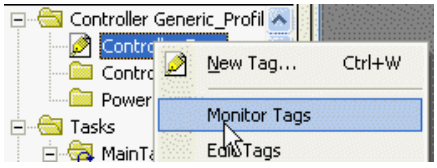
- Use RSLogix 5000 software to display fault data.
- Program logic to monitor fault data so you can take appropriate action.

Display Fault Data

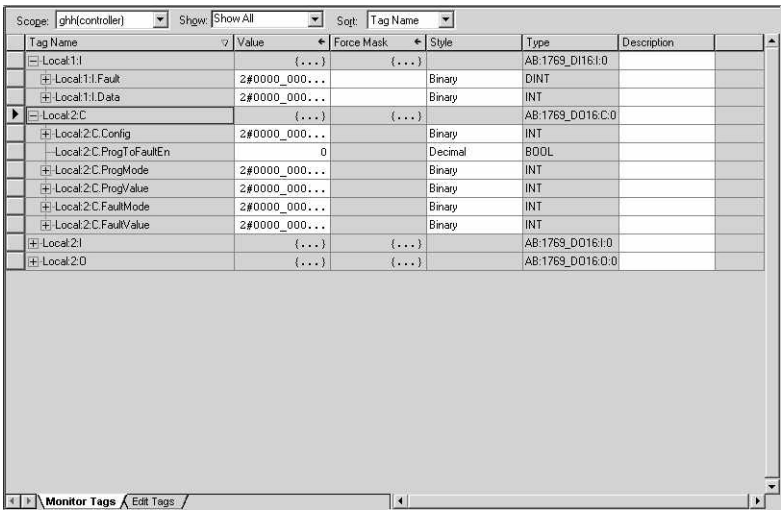
Fault data for certain types of module faults can be viewed through the software.

To display fault data, perform this procedure.

1. In the Controller Organizer, right-click Controller Tags and choose Monitor Tags.



The Monitor Tags dialog box appears.



The default display setting for the fault data is decimal.

2. Change the display setting for the fault data to Hex to read the fault code.

   If the module faults but maintains an open connection to the controller, the controller tags database displays the fault value 16#0E01_0001.

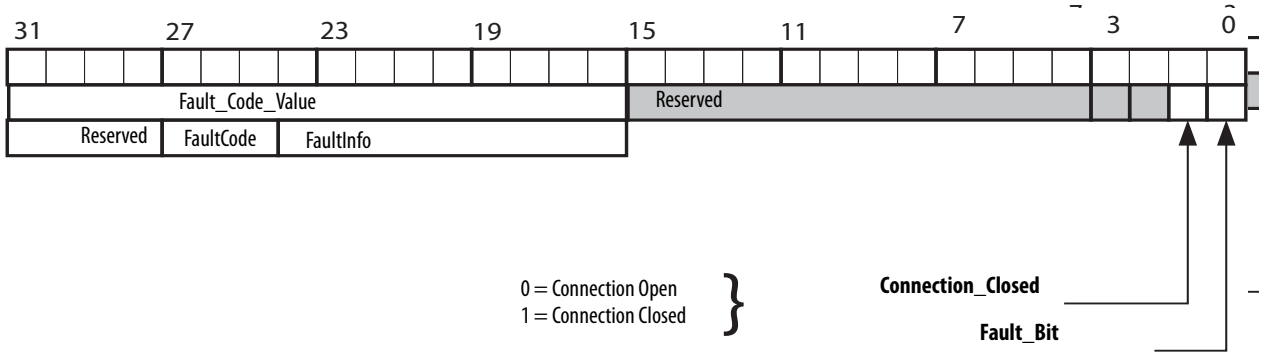


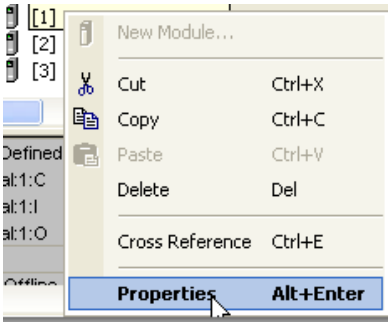
Table 23 - Fault Word Bits

Bit	Description
Fault_Bit	This bit indicates that at least one bit in the fault word is set (1). If all of 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 it set (1).

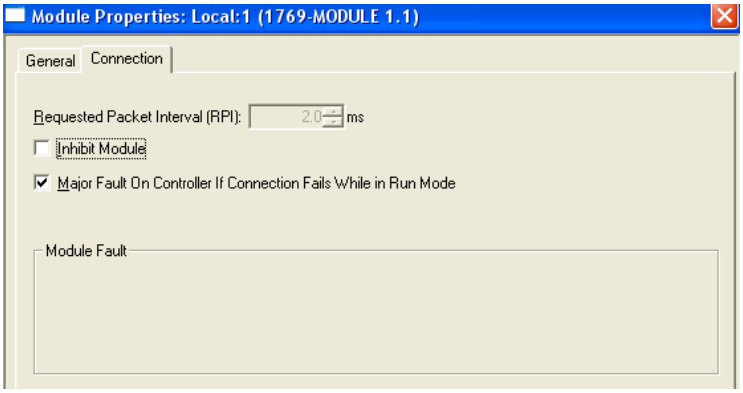
Display Fault Data via Module Properties Dialog Box

To display fault data via another option via RSLogix 5000 software, perform this procedure.

1. Right-click your 1769 I/O module and choose Module Properties.



   The Module Properties dialog box appears.



2. Click the Connection tab.
3. From the Module Fault pull-down menu, view any faults affecting your 1769 I/O module.

End-cap Detection and Module Faults

If the module adjacent to the end cap faults, or any other fault that the controller interprets as bus integrity lost (such as power loss in an expansion I/O rack) occurs, communication with all of the local 1769 I/O ceases. If any of these 1769 I/O modules are configured as required, the controller faults.

Reconfigure an I/O Module

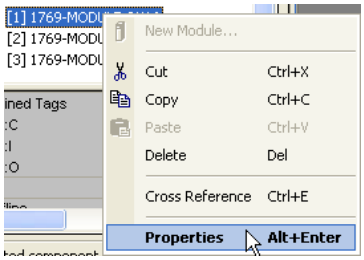
If an I/O module supports reconfiguration, you can reconfigure the module via these methods:

- Module Properties dialog box
- MSG instruction in program logic

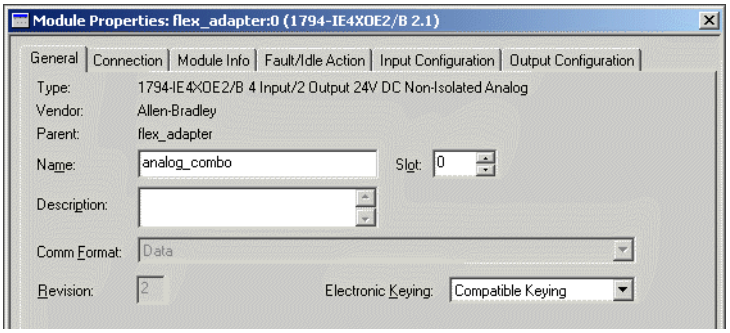
Reconfigure a Module via RSLogix 5000 software

To change the configuration of an I/O module, perform this procedure.

1. In the Controller Organizer, right-click the module and choose Properties.



   The Module Properties dialog box appears. The appearance of the Module Properties dialog box differs from one I/O module to the next.



2. Configure the I/O module.

Reconfigure a Module via an MSG Instruction

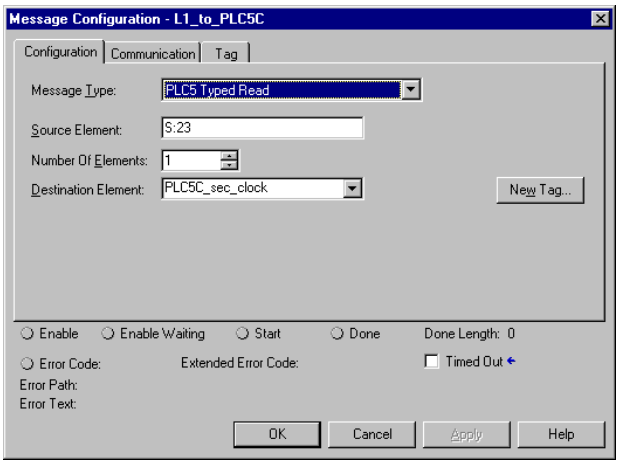
Use a MSG instruction of type Module Reconfigure to send new configuration information to an I/O module. The following occurs during reconfiguration:

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

Use these steps to reconfigure a module via an MSG instruction.

1. Click … in the MSG box.

   The Module Configuration dialog box appears.



   a. From the Message Type pull-down menu, choose Module Reconfigure.

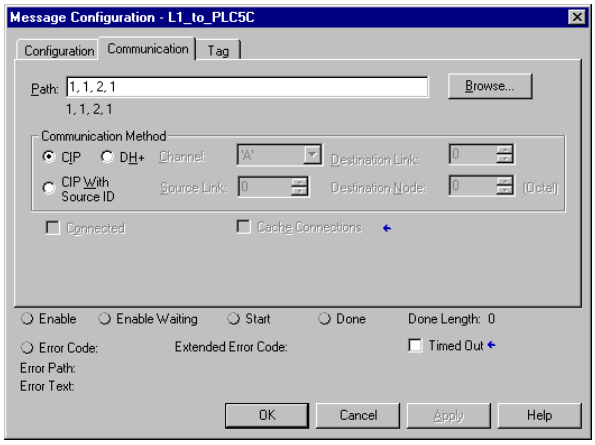
   b. In the Source Element field, type the appropriate information.

   c. From the Number of Elements pull-down menu, choose the number of elements.

   d. From the Destination Element pull-down menu, choose the instruction's destination element.

   The message instruction's destination determines how the message is configured.

2. Click the Communication tab.



   a. Specify the path of the module for which you sent the message instruction to the I/O configuration tree.

If the module	Then
Has been added	Click Browse to choose the path.
Has not been added	Type the path in the Path box.

   b. Click OK.

Additional Resources

These documents contain additional information pertinent to configuring and monitoring I/O.

Resource	Description
Compact I/O Analog Modules User Manual, publication 1769-UM002	Explains how to design, program, and troubleshoot Compact I/O analog modules.
Compact I/O 1769-IR6 RTD/Resistance Input Module User Manual, publication 1769-UM005	Explains how to design, program, and troubleshoot Compact I/O, CompactLogix, or MicroLogix 1500 controllers.
Compact I/O 1769-IT6 Thermocouple/mV Input Module User Manual, publication 1769-UM004	Explains how to design, program, and troubleshoot a CompactLogix system that use this Compact I/O 1769-IT6 module.
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides guidelines for the development of programs for Logix5000 controllers.
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Provides information pertinent to the design of Logix5000 systems.
Logix5000 Controllers General Instruction Set Reference Manual, publication 1756-RM003	Details how to program the controller for sequential applications.

Notes:

Develop Applications

Manage Tasks

A Logix5000 controller lets you use multiple tasks to schedule and prioritize the execution of your programs based on specific criteria. This multitasking allocates the controller's processing time among the different operations in your application.

IMPORTANT Be aware of the following:

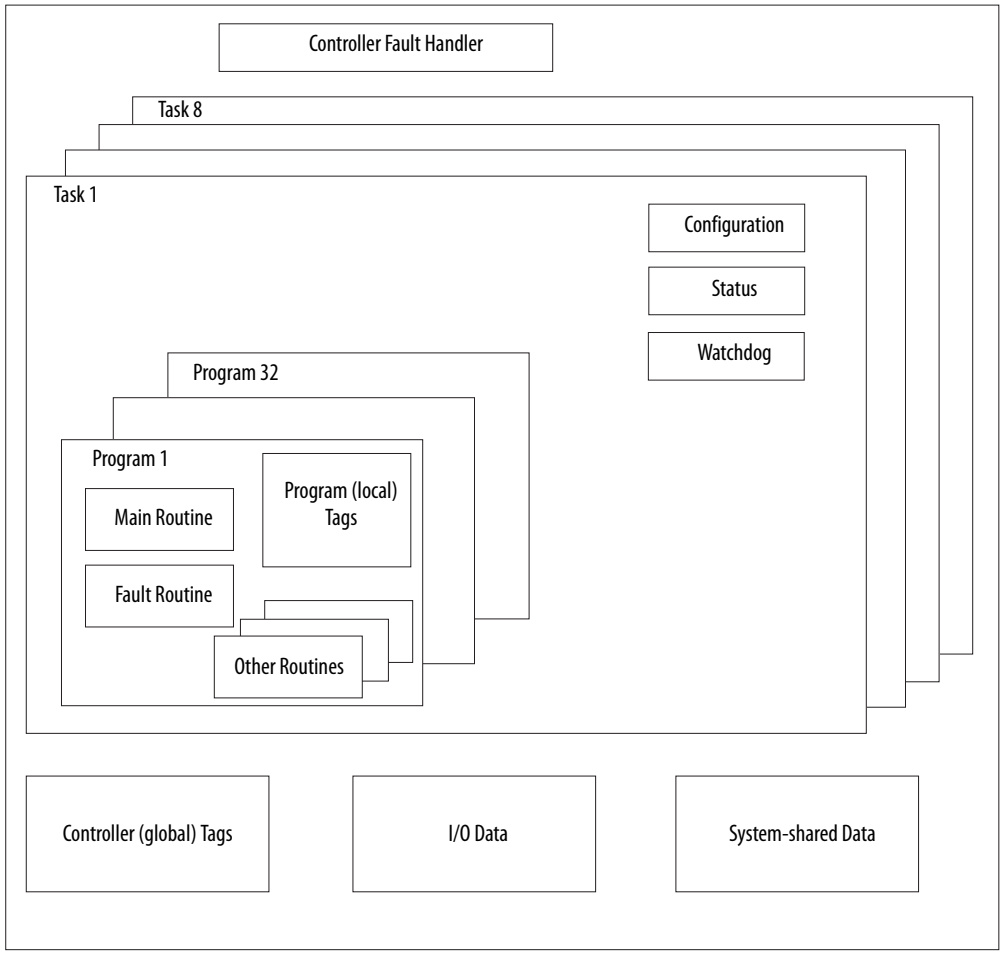
- The controller executes only one task at a time.
- One task can interrupt another executing task and take control.
- In any given task, only one program executes at a time.

