Allen-Bradley

# 1768 CompactLogix Controllers

**Catalog Number 1768-L43**

**Firmware Revision 16**

**User Manual**

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://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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

| | |
|---|---|
| **WARNING**  | Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |
| **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 consequences. |
| **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. |

## Introduction

The release of this document contains new and updated information. To find new and updated information, look for change bars, as shown next to this paragraph.

## Updated Information

The document contains these changes.

| Topic | Page |
|---|---|
| Information for 1768-CNB and 1768-CNBR ControlNet Modules | Throughout manual |
| 1768-EWEB Web Server Module | 24 |
| ControlNet Network Communication | 26 |
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## Notes:

## Chapter 8

**Develop Motion Applications**



## Chapter 9

**Configure PhaseManager**

**Maintain Nonvolatile Memory**

## Chapter 10



**1768 CompactLogix Controller Specifications**

## Appendix A



**LED Indicators**

## Appendix B



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## About This Publication

Use this manual to become familiar with the CompactLogix controller and its features. This version of the manual corresponds to controller firmware revision 16.

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

## Who Should Use This Publication

This manual is for automation engineers and control system developers who design, program, and commission 1768 CompactLogix control systems.

## Additional Resources

These documents address Logix5000 controllers.

| Catalog Number | Title | Publication |
|---|---|---|
| 1768-L43 | 1768-L43 CompactLogix Controller Installation Instructions | 1768-IN004 |
| | CompactLogix L43 Controller Version 15 Firmware Release Note | 1768-RN015 |
| 1768-L43, 1768-CNB, 1768-CNBR, and 1768-EWEB | Logix5000 Controllers Execution Time and Memory Use Reference Manual | 1756-RM087 |
| | PhaseManager User Manual | LOGIX-UM001 |
| | Logix5000 Controllers Quick Start | 1756-QS001 |
| | Logix5000 Controllers Common Procedures Programming Manual | 1756-PM001 |
| | Logix5000 Controllers System Quick Reference | 1756-QR107 |
| | Logix5000 Controllers General Instruction Set Reference Manual | 1756-RM003 |
| | Logix5000 Controllers Process Control/Drives Instruction Set Reference Manual | 1756-RM006 |
| | Logix5000 Controllers Motion Instructions Reference Manual | 1756-RM007 |
| | EtherNet/IP Communication Modules in Logix5000 Control Systems User Manual | ENET-UM001 |
| | ControlNet Communication Modules in Logix5000 Control Systems User Manual | CNET-UM001 |

To view or download manuals, visit
http://literature.rockwellautomation.com

To obtain a hard copy of a manual, contact your local Rockwell Automation distributor or sales representative.

## Notes:

# 1768 CompactLogix Overview

## Introduction

This chapter explains the design and installation requirements of the 1768 CompactLogix controller.



## About the 1768 CompactLogix Controller

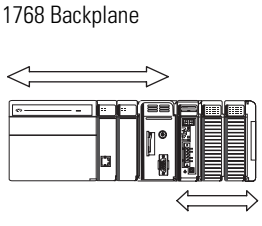
The CompactLogix system is designed to provide a Logix solution for machine-level control applications with I/O, motion, and network requirements.

The 1768-L43 controller offers one built-in serial port. You can install no more than two of these communication modules:

- a 1768-ENBT communication module for EtherNet/IP communication.
- a 1768-M04SE SERCOS adapter module for motion control of SERCOS drives.
- a 1768-EWEB web server module for the remote monitoring and modification of data via an XML web page.
- a 1768-CNB or 1768-CNBR communication module for ControlNet communication.

The 1768-L43 controller has a key on the front panel so you can change controller modes.

**Example - Standalone CompactLogix Controller with I/O and DeviceNet Communication**

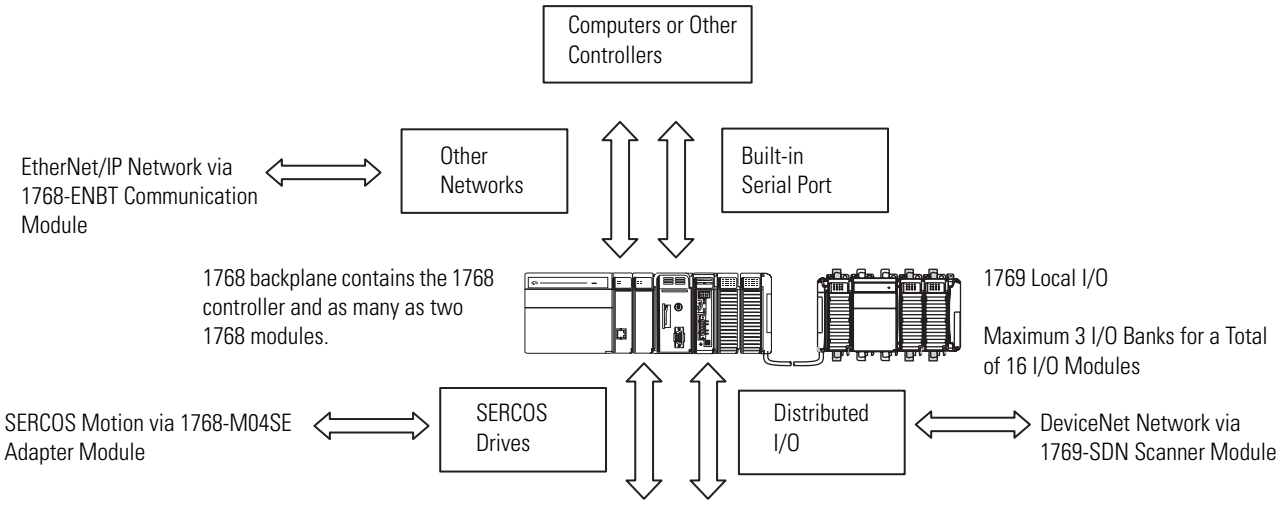


The 1768 CompactLogix controller combines both a 1768 backplane and a 1769 backplane, retaining the advantages of each plane.

In a more complex system, you can add other networks and motion control.

Multiple controllers can communicate across networks and share data via I/O in multiple platforms connected to as many as three banks of I/O modules

**Complex CompactLogix System**




The controller supports a maximum of 16 local 1769 I/O modules. As many as 8 of the local modules can be attached to the 1768 controller.

Install the remaining modules in one or two additional I/O banks that you attach to the 1768/1769 system. The additional banks are powered by standard 1769 power supplies (1769-PA4) and connect to the main rack using standard 1769 extension cables (1769-CRL*x*).

## Design a System

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

- select I/O devices for your DIN-rail or panel-mounted system.
- establish motion control and drives requirements.
- select communication modules with a built-in RS-232 serial port (DF1 or ASCII).
- select controllers.
- select power supplies.
- mount the system.
- select ViewAnyWare products.
- select RSLogix 5000 programming software.

### Additional Resources

For additional information on selecting components and designing your system, consult these publications:

- CompactLogix Selection Guide, publication 1768-SG001
- Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

## Install Hardware

To install a CompactLogix controller, perform this procedure.

1. Install the DIN rail.
2. Mount the controller, 1768 modules, and power supply on the DIN rail.
3. Mount 1769 modules on the DIN rail.
4. Connect the controller.
5. Load controller firmware.
6. Configure communication drivers.

## Additional Resources

For additional information on installing your hardware, consult these publications:

- 1768-L43 CompactLogix Controller Installation Instructions, publication 1768-IN004
- CompactLogix SERCOS interface Module Installation Instructions, publication 1768-IN005

# Directly Connect to the Controller Via the Serial Port

## Introduction

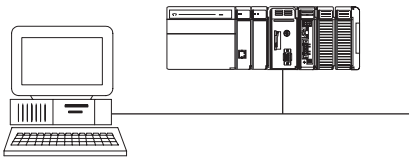
This chapter explains how to connect to the controller via the serial port so you can configure the controller and upload and download a project to the controller.



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

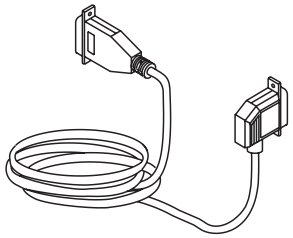
- a workstation with a serial port.
- RSLinx software to configure the serial communication driver.
- RSLogix 5000 programming software to configure the serial port of the controller.

## Connect the Controller Via the Serial Port



Channel 0 on the CompactLogix controller is fully isolated and does not need a separate isolation device. To connect a serial cable, perform this procedure.

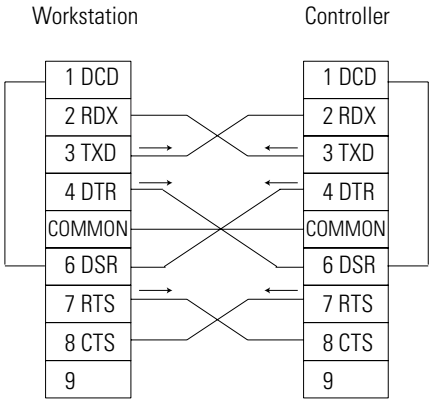
**1.** Obtain a 1747-CP3 or 1756-CP3 serial cable.



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

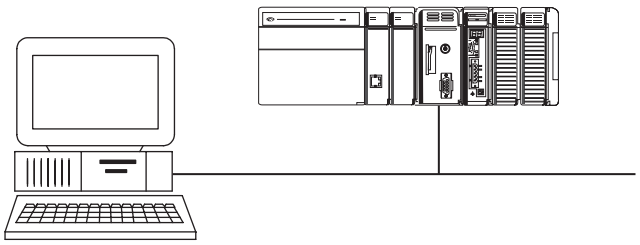
a. Limit the length to 15.2 m (50 ft).

b. Wire the connectors.




c. Attach the shield to both connectors.

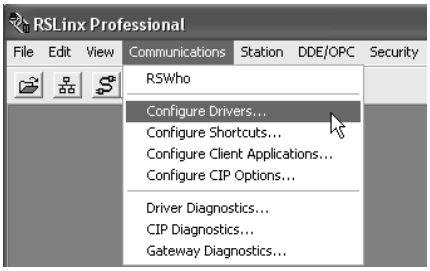
**2.** Connect the cable to the controller and your workstation.



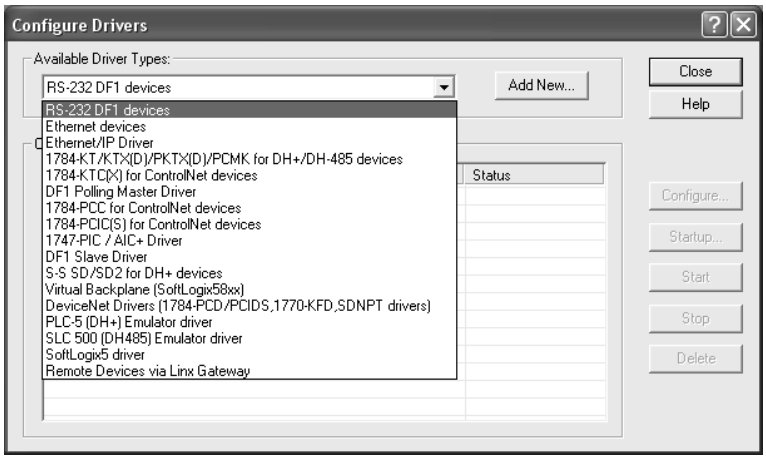
## Configure the Serial Driver

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.



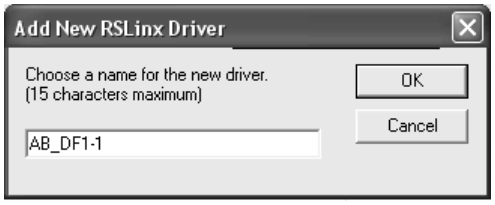

   The Configure Drivers dialog appears.




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 appears.




4. Specify the driver name and click OK.

The Configure RS-232 DF1 Devices dialog 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.

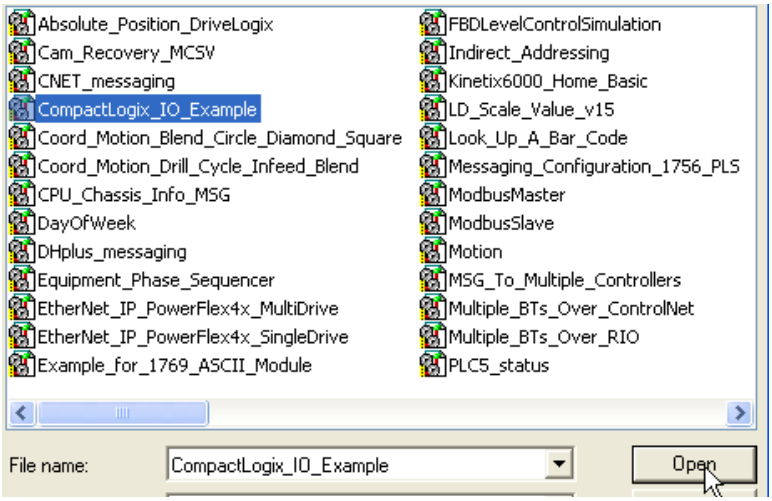
| If | Then |
|---|---|
| Yes | Click OK. |
| No | Return to step 5 and verify that you selected the correct communication port. |

9. In the Configure Drivers dialog, click Close.

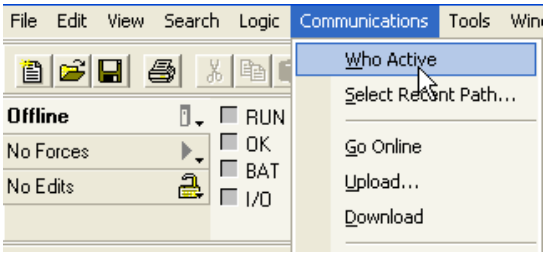
## Select the Controller Path

To select the controller path, perform this procedure.

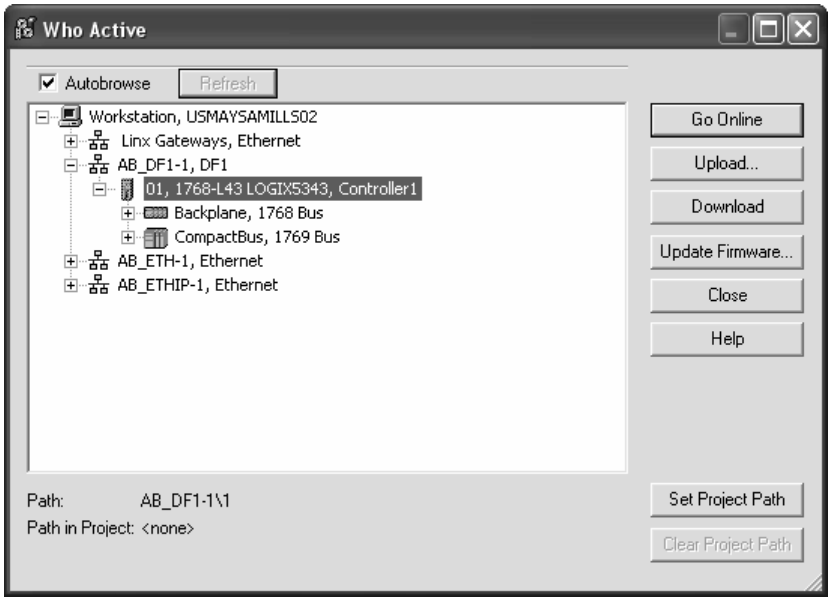
1. In RSLogix 5000 programming software, open a project for the controller.