Develop Programs

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

- Tasks to configure controller execution
- Programs to group data and logic
- Routines to encapsulate executable code written in a single programming language

Figure 15 - Program Development Overview



Define Tasks

A task provides scheduling and priority information for a set of one or more programs. You can configure tasks as continuous, periodic, or event.

Table 24 - Types of Logix5000 Controller Tasks

Task Execution	Task Type	Description
All of the time	Continuous	The continuous task runs in the background. Any CPU time not allocated to other operations, such as motion, communication, and other tasks, is used to execute the programs in the continuous task: • The continuous task runs constantly. When the continuous task completes a full scan, it restarts immediately. • A project does not require a continuous task. If used, there can be only one continuous task.
At a set interval, such as every 100 ms or Multiple times within the scan of your other logic	Periodic	A periodic task performs a function at a specific interval: • Whenever the time for the periodic task expires, the task interrupts any lower priority tasks, executes once, and then returns control to where the previous task left off. • You can configure the time period from 0.1...2000 µs. The default is 10 ms. It is also controller and configuration dependent. • The performance of a periodic task depends on the type of Logix controller and on the logic in the task.
Immediately when an event occurs	Event	An event task performs a function only when a specific event (trigger) occurs. In a 1768 CompactLogix controller, the trigger for the event task can be any of the following: • Consumed tag trigger • EVENT instruction • Axis trigger • Motion event trigger

- The 1768-L43 controller supports 16 tasks, only 1 of which can be continuous.
- The 1768-L45 controller supports 30 tasks, only 1 of which can be continuous.

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 of the programs assigned to the task execute in the order in which they are grouped. A program can appear only once in the Controller Organizer and cannot be shared by multiple tasks.

Specifying 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. Higher-priority tasks interrupt any lower-priority tasks. Periodic tasks take priority and always interrupt continuous tasks, which have the lowest priority.

Define Programs

Each program contains program tags, a main executable routine, other routines, and an optional fault routine. Each task can schedule up to 32 programs.

Scheduled programs within a task execute to completion from first to last. Programs not attached to any task show up as unscheduled programs. You must specify (schedule) a program within a task before the controller can scan the program.

Unscheduled programs within a task are downloaded to the controller with the entire project. The controller verifies unscheduled programs, but does not execute them.

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 resembles 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.

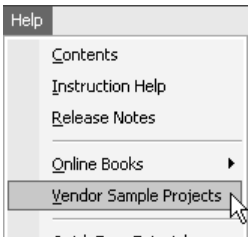
You can also specify an optional program fault routine. The controller executes this routine if it encounters an instruction-execution fault within any of the routines in the associated program.

Sample Controller Projects

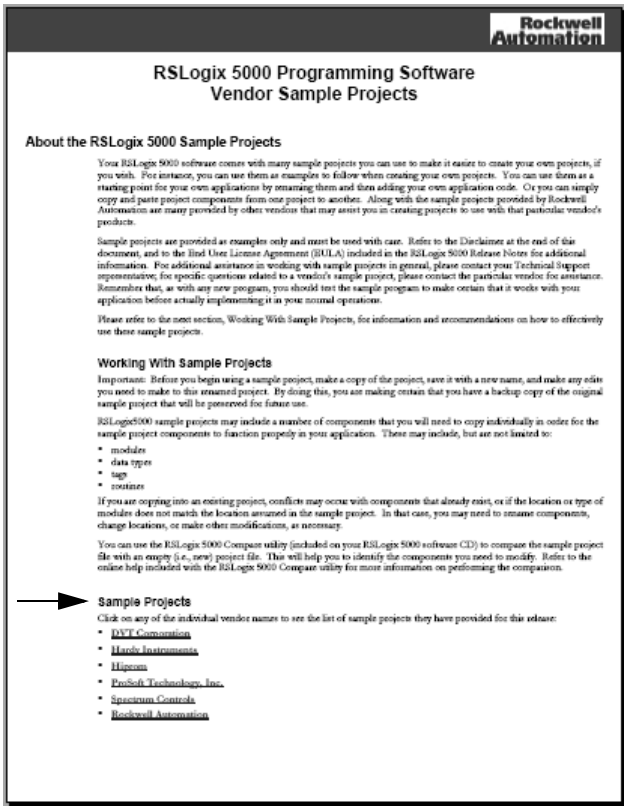
RSLogix 5000 software includes sample projects that you can copy and then modify to fit your application.

To obtain a list of sample projects, perform this procedure.

1. In RSLogix 5000 software, from the Help menu, choose Vendor Sample Projects.



2. Scroll down to select the appropriate set of sample projects.

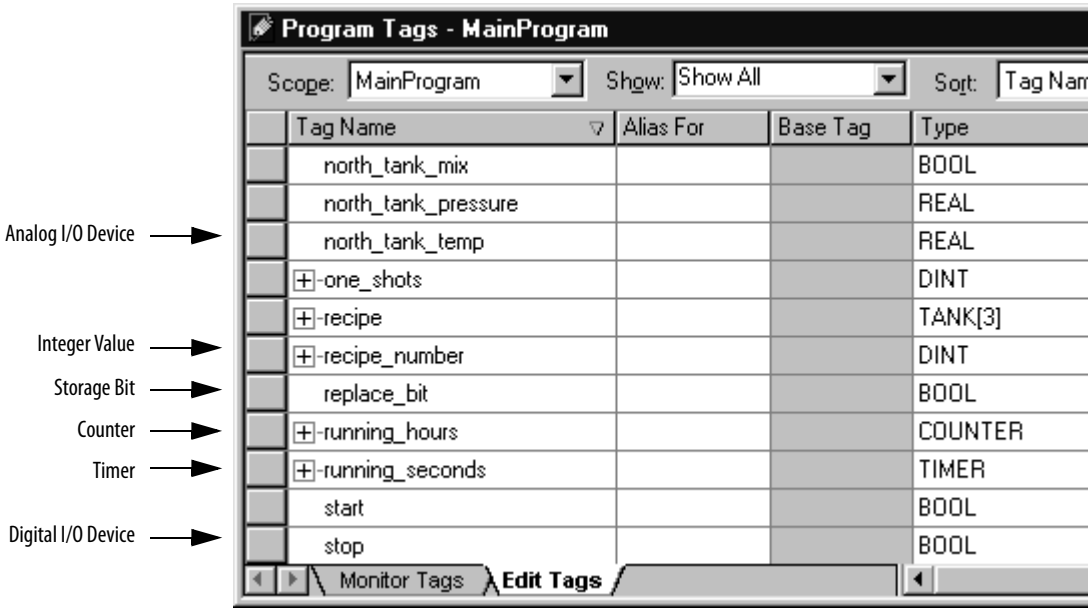


Organize Tags

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 and lets you do the following:

- Organize your data to mirror your machinery
- Document your application as you develop it

Figure 16 - Tag Organization Overview



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 25 - Logix5000 Programming Languages

Required Language	Programs
Ladder diagram (LD)	Continuous or parallel execution of out-of-sequence operations
	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 RSLogix 5000 software, version 16.03.00, 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. Add-On Instructions provide these benefits:

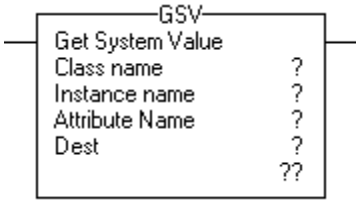
- Ease of maintenance by animating logic for a single instance
- Protection of intellectual property with locking instructions
- Reduced documentation development time

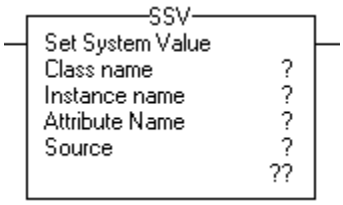
You can use Add-On Instructions across multiple projects. You can define your instructions, obtain them from somebody else, or copy them from another project.

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.

Item	Description
Saving 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.
Using Standard Editors	You create Add-On Instructions by using one of three programming editors. • Standard Ladder • Function Block Diagram • Structured Text Once you have created instructions, you can use them in any programming editor.
Exporting 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.
Using 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.
Creating Custom Help	When you create an instruction, you enter information for the description boxes 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.
Applying Source Protection	As the creator of Add-On Instructions, you can limit users of your instructions to read-only access, or you can bar access to the internal logic or local parameters used by the instructions. This source protection lets you prevent unwanted changes to your instructions 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 software displays the valid object classes, object names, and attribute names for each instruction. For the GSV instruction, you can get values for all available attributes. For the SSV instruction, the software only displays attributes you are permitted to set.

Some object types appear repeatedly, so you may 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 types:

- AXIS
- CONTROLLER
- CONTROLLERDEVICE
- CST
- DF1
- FAULTLOG
- MESSAGE
- MODULE
- MOTIONGROUP
- PROGRAM
- ROUTINE
- SERIALPORT
- TASK
- WALLCLOCKTIME

Monitor Connections

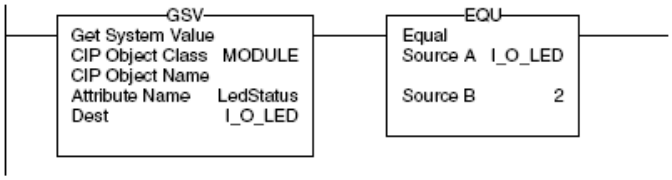
If communication with a device in the I/O configuration of the controller does not occur for 100 ms or 4 times the RPI, whichever is less, the communication times out and the controller produces these warnings:

- The I/O status indicator on the front of the controller flashes green.
- A ⚠ shows over the I/O configuration folder and the timed-out device.
- A module fault code is produced, which you can access from the following:
  - Module Properties dialog box
  - GSV instruction

Determine if Communication has Timed Out with Any Device

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 the I_O_LED tag equals 2, the controller has lost communication with at least one device



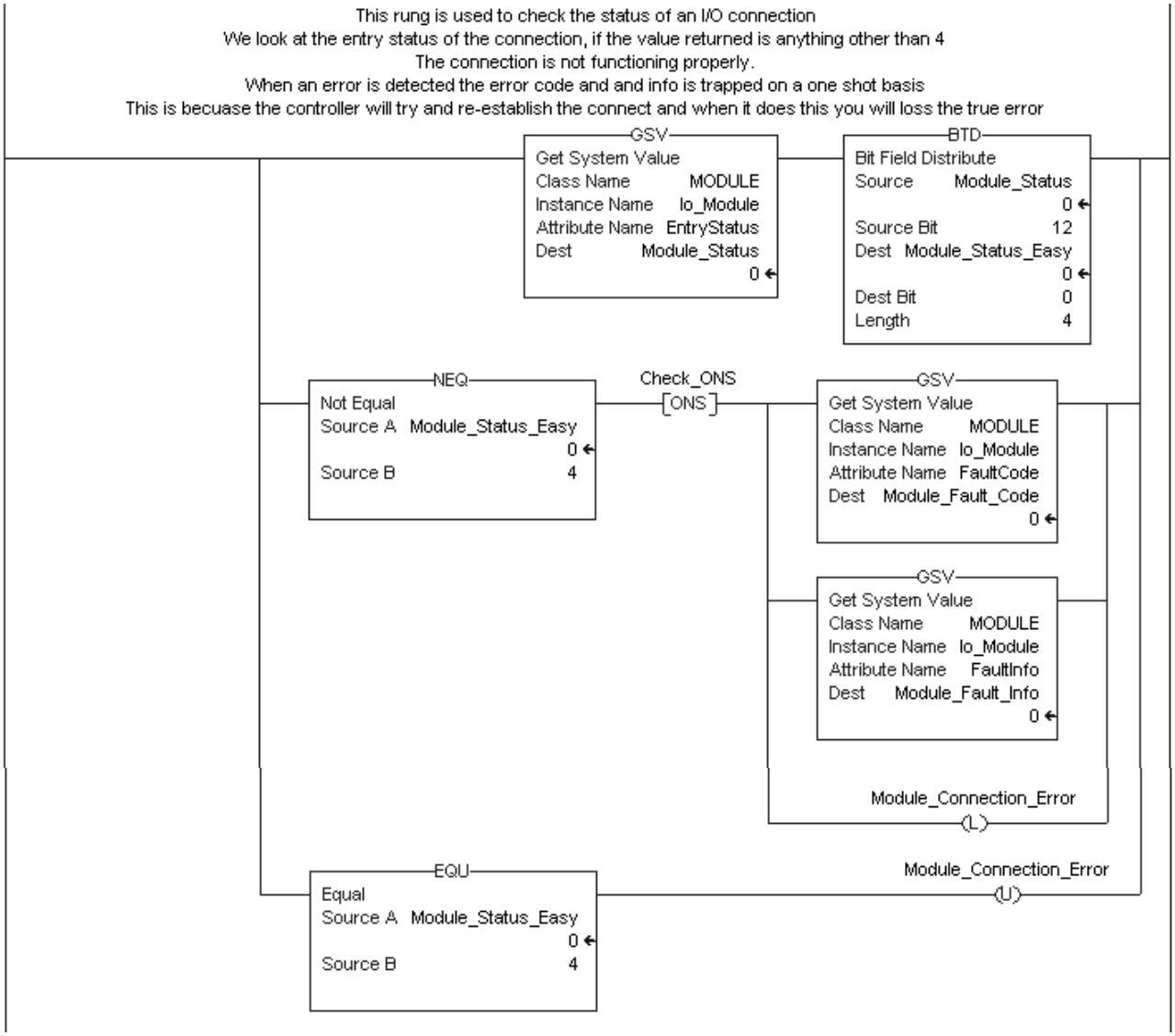
where:

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 Communication has Timed Out with a Specific I/O Module

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.

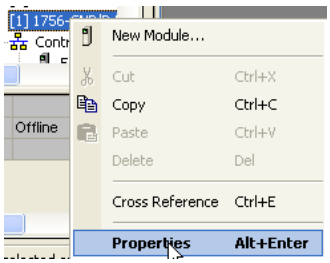
- The GSV instruction gets the fault code for Io_Module and stores it in the Module_Status tag.
- If Module_Status is any value other than 4, the controller is not communicating with the module.