2. From the Communications menu, choose Who Active.




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



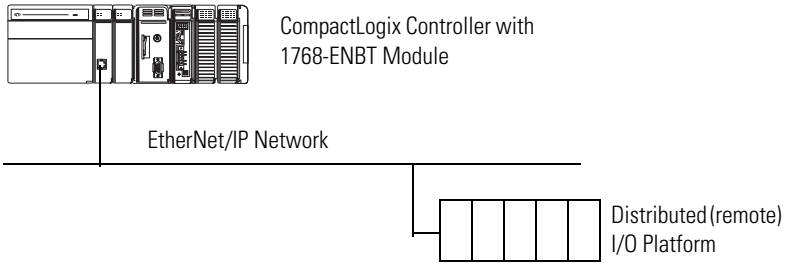
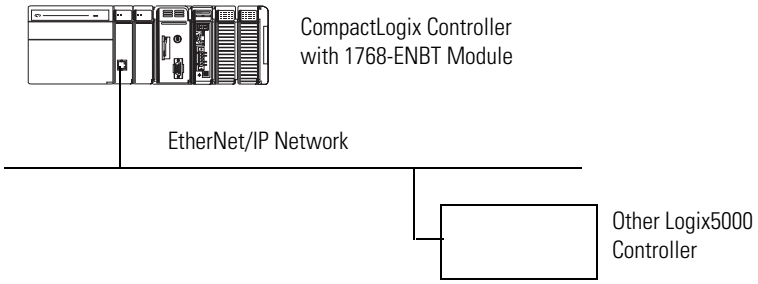
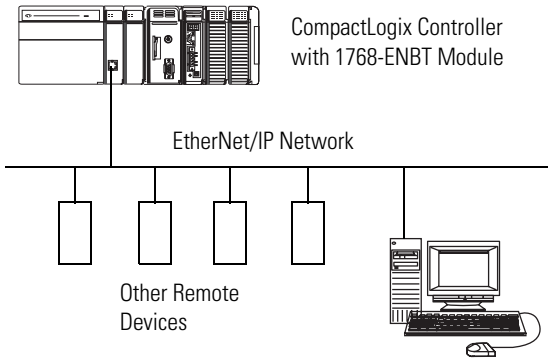
4. Select the controller.

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

# Communicate over Networks

## Introduction

This chapter explains how the CompactLogix controller supports multiple networks.

| Network Support | Example |
|---|---|
| Control distributed (remote) I/O via:<br>• the EtherNet/IP network.<br>• the ControlNet network.<br>• the DeviceNet network. |  |
| Produce and consume data between controllers via:<br>• the EtherNet/IP network.<br>• the ControlNet network. |  |
| Send and receive messages to and from other devices, including access to the controller via RSLogix 5000 programming software, via:<br>• the EtherNet/IP network.<br>• the DeviceNet network (to devices only).<br>• the ControlNet network.<br>• serial networks.<br>• 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. This combination of well-accepted standards provides the capability required to both support information data exchange and control applications.

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

For EtherNet/IP communication, 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.

**Required Software for EtherNet/IP Communication**

| Software | Function(s) | Requirement |
|---|---|---|
| RSLogix 5000 | • Configure CompactLogix projects<br>• Define EtherNet/IP communication. | Yes |
| RSLogix 5000 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 and/or host names.<br>• Provide bandwidth status. | |
| RSLinx | • Configure communication devices.<br>• Provide diagnostics.<br>• Establish communication between devices. | Yes |

## 1768-ENBT EtherNet/IP Communication Module

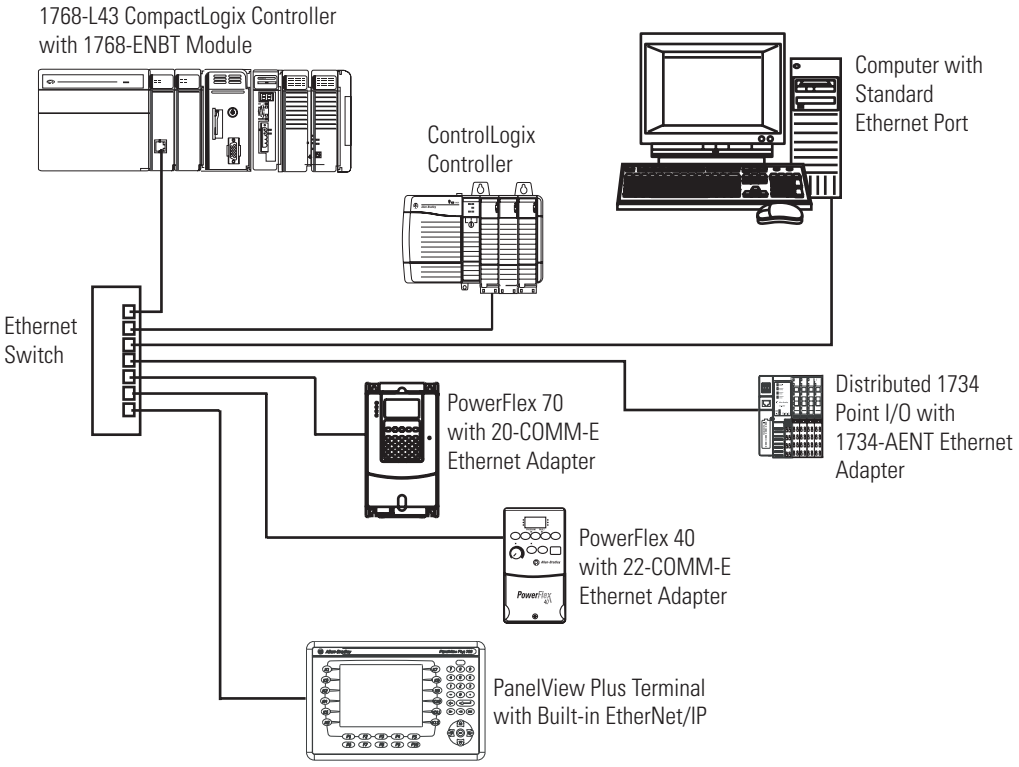
The 1768-ENBT EtherNet/IP communication module:

- supports messaging, produced/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 RJ45 connector.
- supports half/full duplex 10 MB or 100 MB operation.
- supports standard switches.

In this example:

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

**CompactLogix EtherNet/IP Network Overview**



## 1768-EWEB Web Server Module

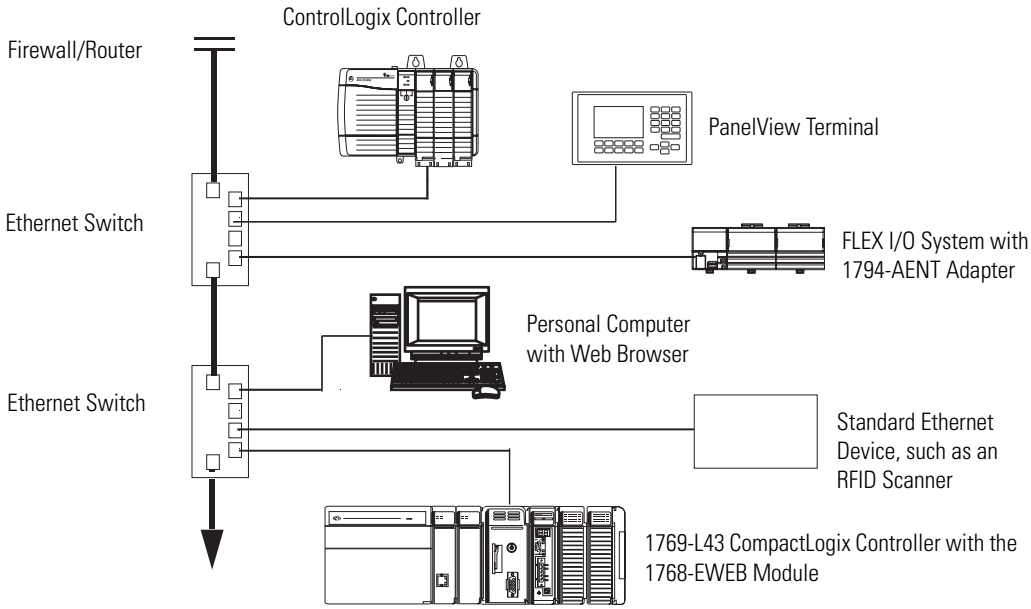
The 1768-EWEB EtherNet/IP web server module supports:

- the bridging and routing of messages, but with no I/O control.
- data access (read and write) to controllers via a standard web browser.
- custom web pages.
- email.
- open-socket interface.