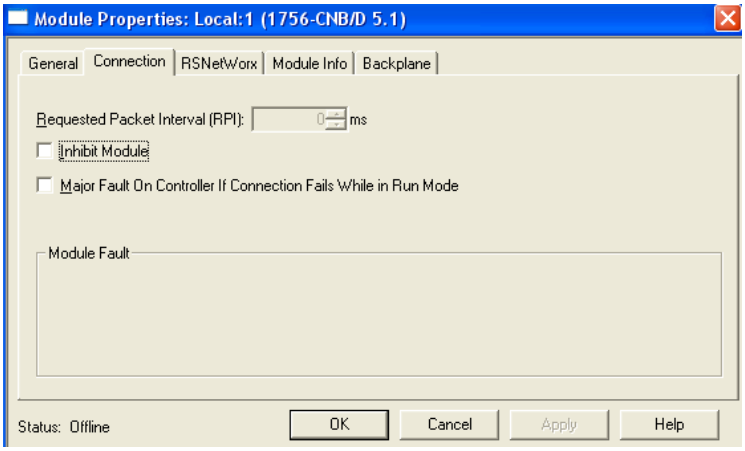
Interrupt the Execution of Logic and Execute the Fault Handler

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

1. In the Controller Organizer, right-click the module and choose Properties.



The Module Properties dialog box appears.



2. Click the Connection tab.
3. Click the Major Fault If Connection Fails While in Run Mode check box.
4. Develop a routine for the Controller Fault Handler.

Select a System Overhead Percentage

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

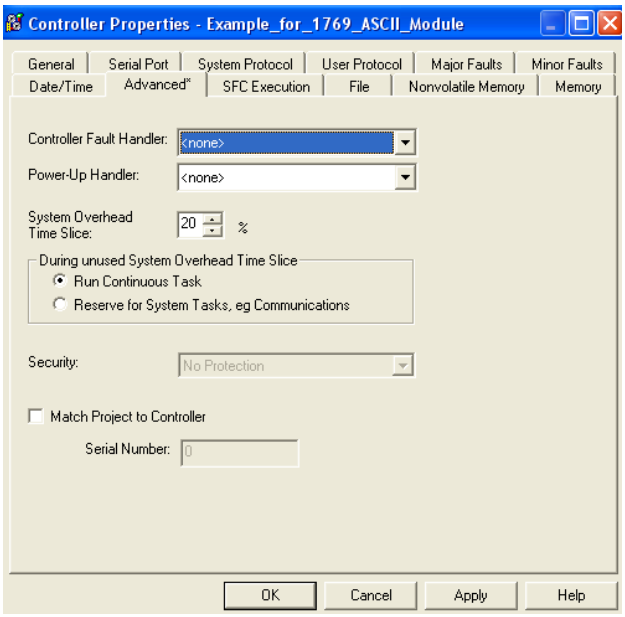
Service communication is any communication that you do not configure through the I/O configuration folder of the project.

- 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 slice, perform this procedure.

1. In the Controller Organizer, right-click the controller and choose Properties.

The Controller Properties dialog box appears.



2. Click the Advanced tab.
   a. From the Controller Fault Handler pull-down menu, choose the program that will run as the result of a system fault.
   b. From the Power-Up Handler pull-down menu, choose the program the processor executes when it starts in Run mode after having been powered down in Run mode.
   c. From the System Overhead Time Slice pull-down menu, choose the percentage of time your controller spends running its system task, relative to running its user tasks.

IMPORTANT	System overhead tasks include the following: • Communication with programming and HMI devices • Responding to messages. • Transmission of messages.

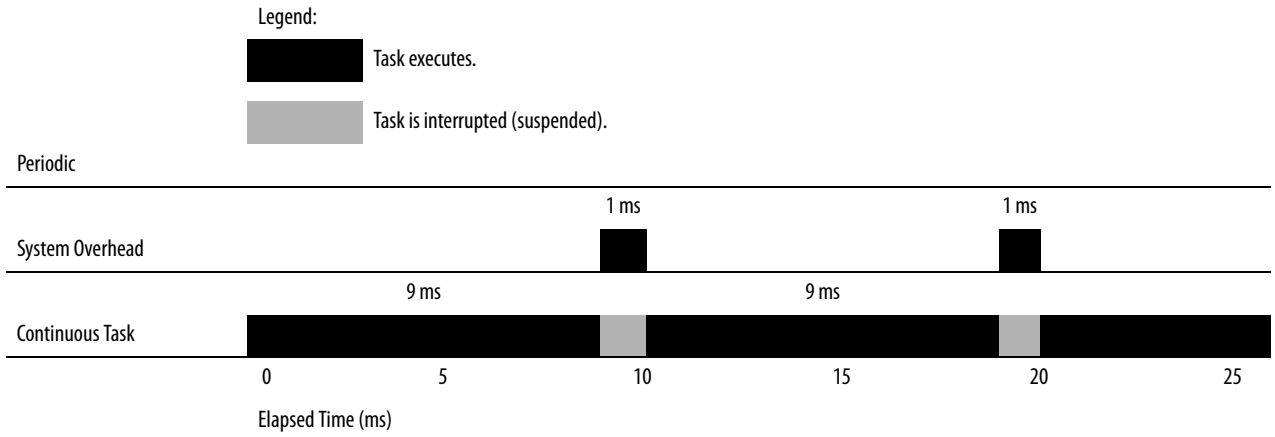
3. Click OK.

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

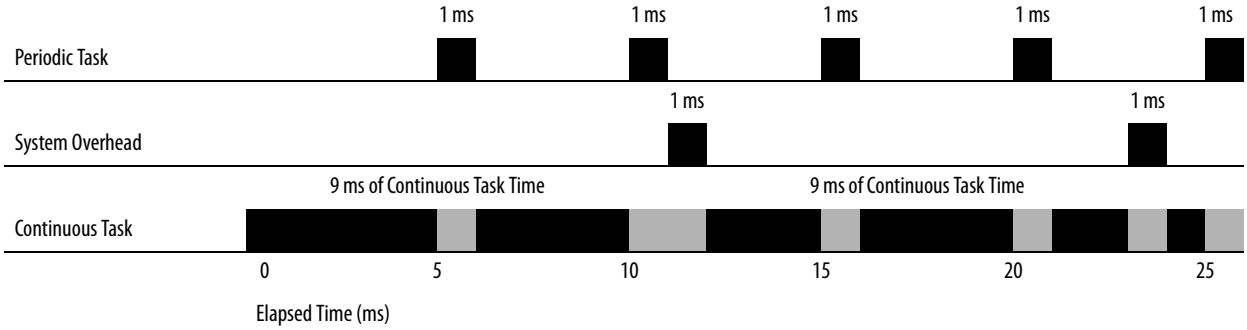
As the system overhead percentage increases, time allocated to executing the continuous task decreases. If there is no communication for the controller to manage, the controller uses the communication time to execute the continuous task. While increasing the system overhead percentage does increase communication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

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

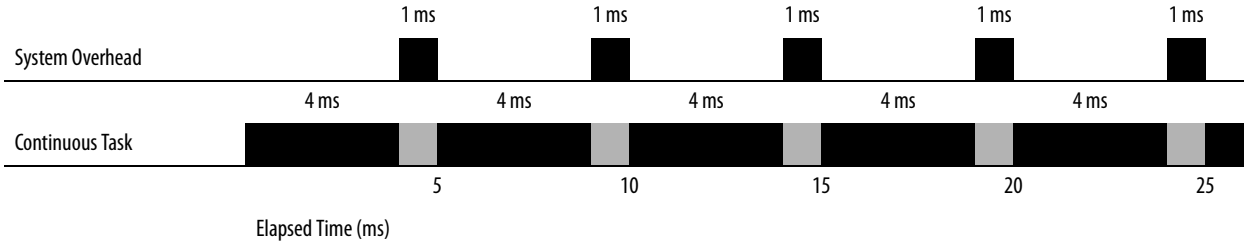
At a time slice of 10%, system overhead interrupts the continuous task every 9 ms (of continuous task time).



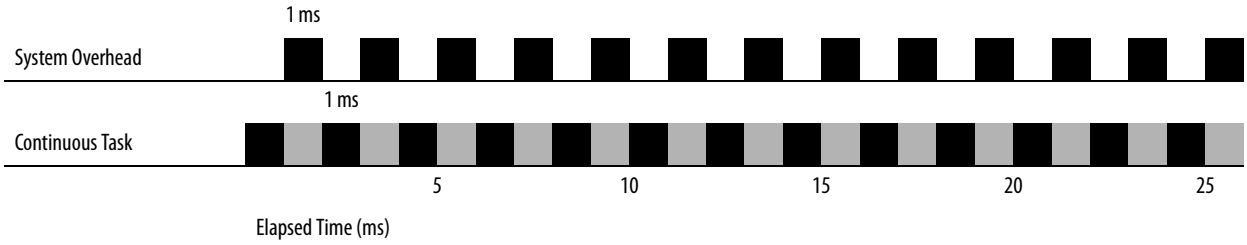
The interruption of a periodic task increases the elapsed time (clock time) between the execution of system overhead functions.



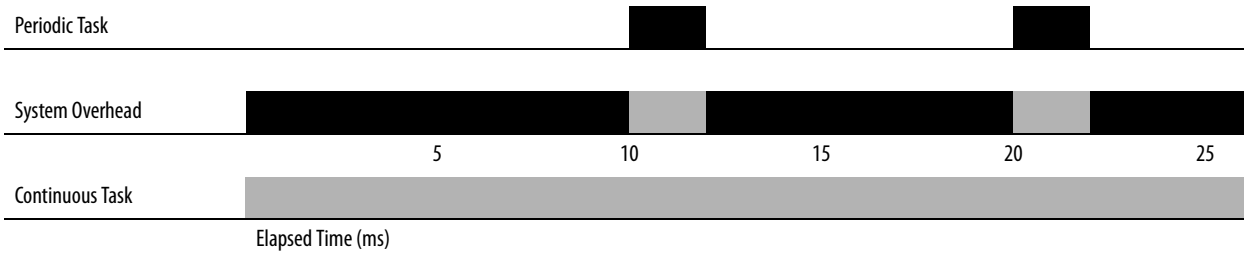
If you use the default time slice of 20%, the system overhead interrupts the continuous task every 4 ms.



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



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



Additional Resources

These documents contain additional information pertinent to the development of applications.

Resource	Description
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides guidance on the development of controller projects.
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Provides information pertinent to the design of Logix5000 systems.
Logix5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087	Details how to estimate the execution time and memory use of the controller's logic.
Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003	Details how to program the controller for sequential applications.

Develop Motion Applications

The CompactLogix L4*x* controllers utilize the 1768-M04SE SERCOS modules for motion control. Each 1768-M04SE module supports up to 4 axis. The following table describes motion capability.

Table 26 - 1768 CompactLogix Controller Motion Support

Controller	SERCOS modules	Axes	Kinetix Drives	Motors Axes	Feedback Axes	Virtual Axes
1768-L43	2	4	4	4	2	6
1768-L45	4	8	8	8	4	6

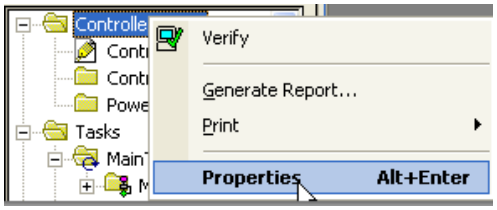
If your solution requires more than eight Kinetix® drives, consider the ControlLogix platform.

Set Master Clock Module for Motion Control

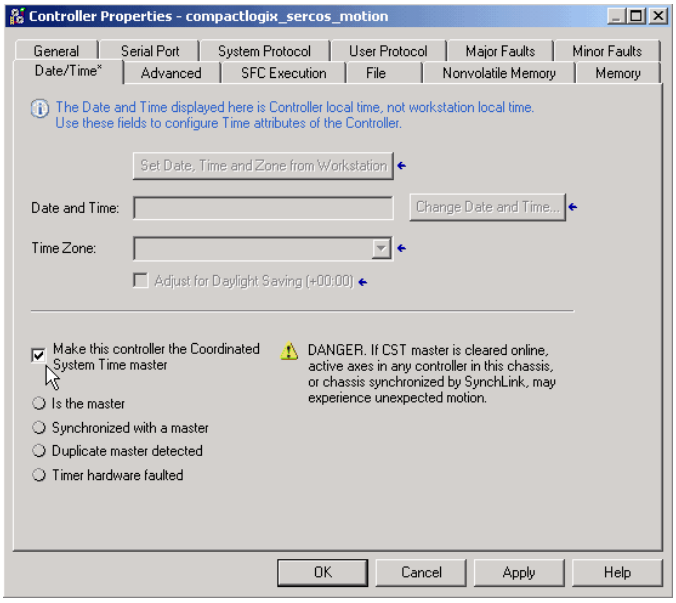
Configuring SERCOS motion initiates with setting the master clock module. You must make one module in the chassis the master clock for motion control. This module is called the coordinated system time (CST) master. The motion modules set their clocks to the CST master. In most cases, make the controller the CST master.

To make the controller the master clock for a motion control application, follow these steps.

1. In the Controller Organizer, right-click your controller and choose Properties.



The Controller Properties dialog box appears.



2. Click the Date/Time tab.
3. Click Make This Controller the Coordinated System Time Master.
4. Click OK.

Configure SERCOS Motion

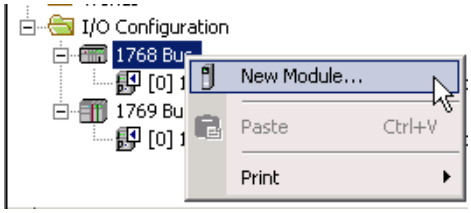
The following describes how to configure SERCOS motion for your CompactLogix controller. Configuration includes adding and configuring the motion module, interface modules, motion group, and axes.

Add and Configure the SERCOS Motion Interface Module

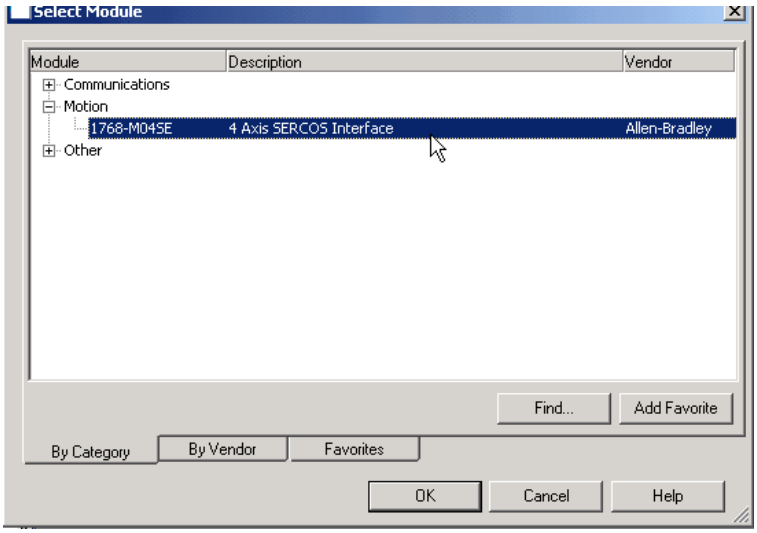
IMPORTANT For your motion modules, use the firmware revision that matches the firmware revision of your controller. See the release notes for your controller's firmware revision.

To add a motion interface module, follow these steps.

1. In the Controller Organizer under the I/O Configuration folder, right-click the backplane and choose New Module.

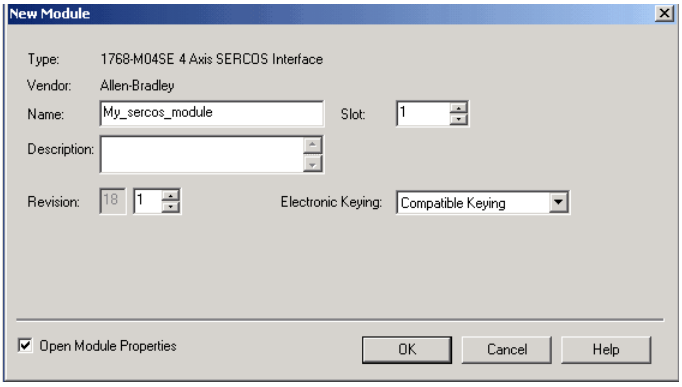


The Select Module dialog box appears.



2. Double-click Motion.
3. Select the 1768-M04SE interface module and click OK.

The New Module dialog box appears.

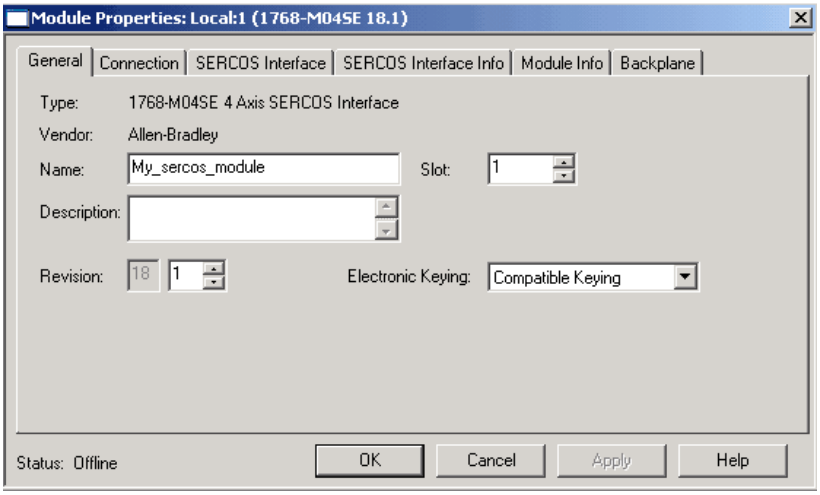


4. Complete the fields described below.

Field	Action
Name	Type the module name.
Slot pull-down menu	Enter the slot location for new module.

5. Check the Open Module Properties checkbox to launch the Module Properties dialog box.
6. Click OK.

The Module Properties dialog box appears.



7. Click each tab and enter the module information.

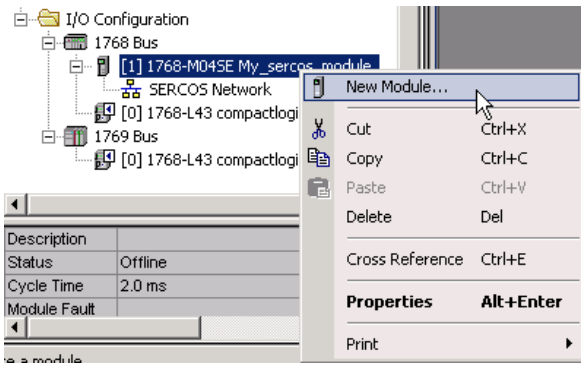
Tab	Action
General	Enter the name and location of the module.
Connection	Set the Requested Packet Interval and Inhibit bit.
SERCOS Interface	Set the data rate and cycle time.
SERCOS Interface Info	View SERCOS Interface module ring status information.
Module Info	View general module information.
Backplane	View bus status and error counters.

Add and Configure SERCOS Interface Drives

With the addition of a SERCOS interface motion module to a controller's I/O configuration, you can use RSLogix 5000 software to add and configure the drives.

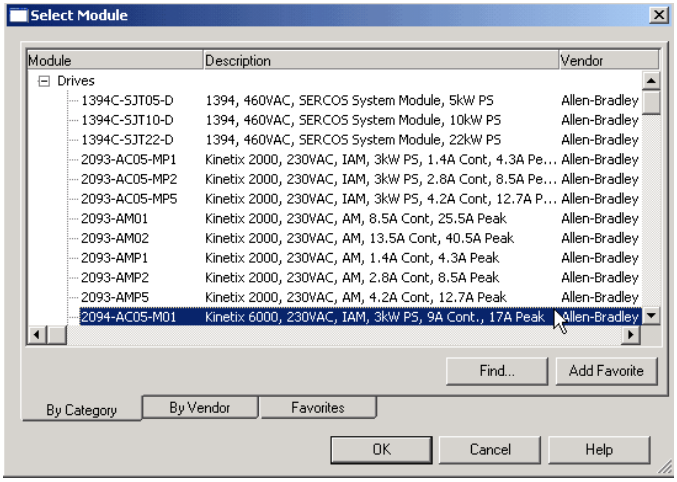
To add a SERCOS drive, follow these steps.

1. In the Controller Organizer under the I/O Configuration folder, right-click your motion module and choose New Module.



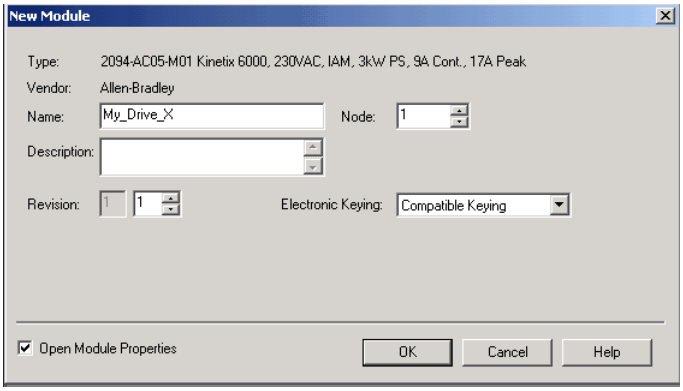
The Select Module dialog box appears.

ATTENTION: Although the dialog box is titled Select Module, this is where you will select and add the drive to your project.



2. Click to expand the Drives category box.
3. Select a drive.
4. Click OK.

   The New Module dialog box appears.

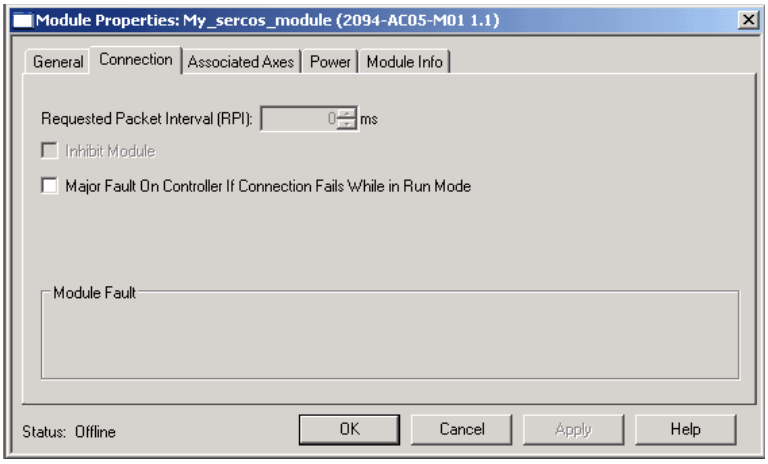


5. Complete the fields described below.

Field	Action
Name	Name the drive.
Node pull-down menu	Node location of the drive on the SERCOS ring.

6. Check the Open Module Properties checkbox to launch the Module Properties dialog box.
7. Click OK.

The Module Properties dialog box appears.



8. Click each tab and enter the information for the drive.

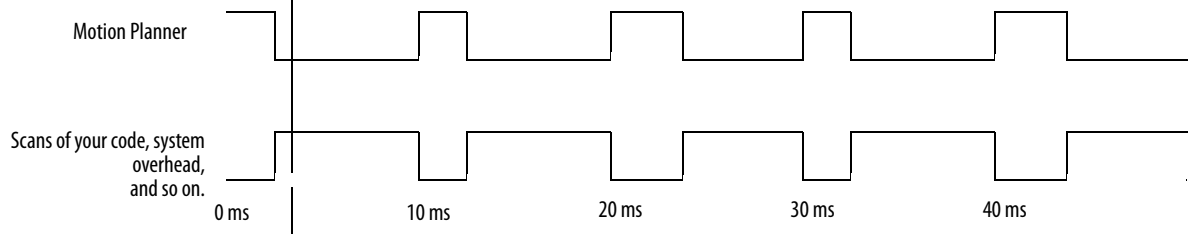
Tab	Action
General	Name and set the location of the drive.
Connection	Set the Requested Packet Interval for the drive.
Associated Axes	Identify the location of any associated axes.
Power	Set the bus regulator configuration.
Module Info	View general module information.

Add and Configure the Motion Group

You can add the motion group to set up the motion planner.

Table 27 - Motion Group Overview

Motion Planner	Part of the controller that takes care of position and velocity information for your axes.
Coarse Update Period	How often the motion planner runs. When the motion planner runs, it interrupts all other tasks regardless of their priority.



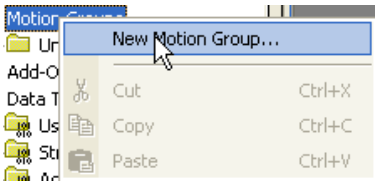
In this example, the coarse update period = 10 ms. Every 10 ms the controller stops scanning your code and whatever else it is doing and runs the motion planner.

To add a motion group to set up the motion planner, perform this procedure.

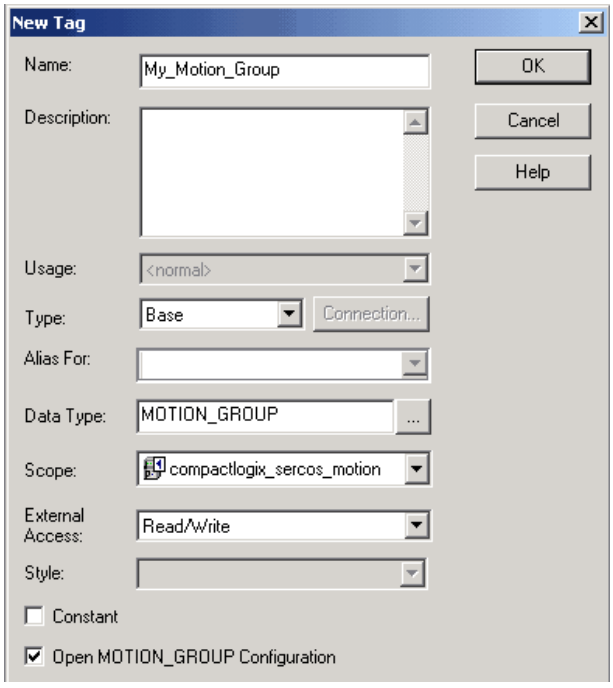
1. Choose your coarse update period.

IMPORTANT	The coarse update period is the interval between updating your axes' positions and scanning your code: • Set the coarse update period to 10 ms. • Leave at least half the controller's time for the scanning of all your code. • Set the coarse update period to a multiple of the motion module's cycle time. **Example:** If the cycle time is 2 ms, set the coarse update period to 8 ms, 10 ms, 12 ms, and so on.

2. In the Controller Organizer, right-click Motion Groups and choose New Motion Group.



The New Tag dialog box appears.