In this example:

- you can route messages, upload/download programs, and flash upgrade modules using the web server module as part of the communication path to access the target device.
- you can view and modify data that resides in a 1768 CompactLogix controller via a standard web browser.
- you can create custom web pages that are tailored to your application. Use ASP functions to populate your web pages with live controller data.
- you can send an email initiated by a Logix controller via a MSG instruction.
- you can open TCP or UDP communication links to other standard Ethernet devices via open sockets.

**CompactLogix EtherNet/IP Web Network**



*Additional Resources*

For more information, see the EtherNet/IP Web Server Module User Manual, publication ENET-UM527.

## Connections Over an EtherNet/IP Network

Each 1768-ENBT or 1768-EWEB module in an EtherNet/IP network can provide a certain amount of connected messaging support.

**EtherNet/IP Connected Messaging Support**

| Each | Supports |
|---|---|
| 1768-ENBT module | • 64 Logix unscheduled connections<br>• 32 TCP/IP connections |
| 1768-EWEB module | • 64 CIP connections for any combination of data views, bridged messages, and ASP function calls<br>• 64 TCP connections |

To avoid exceeding the maximum number of supported connections in these EtherNet/IP modules, you must tally your remote EtherNet/IP network connections.

## Additional Resources

For additional information, consult these publications:

- EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001
- EtherNet/IP Performance Application Solution, publication ENET-AP001
- Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

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

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

The ControlNet network often functions as:

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

**Required Software for ControlNet Communication**

| Software | Functions | Requirement |
|---|---|---|
| RSLogix 5000 | • Configure CompactLogix projects.<br>• Define ControlNet communication. | Yes |
| RSNetWorx for ControlNet | • Configure ControlNet devices by IP addresses and/or host names.<br>• Schedule a network. | |
| RSLinx | • Configure communication devices.<br>• Provide diagnostics.<br>• 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 the CompactLogix controller.

The 1768-CNB and 1768-CNBR ControlNet modules:

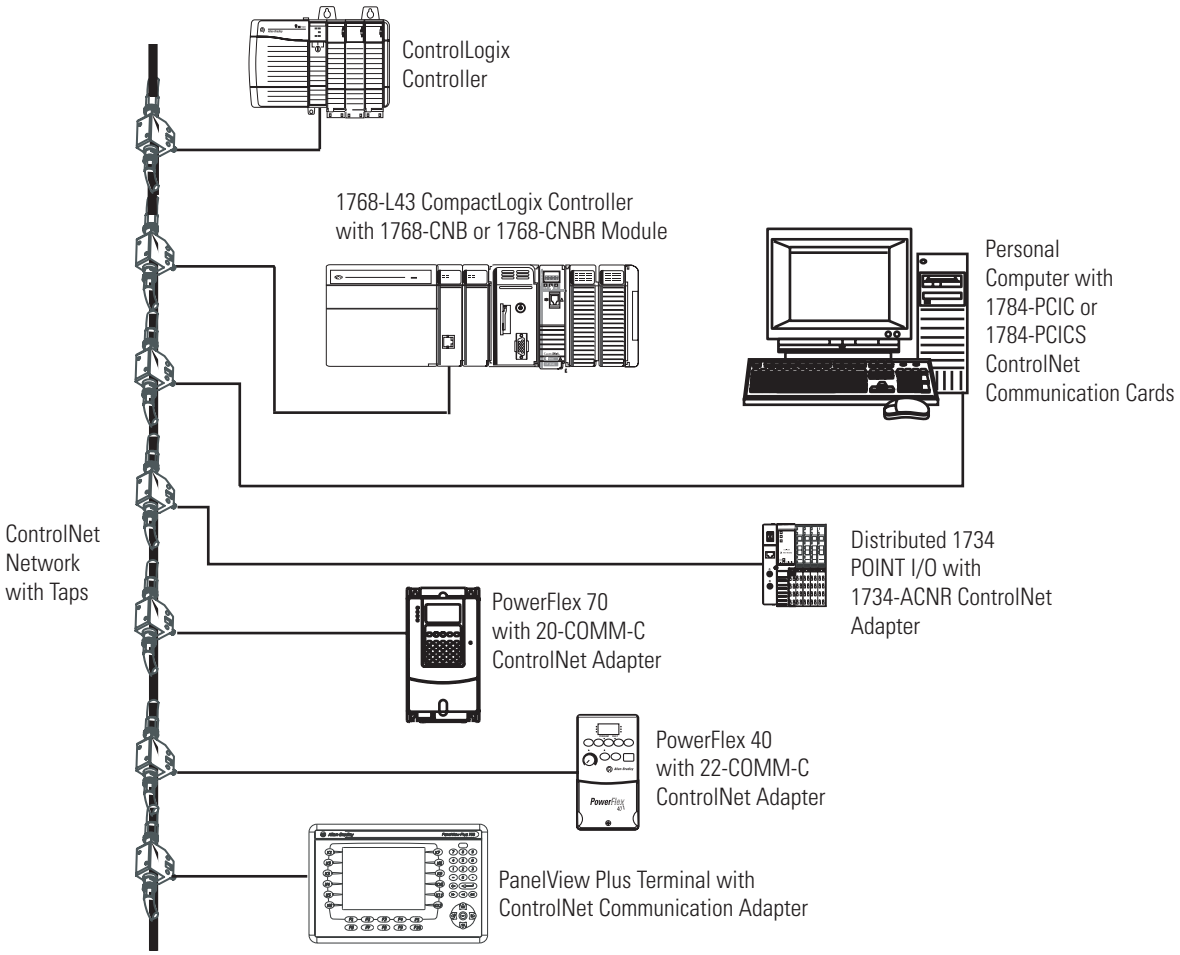
- provide messaging data for configuration and programming.
- support operator interfaces and uploading and downloading.
- support I/O bridging.

- support the transfer of scheduled data via produced/consumed tags.
- support unscheduled MSG instruction communication with other ControlNet nodes.
- support local communication network access through the network access port (NAP).
- support redundant media (1768-CNBR only).

In this example:

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

**CompactLogix ControlNet Network Overview**



## Additional Resources

For additional information, consult ControlNet Modules in the Logix5000 Control Systems User Manual, publication CNET-UM001.

# 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.

**DeviceNet Interfaces**

| Application | Required Interface |
|---|---|
| • Communicates with other DeviceNet devices<br>• Uses the controller as a master on a DeviceNet network | 1769-SDN DeviceNet scanner |
| • Accesses remote Compact I/O modules over a DeviceNet network<br>• 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.

In addition to communication hardware for DeviceNet networks, these software products are available.

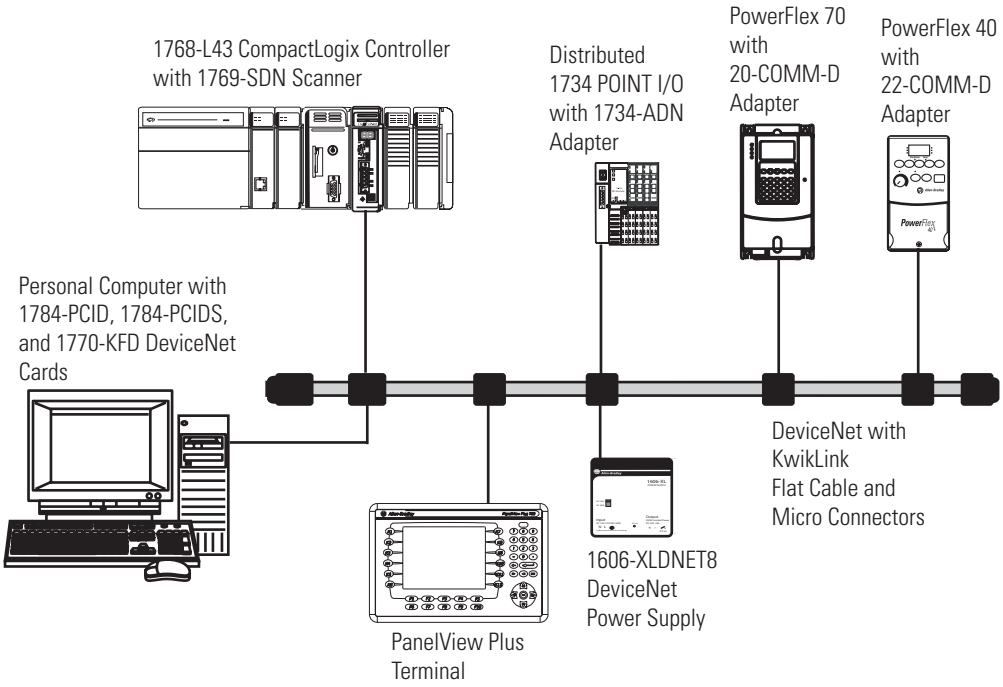
**Required Software for DeviceNet Communication**

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

The DeviceNet communication modules:

- support messaging to devices (not controller to controller).
- share a common application layer with ControlNet and EtherNet/IP networks.
- offer diagnostics for improved data collection and fault detection.
- require less wiring than traditional, hardwired systems.

**CompactLogix DeviceNet Network Overview**




## Additional Resources

For additional information, consult these publications:

- DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004
- Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

## Serial Network Communication

The 1768 CompactLogix controller has a built-in RS-232 serial port.

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

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

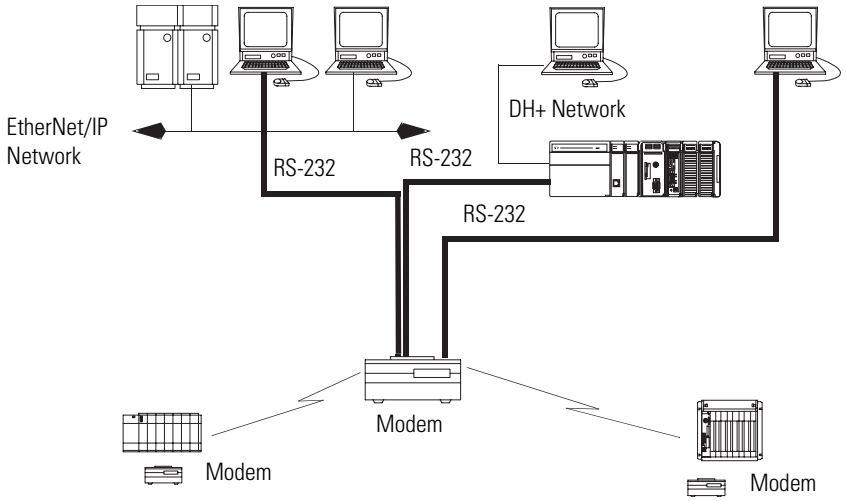
**DF1 Modes for Logix5000 Controllers**

| Mode | Function |
|---|---|
| DF1 Point-to-Point | Communication between the controller and one other DF1-protocol-compatible device.<br>This is the Default System mode. Default parameters are:<br>• Communication Rate: 19,200 bps.<br>• Data Bits: 8.<br>• Parity: None.<br>• Stop Bits: 1.<br>• Control Line: No Handshake.<br>• RTS send Delay: 0.<br>• RTS Off Delay: 0.<br>This mode is typically used to program the controller through its serial port. |
| DF1 Master | • Control of polling and message transmission between the master and slave nodes.<br>• The master/slave network includes one controller configured as the master node and as many as 254 slave nodes. Link slave nodes using modems or line drivers.<br>• A master/slave network can have node numbers from 0...254. Each node must have a unique node address. Also, at least two nodes must exist to define your link as a network (one master and one slave station are the two nodes). |
| DF1 Slave | • A controller to operate as a slave station in a master/slave serial communication network.<br>• When there are multiple slave stations on the network, link slave stations using modems or line drivers to the master. When you have a single slave station on the network, you do not need a modem to connect the slave station to the master. You can configure the control parameters for no handshaking. You can connect 2...255 nodes to a single link. In DF1 Slave mode, a controller uses DF1 half-duplex protocol.<br>• 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.<br>• This mode supports master and slave, and store and forward modes. |
| User (channel 0 only) | • Communication with ASCII devices.<br>• 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.<br>• This multi-master, token-passing network permits programming and peer-to-peer messaging. |

## Communicate with DF1 Devices

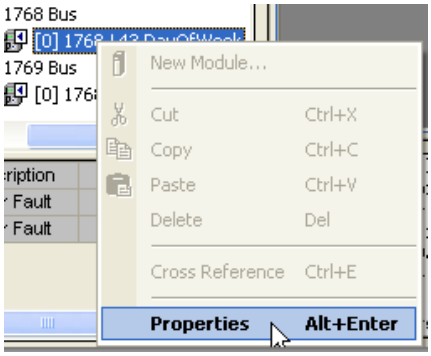
You can configure the controller as a master or slave on a serial network. Use serial communication to get information to and from remote controllers (stations) when:

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

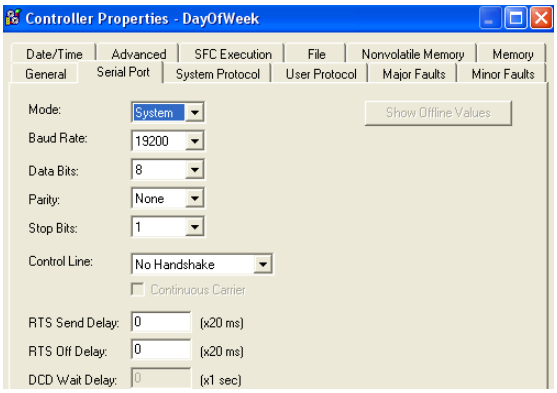



To configure your controller for DF1 communication, perform this procedure.

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



The Controller Properties dialog appears.

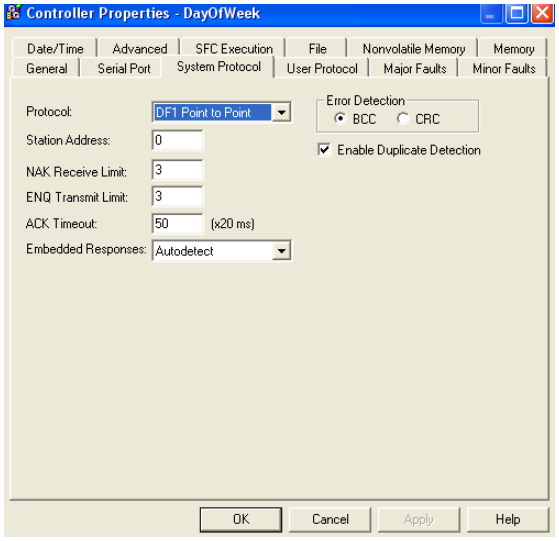



2. Click the Serial Port tab.

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.

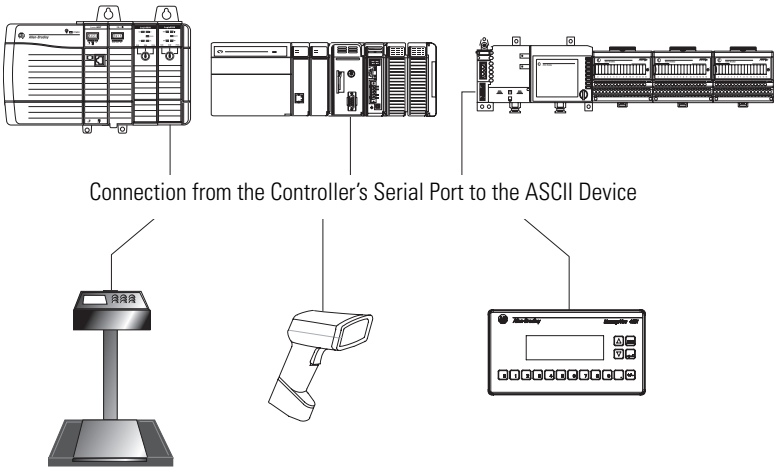
### *Additional Resources*

For additional information, consult SCADA System Application Guide User Manual, publication AG-UM008.