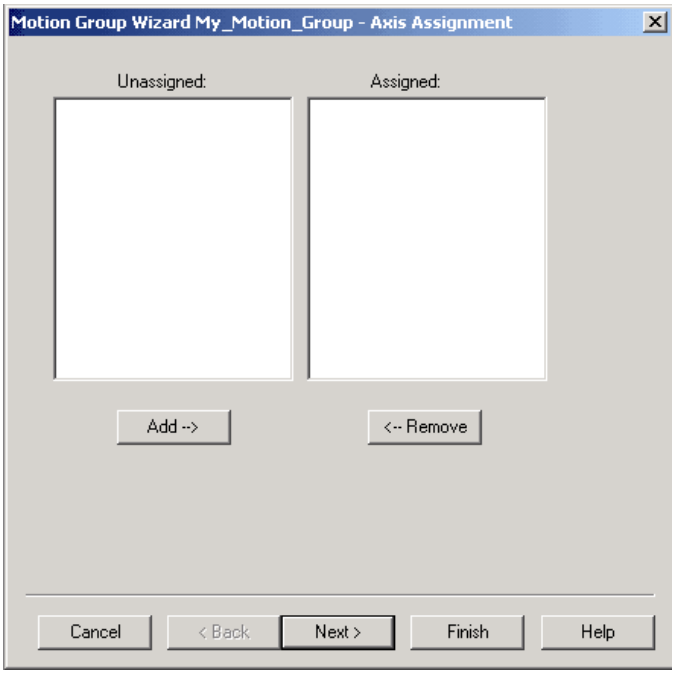


3. Complete the fields described below.

Field	Action
Name	Name the motion group
Type pull-down menu	Choose the motion group type
Scope	Choose the scope
External access	Choose how the motion group will be accessed

4. Make sure the Open MOTION_GROUP Configuration box is checked.

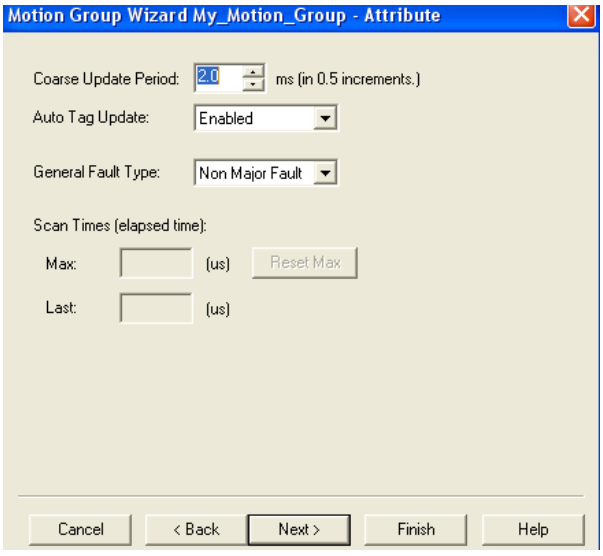
   The Motion Group Wizard dialog box appears.



5. Click Next

6. Click OK.

   The Motion Group Wizard Attributes dialog box appears.



7. Click through the Motion Group Wizard using the Next button to complete the information for the motion group.

   The Wizard displays the following screens.

Dialog Box	Action
Attribute	Set the coarse update period to run your motion planner.
Tag	Enter tag information to create a new tag for the motion group.

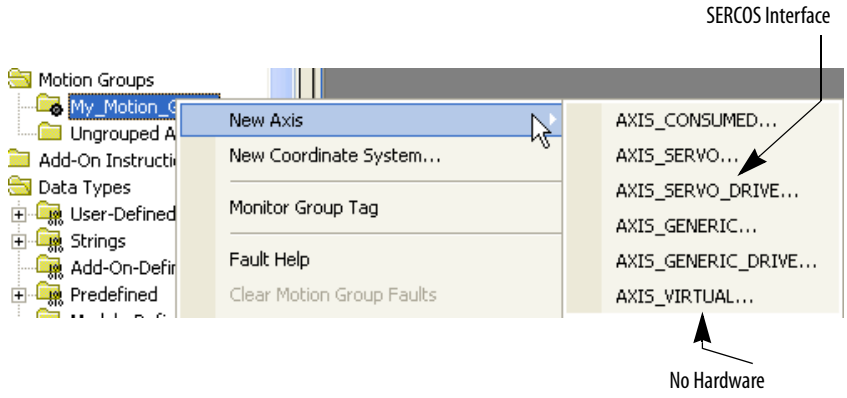
Add and Configure an Axis

To add and configure axis for your drives, follow these steps.

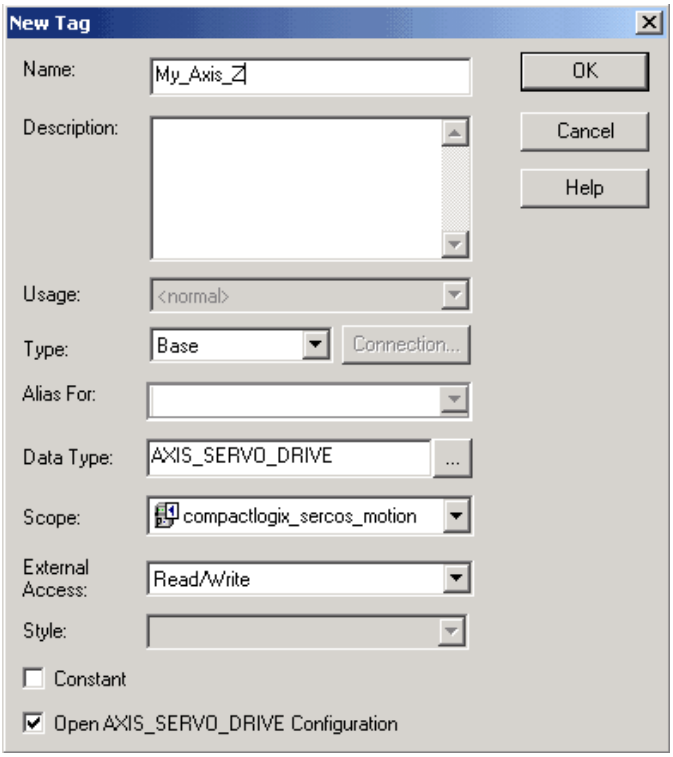
1. Decide which data type to use.

Motion Module	Data Type
1768-M04SE	AXIS_SERVO_DRIVE
No hardware	AXIS_VIRTUAL

2. In the Controller Organizer under the Motion Groups folder, right-click My Motion Group and choose New Axis and then the type of axis you want to add.



The New Tag dialog box appears.

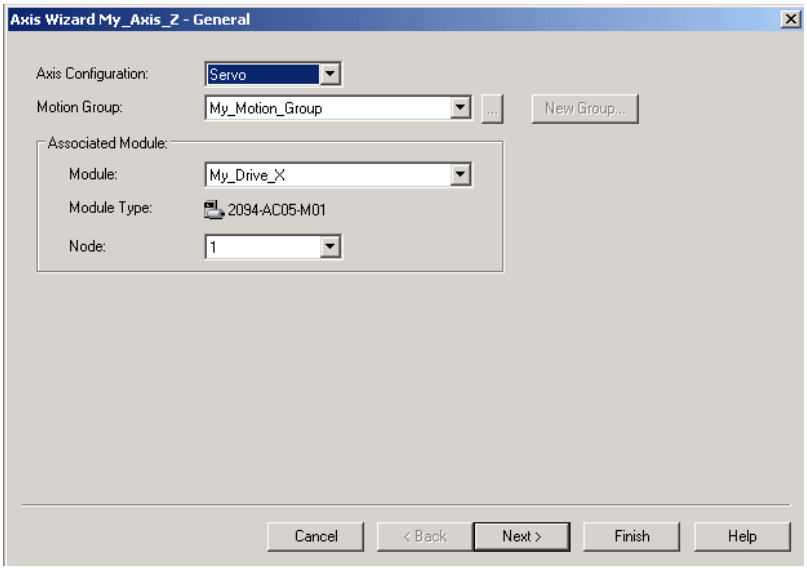


3. Complete the fields described below.

Field	Action
Name	Type the new axis tab name
Type	Enter the type of axis tag
Data type	Enter the Data Type for the new axis
Scope	Enter the scope for the new axis

4. Click OK.

The Axis Configuration Wizard appears.



5. Click through the Axis Wizard using the Next button to configure the new axis for the SERCOS interface drive.

   The Wizard displays the following screens.

Dialog Box	Action
General	Select the motion group and choose the name you gave to the drive for this axis.
Motion Planner	Set number of targets and stop type.
Units	Set units of measure, such as revolutions (revs), degrees, inches, or millimeters.
Drive/Motor	Enter catalog number of your drive, select your motor's catalog number and enter the feedback revolutions.
Motor Feedback	Set type of feedback and number of cycles.
Aux Feedback	Set auxiliary feedback type, cycles and resolution.
Conversion	Set positioning mode and conversion constant.
Homing	Set mode, position and sequence.
Hookup	Set test increment and drive polarity.
Tune	Set the tuning settings.
Dynamics	Set speed, acceleration, and deceleration of position units.
Gains	Set position and velocity gains.
Output	Set motor and inertia ratios.
Limits	Set position tolerance limits.
Offset	Set friction compensation and velocity offset limits.
Fault Actions	Set stop actions.
Tag	Assign a tag description.

Check the Wiring of Each Drive

Use these tests to check a drive's wiring.

Table 28 - Wiring Tests

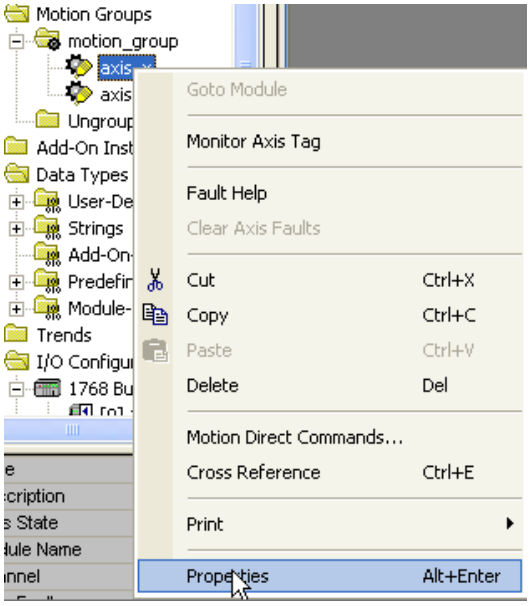
Test	Function	Requirement
Test marker	Verify that the encoder A, B, and Z channels are connected and phased properly for marker detection.	You must manually move the axis for this test.
Test feedback	Verify the polarity of the feedback.	You must manually move the axis for this test.
Test command and feedback	Verify the polarity of the drive.	N/A

ATTENTION: These tests move the axis even with the controller in Remote Program mode:

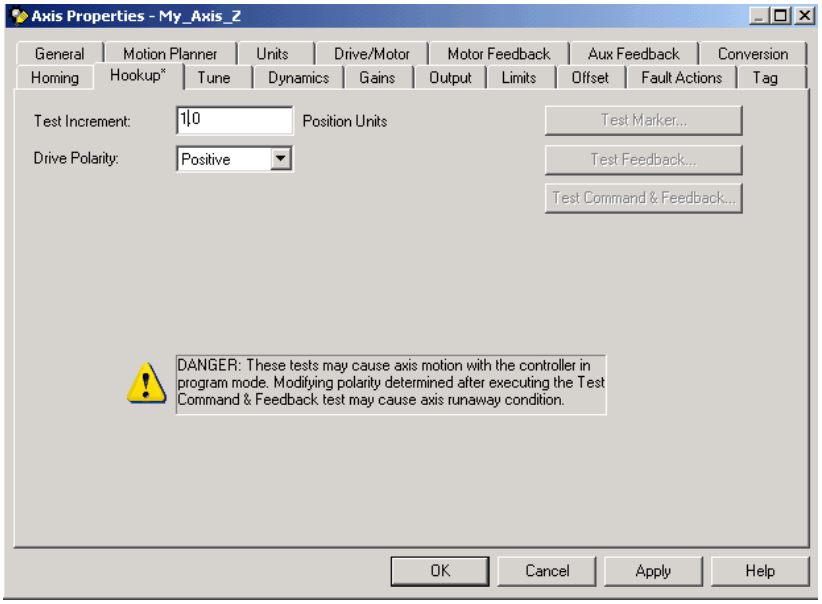
- Before you do the tests, make sure no one is in the path of the axis.
- Do not change the polarity after you do the tests, or you may cause an axis-runaway condition.

To check the wiring of each drive, perform this procedure.

1. In the Controller Organizer under the Motion Groups folder, click Motion_Group, and then right-click an axis and choose Properties.



The Axis Properties dialog box appears.



2. Complete the fields described below.

Field	Action
Test increment	Specify number of axis revolutions
Text marker	Click to check the channels for proper connection and phasing
Test feedback	Click to test the polarity of the feedback
Test command & feedback	Click the Test Command & Feedback button to test the drive's polarity.

3. Click the Hookup tab.
   a. In the Test Increment field, specify how many revolutions you want the axis to turn during each test.
   b. Click Test Marker to check the channels for proper connection and phasing.
   c. Click Test Feedback to test the polarity of the feedback.
   d. Click Test Command & Feedback to test the drive's polarity.
4. Click OK.

Tune Each Axis

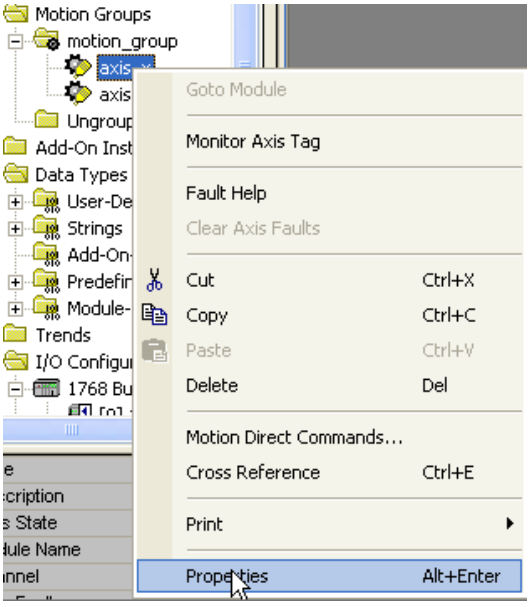
You need to tune each axis.

ATTENTION: When you tune an axis, it moves even with the controller in Remote Program mode. In that mode, your code is not in control of the axis.

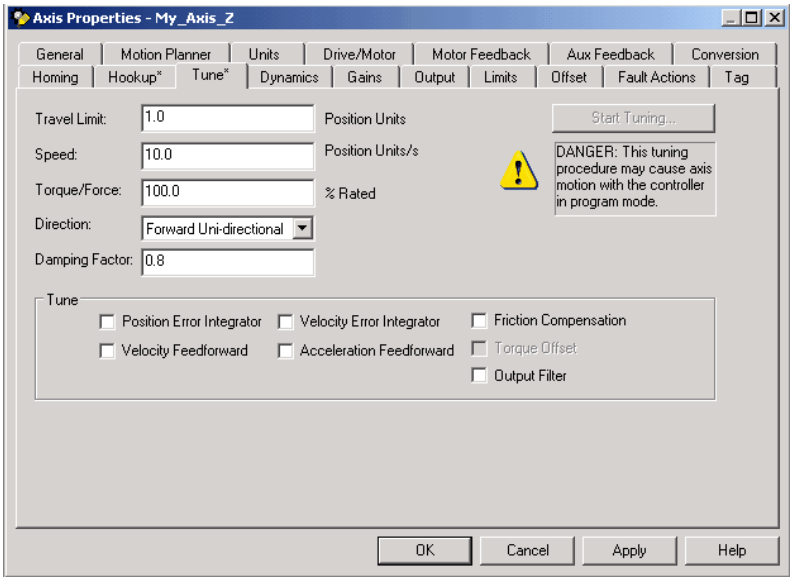
Before you tune an axis, make sure no one is in its path.