## Communicate with ASCII Devices

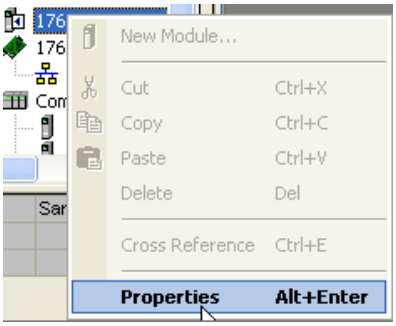
When you configure the serial port for User mode, you can use it to:

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

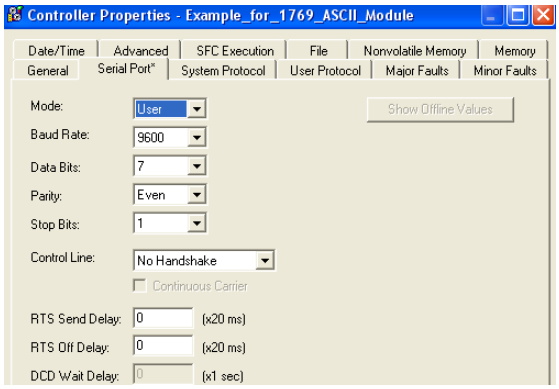



To communicate with ASCII devices, perform this procedure.

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



The Controller Properties dialog appears.

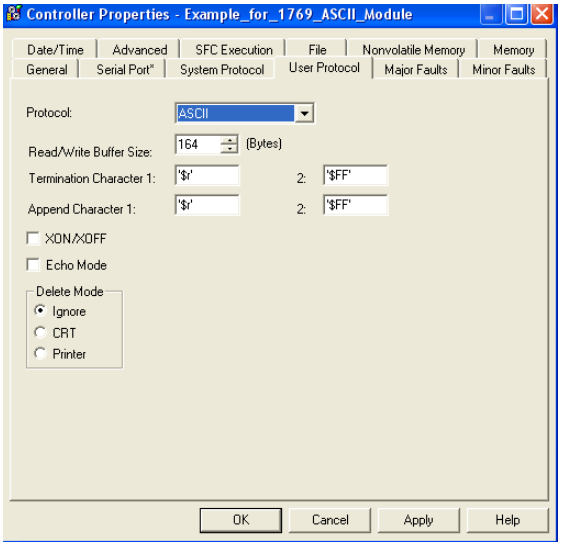



2. Click the Serial Port tab.

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.

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

**Read and Write ASCII Characters**

| Instruction Code | Description |
|---|---|
| ABL | Determine when the buffer contains termination characters |
| ACB | Count the characters in the buffer |
| ACL | Clear the buffer |
| | Clear out ASCII serial port instructions that are currently executing or are in the queue |
| AHL | Obtain the status of the serial port control lines |
| | Turn 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 |

**Create and Modify Strings of ASCII Characters**

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

**Convert Data To or From ASCII Characters**

| Instruction Code | Description |
|---|---|
| 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 |

## Additional Resources

For additional information, consult these publications:

- Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003
- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001

## Modbus Support

To use Logix5000 controllers on the Modbus protocol, establish a serial port connection and execute a specific ladder-logic routine. The controller project is available with RSLogix 5000 programming software.

### *Additional Resources*

For additional information, consult Using Logix5000 Controllers as Masters or Slaves on Modbus Application Solution, publication CIG-AP129.

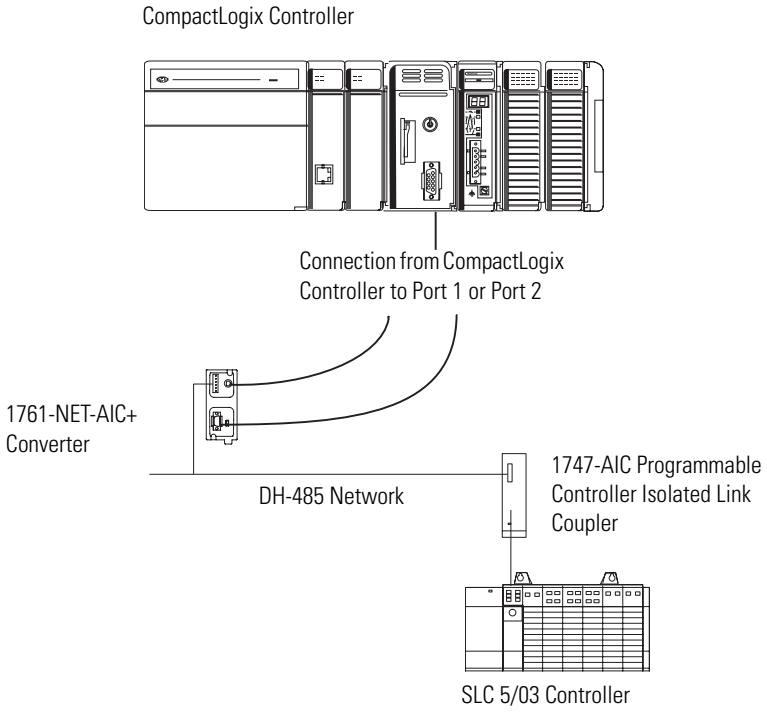
## DH-485 Network Communication

For DH-485 communication, use the serial port of the controller. The controller can send and receive messages to and from other controllers on a DH-485 network. The DH-485 connection supports remote programming and monitoring via RSLogix 5000 programming software. However, excessive traffic over a DH-485 connection can adversely affect overall performance and lead to timeouts and decreased RSLogix 5000 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 the CompactLogix controller to act as a DH-485 interface. By using a 1761-NET-AIC converter and the appropriate RS-232 cable (1756-CP3 or 1747-CP3), a CompactLogix controller can send and receive data on a DH-485 network.

**CompactLogix DH-485 Network Communication Overview**



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

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

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

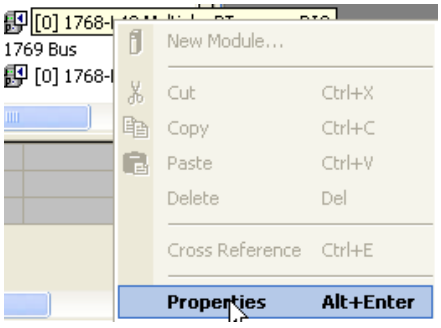
You can have two controllers for each 1761-NET-AIC converter, but you need a separate cable for each controller. Connect the serial port of the controller to either port 1 or port 2 of the 1761-NET-AIC converter. Use the RS-485 port to connect the converter to the DH-485 network.

### Cable Selection

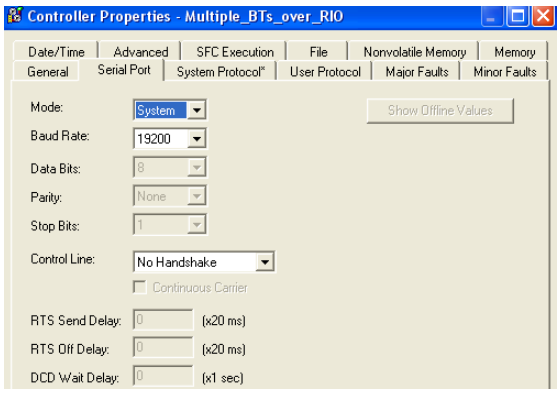
| Connection | Required Cable |
|---|---|
| Port 1<br>DB-9 RS-232, DTE connection | 1747-CP3<br>or<br>1761-CBL-AC00 |
| Port 2<br>Mini-DIN 8 RS-232 connection | 1761-CBL-AP00<br>or<br>1761-CBL-PM02 |

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

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



The Controller Properties dialog appears.




2. Click the Serial Port tab.

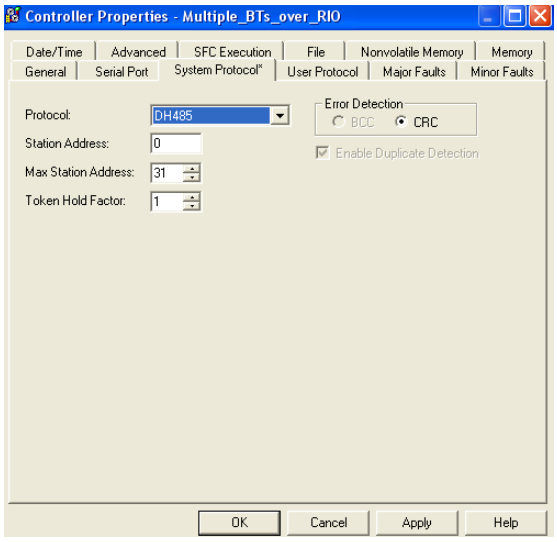
3. From the Mode pull-down menu, choose System.

4. Specify DH-485 communication settings.

   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.

   a. From the Baud Rate pull-down menu, choose 9600 or 19200 kbps.

5. Click the System Protocol tab.




6. Specify system protocol settings.

   The station address specifies the node address of the controller on the DH-485 network.

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

   To optimize network performance, assign station addresses in sequential order.

   Assign initiators, such as personal computers, 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.

   To optimize network performance, make sure:

   - the maximum station address is the highest node number being used on the network.
   - that all the devices on the same DH-485 network have the same selection for the maximum station address.

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.

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

   The default is 1.

**7.** Click OK.

## Additional Resources

For more information, consult Data Highway/Data Highway Plus/Data Highway II/Data Highway-485 Cable Installation Manual, publication 1770-6.2.2.

# Manage Controller Communication

## Introduction

This chapter explains how to 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 by RSLogix 5000 programming software
- Controller access by RSLinx software for HMI or other applications

### Additional Resources

For additional information, consult Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

## Produce and Consume (interlock) Data

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

**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.<br><br>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 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.

## Additional Resources

For additional information, consult these publications:

- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
- Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

## Send and Receive Messages

Messages transfer data to other devices, such as other controllers or operator interfaces. Some messages use unscheduled 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. To conserve connections, configure one message to read from or write to multiple devices.

**Message Types**

| Message Type | Communication Method | Connected Message | Message Can Be Cached |
|---|---|---|---|
| CIP data table read or write | N/A | Yes | Yes |
| PLC-2, PLC-3, PLC-5, or SLC (all types) | CIP | No | No |
| | CIP with Source ID | No | No |
| | DH+ | Yes | Yes |
| CIP generic | N/A | Optional [1] | Yes[2] |
| Block-transfer read or write | N/A | Yes | Yes |

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

[2] Consider caching only if the target module requires a connection.

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

### Determine Whether to Cache Message Connections

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

**Caching Message Connections**

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

In a 1768 CompactLogix system, only consider connections associated with each 1768-ENBT, 1768-CNB or 1768-CNBR module. Each module supports 64 unscheduled Logix connections.

## Additional Resources

For additional information, consult these publications:

- Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003
- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
- Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

# 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.

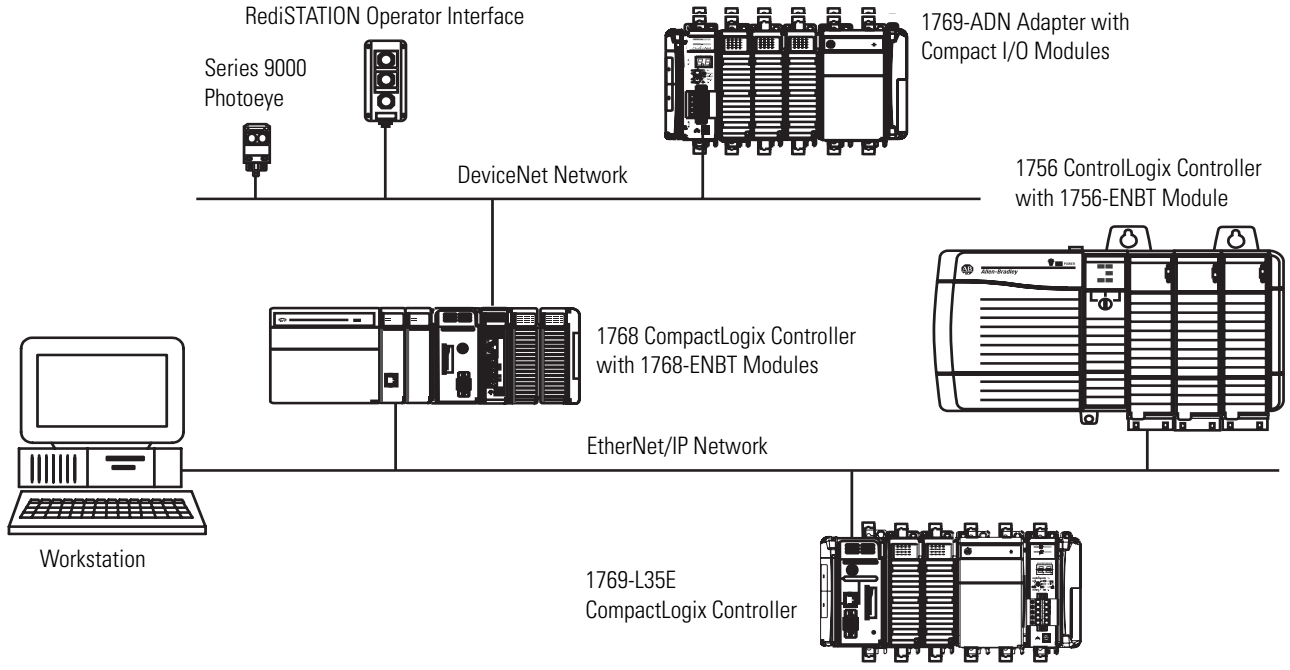
**Tallying Remote Connection Use**

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

## Connections Example

In this example system, the 1768-L43 CompactLogix controller:

- sends and receives messages to and from a ControlLogix controller on an EtherNet/IP network.
- produces one tag that the 1769-L35E CompactLogix controller consumes.
- is programmed via RSLogix 5000 programming software.




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

**Example Connection Types**

| Connection Type | Device Quantity | Connections per Device | Total Connections |
|---|---|---|---|
| Controller to RSLogix 5000 programming software | 1 | 1 | 1 |
| Message to 1756 ControlLogix controller | 1 | 1 | 1 |
| Message to 1769-L35E controller | 1 | 1 | 1 |
| Controller to 1769-SDN module | 1 | N/A | N/A |
| Produced tag consumed by 1769-L35E CompactLogix controller | 1 | 1 | 1 |
| | | **Total** | 4 |

## Notes:

# Place 1768 and 1769 Modules

## Introduction

This chapter explains the placement of 1768 and 1769 modules.

The 1768 CompactLogix controller combines both a 1768 backplane and a 1769 backplane. This combination includes the advantages of the 1768 architecture while retaining the advantages of 1769 I/O support.