To tune each axis, perform this procedure.

1. In the Controller Organizer under the Motion Groups folder, click Motion_Group, and then right-click an axis and choose Properties.



The Axis Properties dialog box appears.



2. Click the Tune tab.

Field	Action
Travel limit	Limits number of axis revolutions
Speed	Number of revolutions per second you want to limit the axis during tuning
Start tuning	Click to start the tuning function

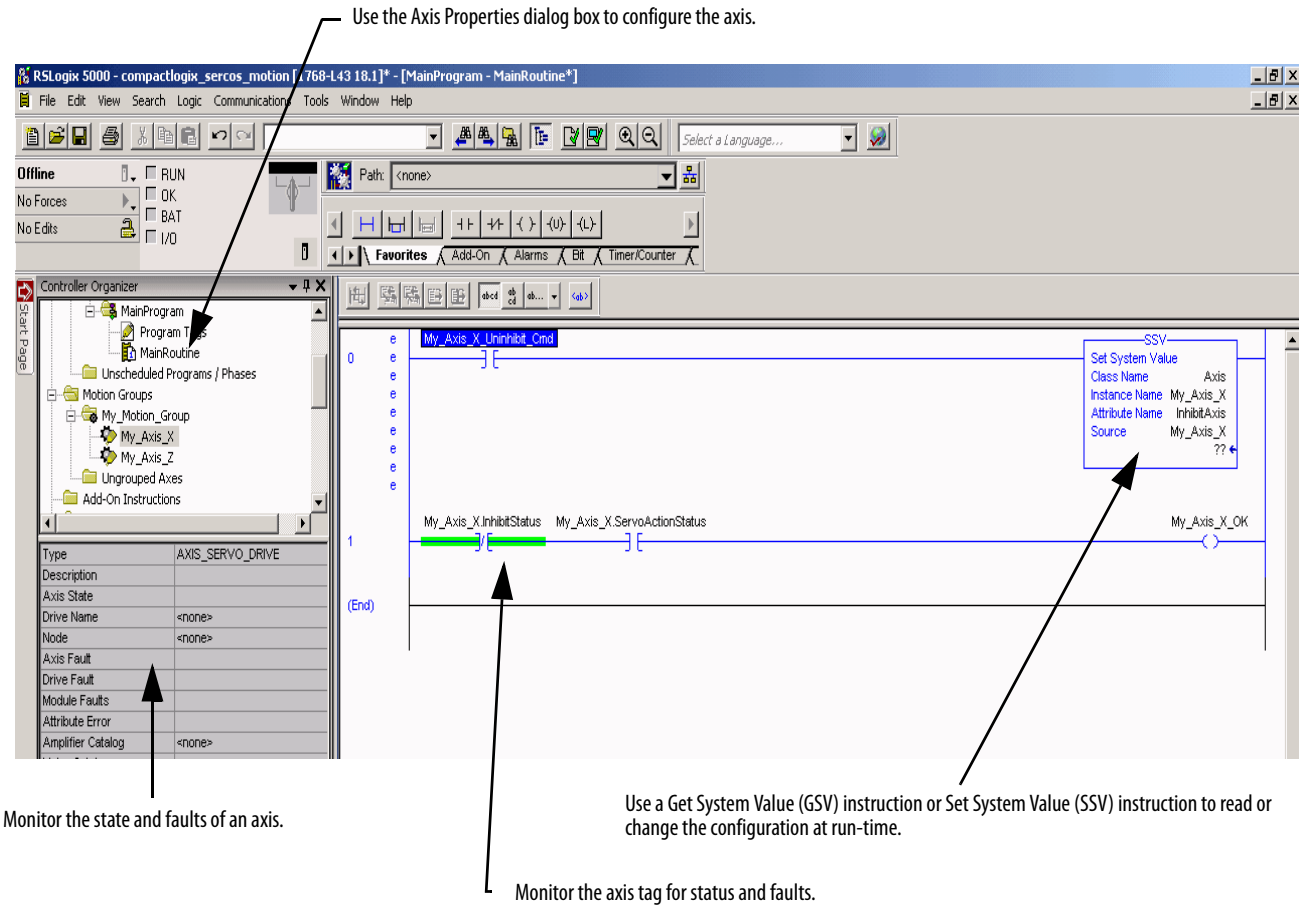
3. Click OK.

Obtain Axis Information

You can obtain axis information through any one of several methods.

To obtain axis information, take any one, or all, of these steps.

Figure 17 - Obtaining Axis Information



Program Motion Control

The controller gives you a set of motion control instructions for your axes:

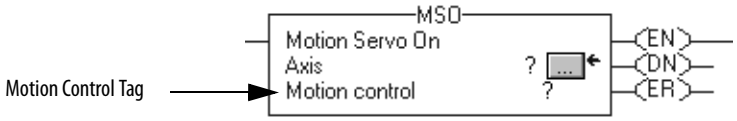
- The controller uses these instructions just like the rest of the Logix5000 instructions.

  You can program motion control in these programming languages:
  - Ladder diagram (LD)
  - Structured text (ST)
  - Sequential function chart (SFC)

- Each motion instruction works on one or more axes.

- Each motion instruction needs a motion control tag. The tag uses a MOTION_INSTRUCTION data type and stores the instruction's information status.

Figure 18 - Motion Control Instruction



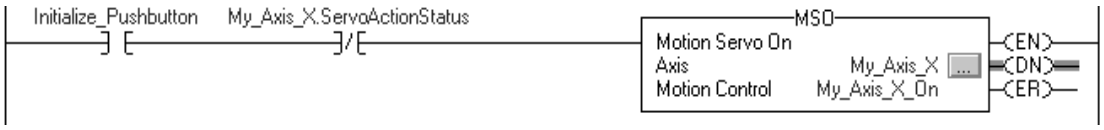
ATTENTION: Use the tag for the motion control operand of motion instruction only once. Reuse of the same motion control tag in other instructions may cause unintended operation of the control variables.

Example

Here is an example of a simple ladder diagram that homes, jogs, and moves an axis.

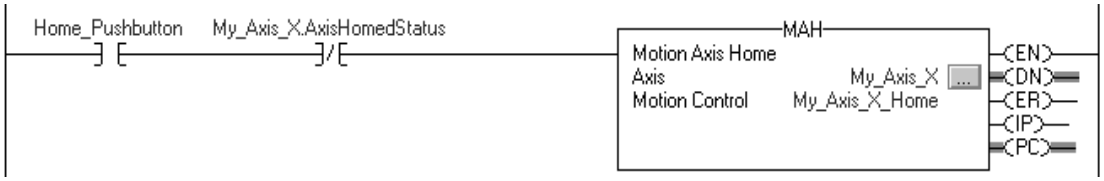
If Initialize_Pushbutton = On and the axis = Off (My_Axis_X.ServoActionStatus = Off) then

The MSO instruction turns on the axis.



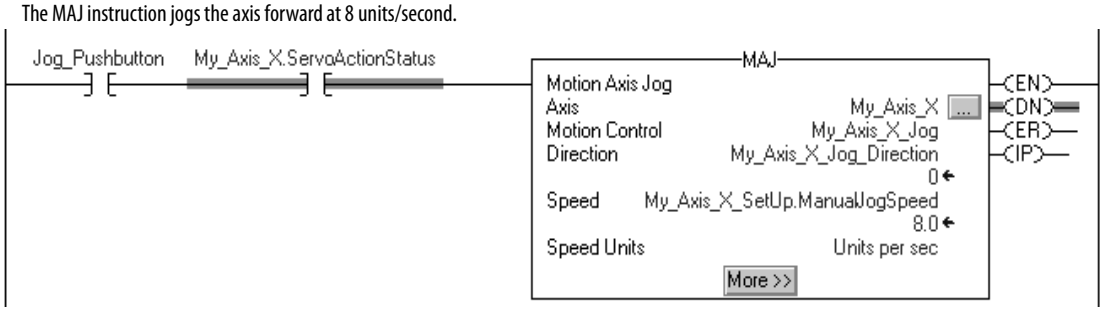
If Home_Pushbutton = On and the axis hasn't been homed (My_Axis_X.AxisHomedStatus = Off) then

The MAH instruction homes the axis.



If Jog_Pushbutton = On and the axis = On (My_Axis_X.ServoActionStatus = On) then

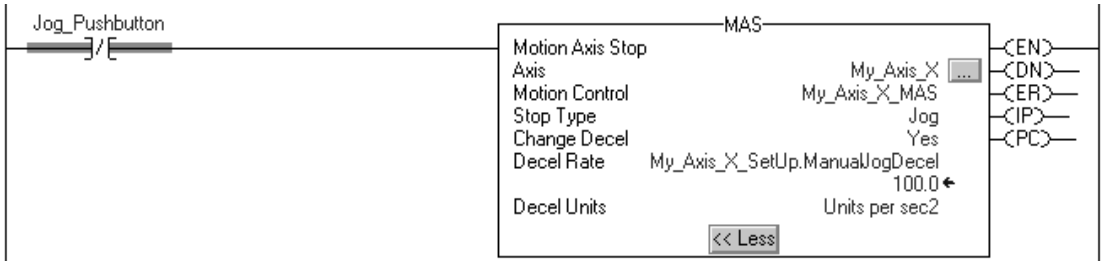
The MAJ instruction jogs the axis forward at 8 units/second.



If Jog_Pushbutton = Off then

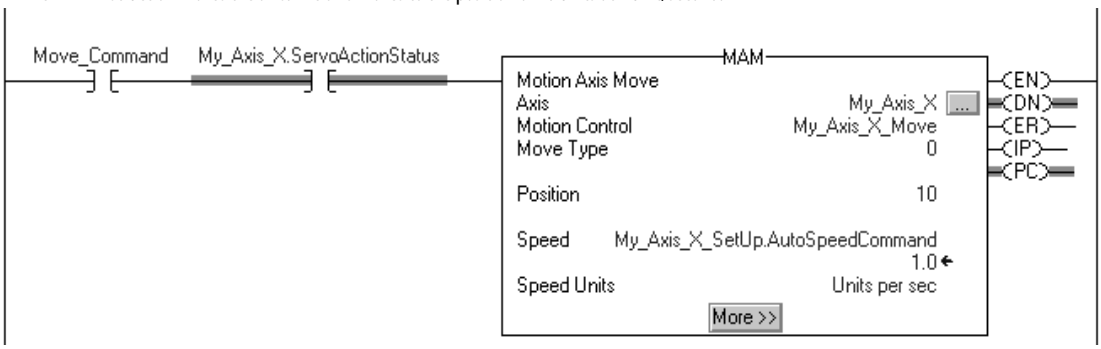
The MAS instruction stops the axis at 100 units/second^2.

Make sure that Change Decel is Yes. Otherwise, the axis decelerates at its maximum speed.



If Move_Command = On and the axis = On (My_Axis_X.ServoActionStatus = On) then

The MAM instruction moves the axis. The axis moves to the position of 10 units at 1 unit/second.



Additional Resources

These documents contain information pertinent to the development of motion applications.

Resource	Description
Motion Configuration and Startup User Manual, publication MOTION-UM001	Details how to configure a motion application system.
Motion Coordinate System User Manual, publication MOTION-UM002	Details how to create and configure a coordinated motion system.
Logix5000 Motion Controllers Instructions Reference Manual, publication MOTION-RM002	Describes motion instructions for use in Ladder Logic programming software.

Configure PhaseManager Software

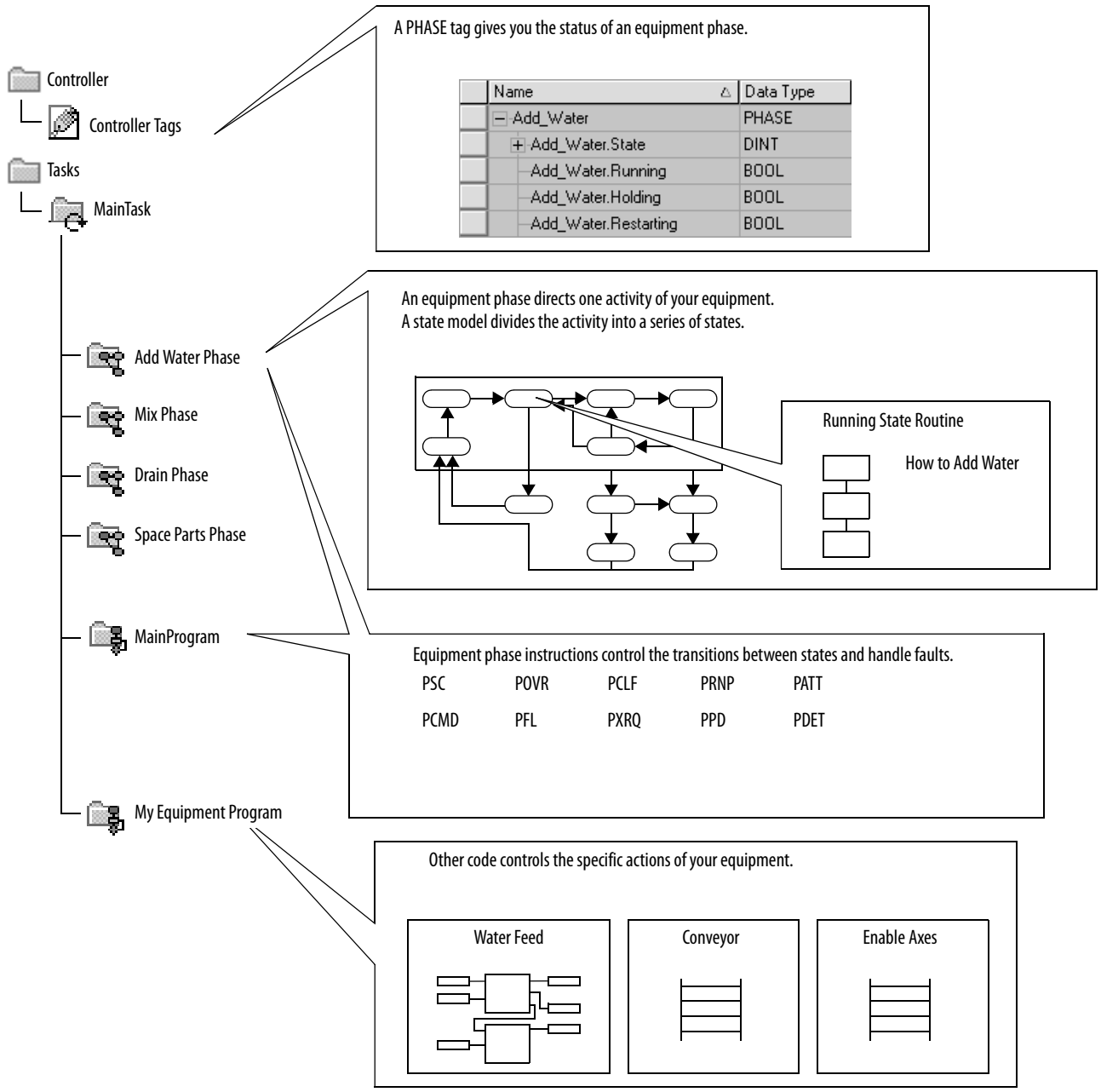
PhaseManager Software Overview

PhaseManager™ software 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.

Table 29 - PhaseManager Terms

Term	Description
Equipment phase	• As with a program, an equipment phase is run in a task and is given a set of routines and tags. • Unlike a program, an equipment phase runs by a state model and lets you do one activity.
State model	• 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, the actions, or conditions of the equipment at a given time. • The state model of an equipment phase resembles that of the S88 and Pack*ML* state models.
State machine	An equipment phase includes an embedded state machine that does the following: • Calls the main routine (state routine) for an acting state. • Manages the transitions between states with minimal coding. • Makes sure that the equipment goes from state to state along an allowable path.
PHASE tag	When you add an equipment phase, the application creates a tag for the equipment phase. The tag uses the PHASE data type.

Figure 19 - PhaseManager Software Overview



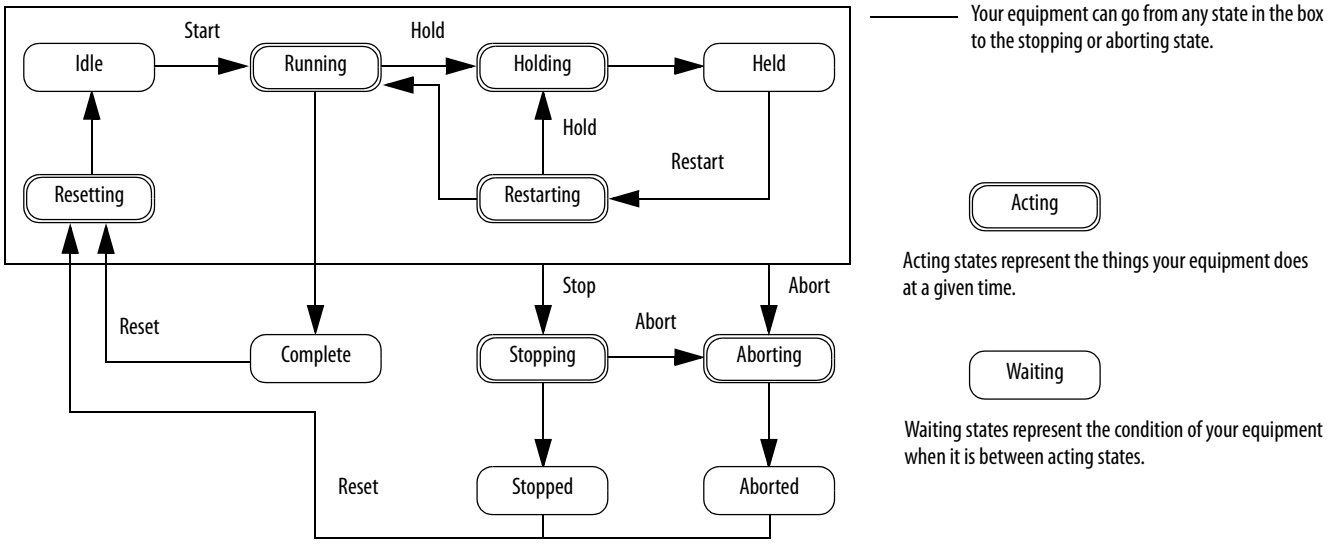
State Model Overview

A state model defines what your equipment does under different conditions, such as run, hold, and stop.

Table 30 - PhaseManager States

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

Figure 20 - PhaseManager State Transitions



With a state model, you define the behavior of your equipment.

Table 31 - PhaseManager State Models

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 is done with what it had to do?
Stopping	What happens during a normal shutdown?
Aborting	How does the equipment shut down if a fault or failure occurs?
Aborted	How do you tell if the equipment is safely shut down?

How Equipment Changes States

The state model's arrows show the states through which your equipment progresses:

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

Figure 21 - PhaseManager State Model

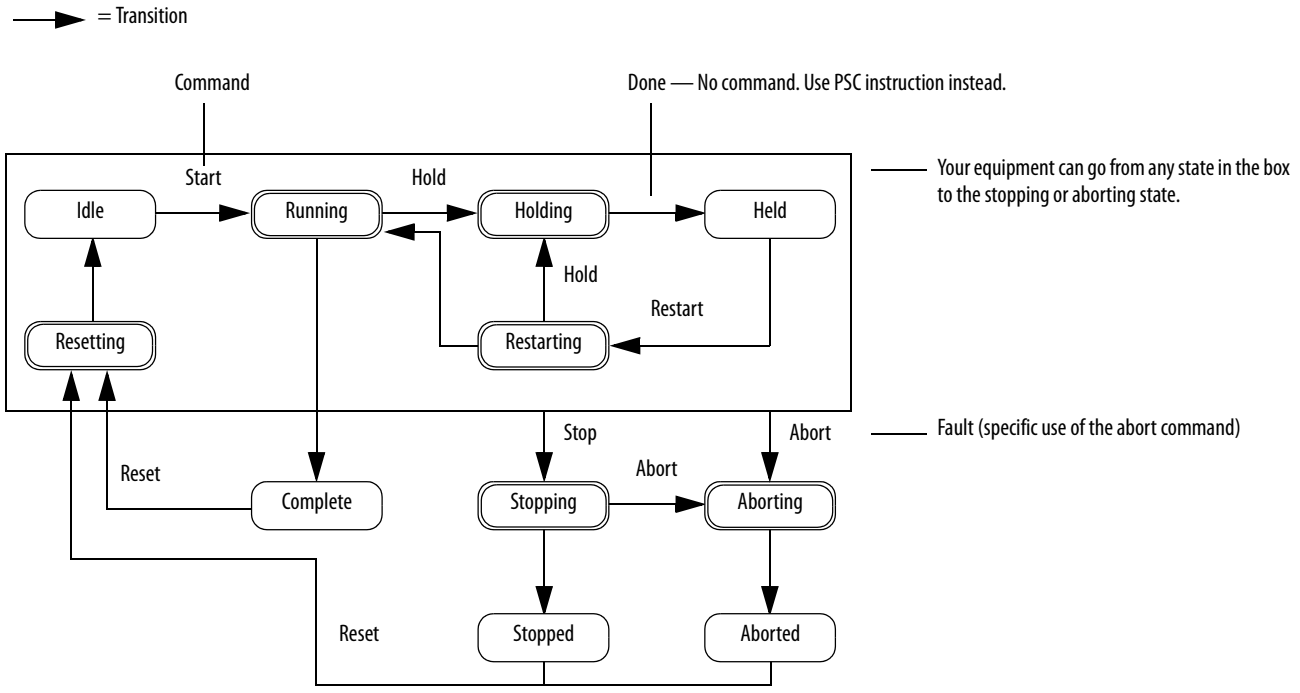


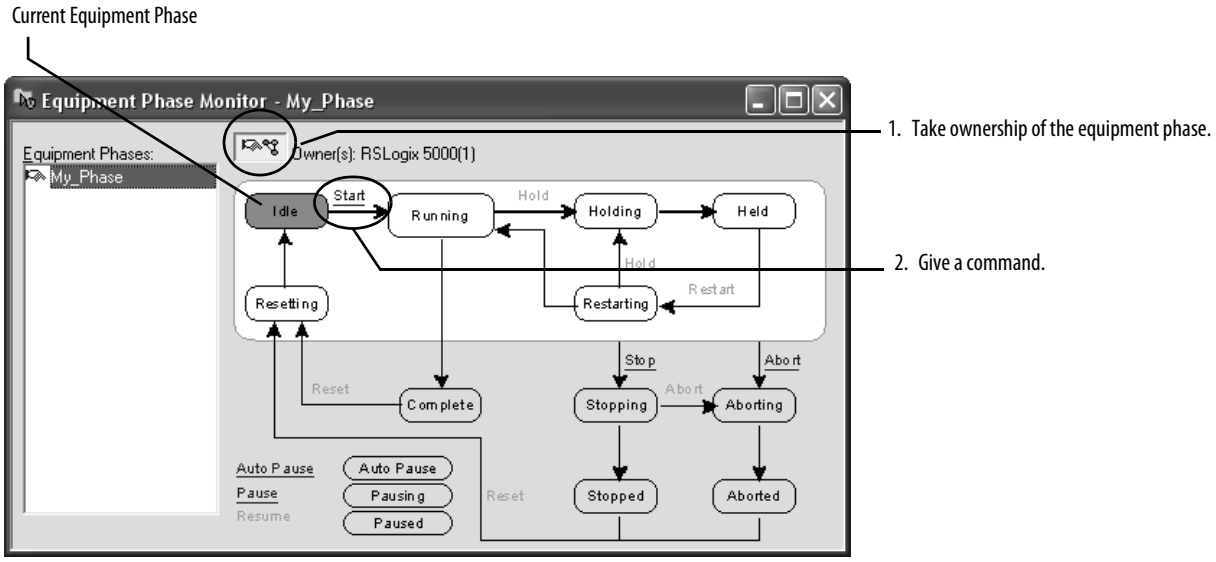
Table 32 - PhaseManager Transition Commands

Type of Transition	Description		
Command	A command tells the equipment to do something. For example, the operator pushes the start button to start production and the stop button to halt production. PhaseManager software uses these commands:		
	Reset	Stop	Restart
	Start	Hold	Abort
Done	Equipment goes to a waiting state when it is finished with what it is doing. You do not give the equipment a command. Instead, you set up your code to signal when the equipment is finished.		
Fault	A fault tells you that something out of the ordinary has happened. You set up your code to look for faults and take action if it finds any. If you want to shut down your equipment as quickly as possible when it detects a fault, set up your code to look for that fault and give the abort command if it finds it.		

Manually Change States

With RSLogix 5000 software, you can manually change an equipment phase.

To manually change a PhaseManager state, perform this procedure.



Compare PhaseManager State Models to Other State Models

You can compare PhaseManager state models to other state models.

Table 33 - State Model Comparisons

S88 State	Pack*ML* State	PhaseManager State
Idle	Starting ? Ready	Resetting ? Idle
Running ? Complete	Producing	Running ? Complete
Pausing ? Paused	Standby	Subroutines 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 the following:

- CompactLogix controller, firmware revision 15.000 or later
- Communication path to the controller
- RSLogix 5000 software, version 15.02.00 or later

  The major revision of the controller and software must match.

Equipment Phase Instructions

The controller supports several equipment-phase ladder diagram (LD) and structured text (ST) instructions.

Table 34 - PhaseManager Instructions

Instruction	Instruction Function
PSC	Signal a phase that the state routine is complete and to proceed 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 do the following: • Prevent another program or RSBizWare Batch software from commanding a phase. • Make sure another program or RSBizWare Batch software does not already own a phase.
PDET	Relinquish ownership of a phase.
POVR	Override a command.

Additional Resources

For more information about how to configure PhaseManager software, refer to The PhaseManager User Manual, publication LOGIX-UM001.

Use a CompactFlash Card

CompactLogix controllers only support nonvolatile storage through CompactFlash memory cards.

Use a CompactFlash Card to Store a Project

You can load a project from the nonvolatile memory of a CompactFlash card to the user memory of a controller at these times:

- On every power-up
- On corrupt memory
- Anytime through RSLogix 5000 software

ATTENTION: Fault conditions can occur if the controller types do not match. For example, if the project on the CompactFlash card and the controller firmware were created for a 1768-L43 controller, and then an attempt was made to load that program and/or firmware into a 1768-L45 controller.

IMPORTANT The project 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 A CompactFlash card stores the contents of the controller's memory at the time 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.

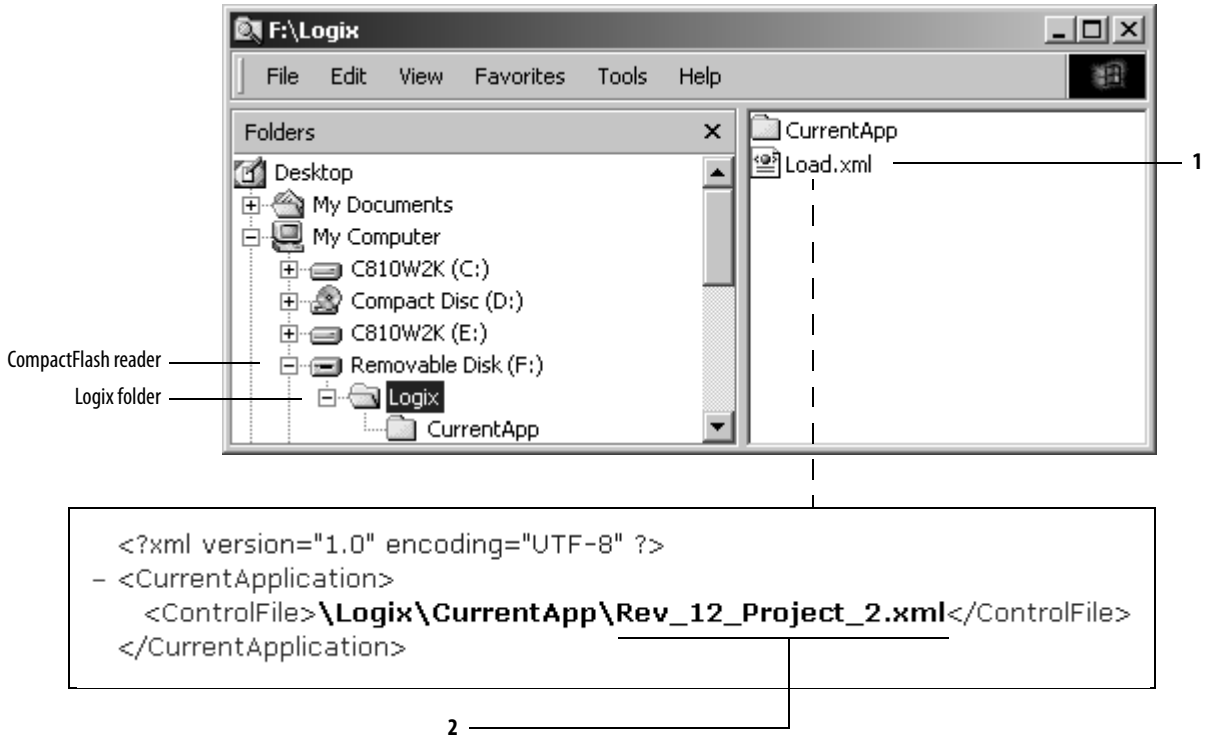
When you store a project to a CompactFlash card, the controller formats the card, if required. For specifics about formatting features per revision, or options for updating firmware, see the Logix5000 Controllers Nonvolatile Memory Programming Manual, publication 1756-PM017.

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.

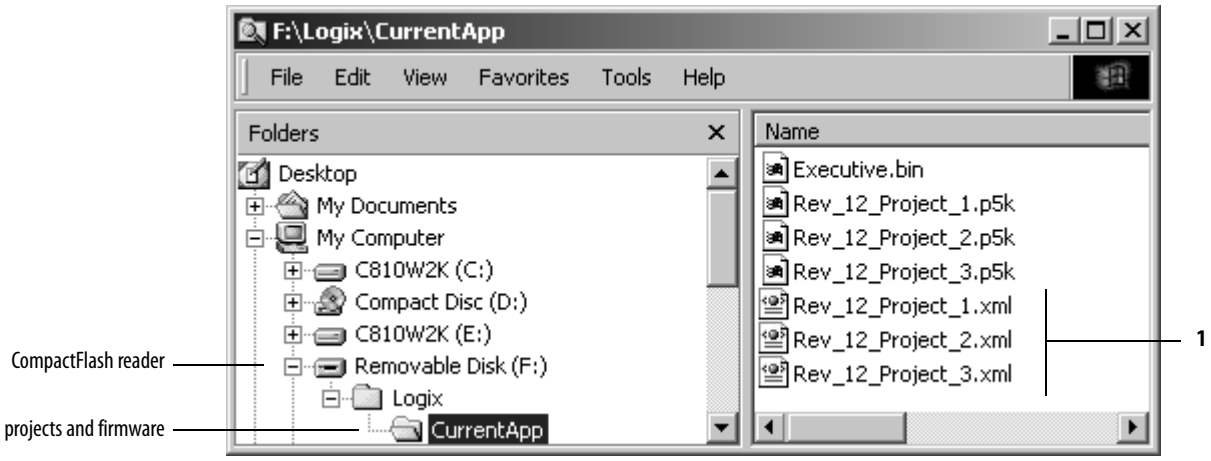
Manually Change the Load Parameters

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

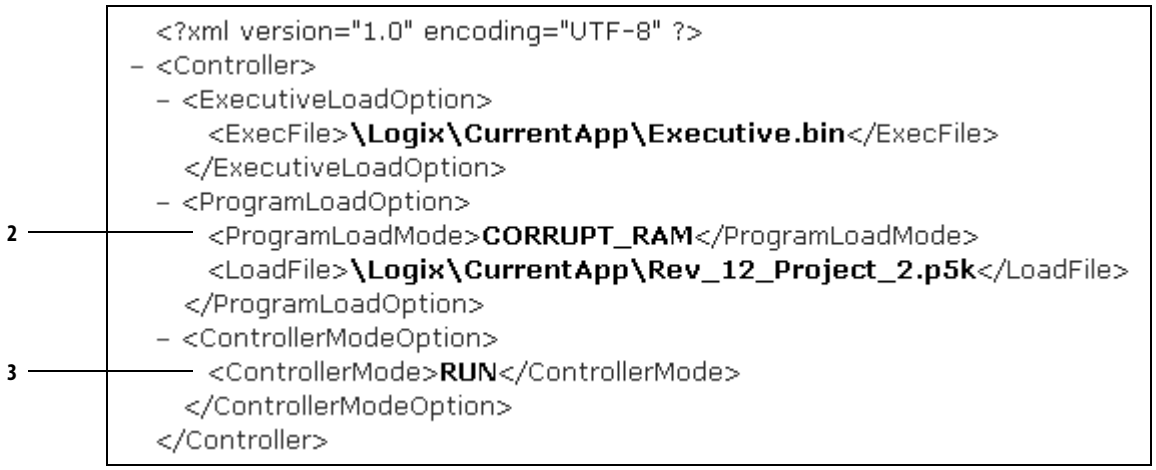
- When the project is to load (On Power Up, On Corrupt Memory, User Initiated).
- The mode to which to set the controller (if the keyswitch is in REM and the load mode is not User Initiated).

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.



2. Edit the Load Image option of the project.

Load Image Option	Enter
On Power Up	ALWAYS
On Corrupt Memory	CORRUPT_RAM
User Initiated	USER_INITIATED

3. Edit the Load Mode option of the project.

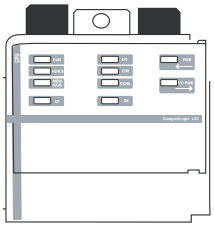
   The Load Mode does not apply if the Load Image option is User Initiated.

Load Mode	Enter
Program (Remote Only)	PROGRAM
Run (Remote Only)	RUN

For additional information, refer to the Logix5000 Controllers Nonvolatile Memory Card Programming Manual, publication 1756-PM017.

Status Indicators

CompactLogix Controller Status Indicators



The following table describes the CompactLogix controller status indicators. The table also provides controller behavior interpretations and offers you recommended actions.

Table 35 - Status Indicators

Indicator	Status	Description	Recommended Actions
RUN	Off	The controller is in Program or Test mode.	Normal operation. No action is required.
	Green	The controller is in Run mode.	
FORCE	Off	• No tags contain I/O force values. • I/O forces are inactive (disabled).	
	Steady amber	• I/O forces are active (enabled). • I/O force values may or may not exist.	
	Flashing amber	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled.	Enable forces, or remove the individual I/O from being forced.
MEM SAVE	Off	The user program and configuration data are not actively being saved to flash memory.	Normal operation. No action is required.
	Green	The user program and configuration data are being saved to flash memory.	
I/O	Off	• There are no devices in the I/O configuration of the controller. • The controller does not contain a project (controller memory is empty).	
	Steady green	The controller is communicating with all of the devices in its I/O configuration.	

Table 35 - Status Indicators (Continued)

Indicator	Status	Description	Recommended Actions
I/O	Flashing green	One or more devices in the controller's I/O configuration are not responding.	To determine why a device may not be responding, perform this procedure. 1. Verify that all I/O modules in your project are installed in the same order. 2. Verify that all devices have been updated to the latest major and minor firmware revisions. 3. Use online Help in RSLogix 5000 software to determine which I/O module is not responding.
	Flashing red	The controller is not communicating with any of the devices in its I/O configuration.	
OK	Off	• No power is applied. • If MEM SAVE is green, the user program and configuration data are being saved to flash memory.	Normal operation. No action is required.
	Flashing red	The controller requires a firmware update.	1. Download the latest firmware from http://www.rockwellautomation.com/support 2. To install the latest firmware, either – use the ControlFLASH utility. – use AutoFlash. – use your CompactFlash card.
		A major recoverable fault occurred on the controller.	To clear the fault, perform this procedure. 1. Turn the controller keyswitch from PROG to RUN to PROG. 2. Go online.
		• A nonrecoverable major fault occurred on the controller and produces either Fault Code 60 or Fault Code 61. • Fault Code 60 indicates that the CompactFlash card is not installed. • Fault Code 61 means that the CompactFlash card is installed. To recover from this fault, perform this procedure.	To recover from Fault Code 60 or 61, perform this procedure. 1. Clear the fault. 2. Download the project. 3. Change to Remote Run/Run mode. 4. 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. See the back cover of this publication.
	Red	The controller detected a nonrecoverable major fault, so it cleared the project from memory.	To recover from this fault, perform this procedure. 1. Cycle power to the chassis. 2. Download the project. 3. Change to Run mode. If the OK Status indicator remains red, contact Rockwell Automation.
	Green	The controller is operating normally.	Normal operation. No action is required.
	Flashing green	The controller is storing or loading a project to or from nonvolatile memory.	
PWR	Off	The power supply is turned off or lacks adequate input power.	Verify that the power supply is turned on and that adequate input power is properly connected.
		The power supply has failed.	Replace the power supply.
	Steady green	The power supply is operating properly.	Normal operation. No action is required.
PWR	Steady red	The power supply cannot produce valid 24V power to the 1768 modules.	To supply 24V power, perform this procedure. 1. Disconnect all modules from the system. 2. Reapply power. 3. Check the PWR status indicator. c. If the status indicator remains red, replace the power supply. d. If the status indicator is green, one of the other modules in the system is causing the red indicator. Move to the next step. 4. Reinstall any 1768 motion or communication modules. 5. Reapply power. a. If the status indicator is green, either the 1768 controller or one of the 1769 I/O modules is causing the red indicator. b. If the status indicator remains red, one of the 1768 communication or motion modules is causing the red indicator. Move to the next step. 6. Disconnect the 1768 communication or motion modules from the system one at a time. 7. After each module is removed from the system, reapply power to the power supply and check the PWR status indicator. a. If the status indicator is green, the most recently removed 1768 module caused the red indicator and should be replaced. b. If the status indicator remains red, continue disconnecting 1768 modules one at a time until the PWR status indicator turns green.

Table 35 - Status Indicators (Continued)

Indicator	Status	Description	Recommended Actions
I/O PWR	Off	Either the controller or the power supply is not operating properly.	To recover from this fault, perform this procedure. 1. Make sure all modules in the system are installed properly and fully engaged with each other. If the controller PWR status indicator remains off, proceed to the next step. 2. Disconnect any 1768 communication or motion modules from the system. 3. Reinstall the controller directly next to the power supply and reapply power. 4. If the controller PWR status indicator remains off, replace the controller. 5. If the controller PWR status indicator on the new controller remains off, replace the power supply.
	Steady green	The controller is sending power to the 1768 modules as it should.	Normal operation. No action is required.
	Steady red	• The controller needs to be replaced. • If 1768 communication and motion modules are installed in the system, one of the 1768 modules needs to be replaced.	Perform this procedure. 1. Disconnect all of the 1768 communication and motion modules from the system. 2. Reapply power. 3. Check the controller PWR status indicator. a. If the status indicator is green, the controller is operating properly and one of the other 1768 modules needs to be replaced. b. To troubleshoot the 1768 modules, see their respective installation instructions. c. If the status indicator remains red, replace the controller.

CompactFlash Card Status Indicator

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. This could corrupt the data on the card or in the controller, as well as corrupt the latest firmware in the controller.

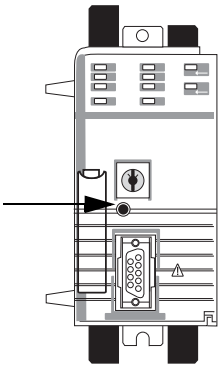
Indicator	Condition	Description
CF	Off	No activity.
	Flashing green	The controller is reading from or writing to the CompactFlash card.
	Flashing red	CompactFlash card does not have a valid file system.

RS-232 Serial Port Status Indicators

The RS-232 serial port has two status indicators.

Indicator	Condition	Description
DCH0	Off	Channel 0 is configured differently than the default serial configuration.
	Steady green	Channel 0 has the default serial configuration.
CH0	Off	There is no RS-232 activity.
	Flashing green	There is RS-232 activity. No action is required.

Faceplate Push Button



On the faceplate of the controller, there is a recessed push button.

Table 36 - Push Button Actions

If you access the push button	The action
After power is applied to the controller	Resets the RS-232 configuration setting to the defaults
While the controller is powering up	Clears the user program from controller memory

History of Changes

Topic	Page
1768-UM001E-EN-P, April 2012	139
1756-UM058D-EN-P, October 2009	139

This appendix summarizes the revisions to this manual. Reference this appendix if you need information to determine what changes have been made across multiple revisions. This may be especially useful if you are deciding to upgrade your hardware or software based on information added with previous revisions of this manual.

1768-UM001E-EN-P, April 2012

Change
Updated Additional Resources listing
Added installation instructions

1756-UM058D-EN-P, October 2009

Change
Updated the About the 1768 CompactLogix Controllers section
Added software and firmware compatibility
Added the About 1768 GuardLogix Controllers section
Added content about DF1 radio modem support
Added the broadcast messages over serial section
Added the Configure Distributed I/O on a ControlNet Network section
Added the Interrupt the Execution of Logic and Execute the Fault Handler section
Updated the Select a System Overhead Percentage section
Added the Configure SERCOS Motion section

Notes:

Numerics

A

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U

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^{SM} support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

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

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

New Product Satisfaction Return

Rockwell Automation tests all of its products to help 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.

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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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