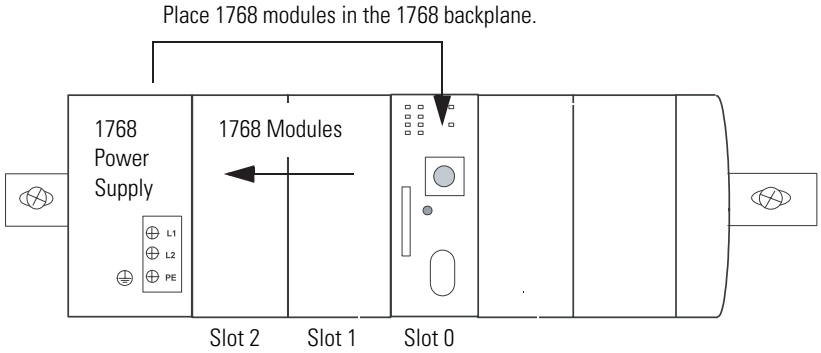


## 1768 Module Placement

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

- The 1768 power supply must be the leftmost module in the 1768 backplane.
- The controller must be the rightmost module in the 1768 backplane.
- As many as two additional 1768 modules can be between the controller and power supply.
  - 1768-ENBT and 1768-EWEB for EtherNet/IP communication (maximum of two)
  - 1768-CNB or 1768-CNBR for ControlNet communication (maximum of two)
  - 1768-M04SE for SERCOS motion control (maximum of two)

**1768 Module Placement Overview**




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:

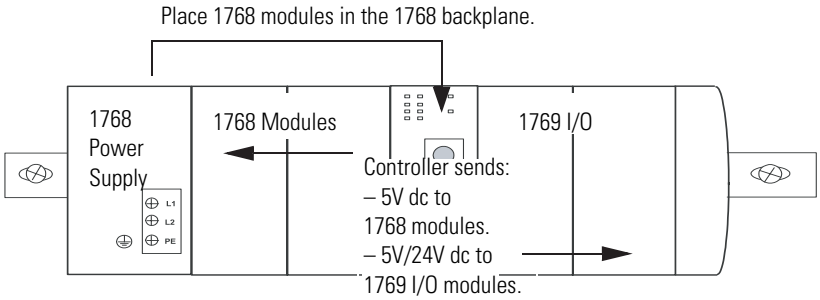
- 86...265V ac
- 108...132V dc

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

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

**1768 Power Supply**




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

## 1769 Module Placement

The controller supports a maximum of 16 local 1769 I/O modules. As many as eight of the local modules can be attached to the 1768 controller. Install the remaining modules in one or two additional I/O banks. The additional banks are powered by standard 1769 power supplies (1769-PA4) and connect to the main rack using standard 1769 extension cables (1769-CRL*x*).

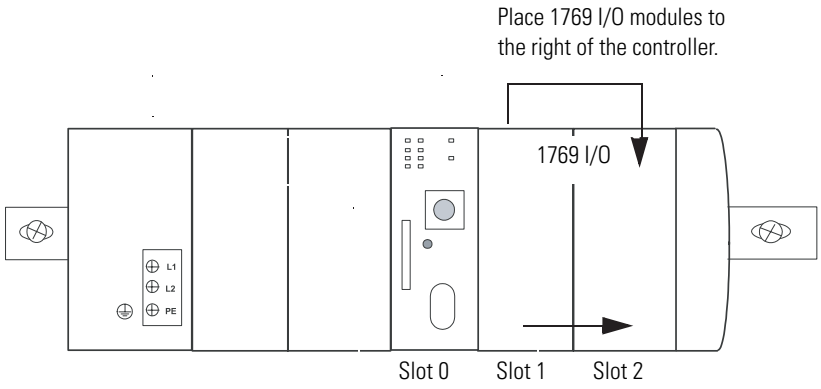
Follow these guidelines as you place 1769 modules to the right of the 1768 controller:

- As many as 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 a standard 1769 power supply, such as 1769-PA4.

**1769 Module Placement Overview**




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

Each additional bank of 1769 I/O modules requires a 1769 power supply. Place 1769 I/O modules to the left or the right of the 1769 power supply. As many as eight I/O modules can be placed on each side of a 1769 power supply. Each 1769 module also has a power supply distance rating (the number of modules from the power supply). Each module must be within its distance rating. See the specifications for the module to determine its distance rating.

## Notes:

# Configure and Monitor I/O

## Introduction

This chapter explains how to configure and monitor I/O.



## Select I/O Modules

When selecting 1769 I/O modules, choose:

- specialty I/O modules, when appropriate.

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

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

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:

- 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:

- configure an individual requested packet interval (RPI) for each local 1769 I/O module.
- select individual RPI of 1 millisecond.
- use faster RPI for time critical I/O without impacting overall 1769 I/O performance.
- program Immediate Output (IOT) instructions for further reduction in I/O update times.

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

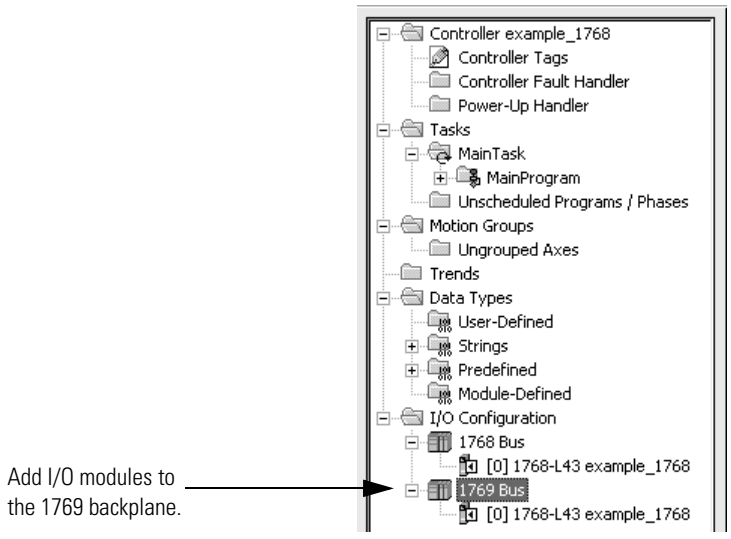
### Additional Resources

For additional information, consult these publications:

- Compact I/O Selection Guide, publication 1769-SG002
- Compact I/O Analog Modules User Manual, publication 1769-UM002
- Compact I/O 1769-IR6 RTD/Resistance Input Module User Manual, publication 1769-UM005
- Compact I/O 1769-IT6 Thermocouple/mV Input Module User Manual, publication 1769-UM004

## 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.

**Configuration Options for I/O Modules**

| Configuration Option | Description |
|---|---|
| Requested Packet Interval (RPI)<br><br>(applies to local 1769 I/O and distributed I/O) | 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.<br>• Typically, you configure an RPI in milliseconds (ms). The minimum RPI for 1769 I/O is 1 millisecond.<br>• 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)<br><br>(only applies to distributed I/O) | 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.<br><br>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<br><br>(only applies to distributed I/O) | Many I/O modules support different formats. The communication format that you choose also determines:<br>• data structure of tags.<br>• connections.<br>• network use.<br>• ownership.<br>• whether the module returns diagnostic information. |
| Electronic Keying<br><br>(applies to local 1769 I/O and distributed I/O) | When you configure a module, you specify the slot number for the module. However, it is possible to purposely or accidentally place a different module in that slot. Electronic keying lets you protect your system against the accidental placement of the wrong module in a slot. The chosen keying option determines how closely any module in a slot must match the configuration for that slot before the controller opens a connection to the module. Keying options differ depending on your application needs. |

**IMPORTANT** The RSLogix 5000 configuration dialogs for 1769 I/O modules offer a Hold Last State option for how to react when the controller faults. The 1768-L43 controller does not support this function.

## I/O Connections

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

**Logix5000 Connection Types**

| Connection | Description |
|---|---|
| Direct<br><br>(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.<br><br>Typically, analog I/O modules, diagnostic I/O modules, and specialty modules require direct connections. |
| Rack-optimized<br><br>(applies to distributed I/O) | 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). |

## Additional Resources

For additional information, consult these publications:

- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
- Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

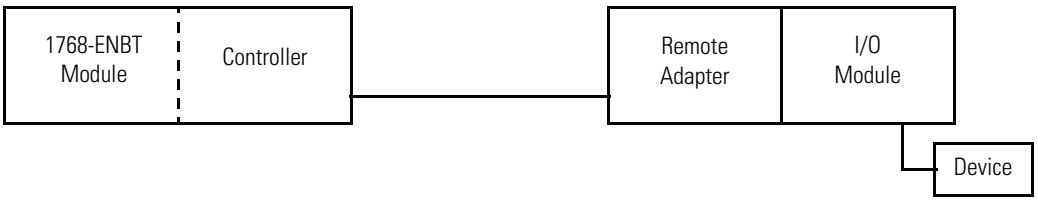
## Configure Distributed I/O on an EtherNet/IP Network

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

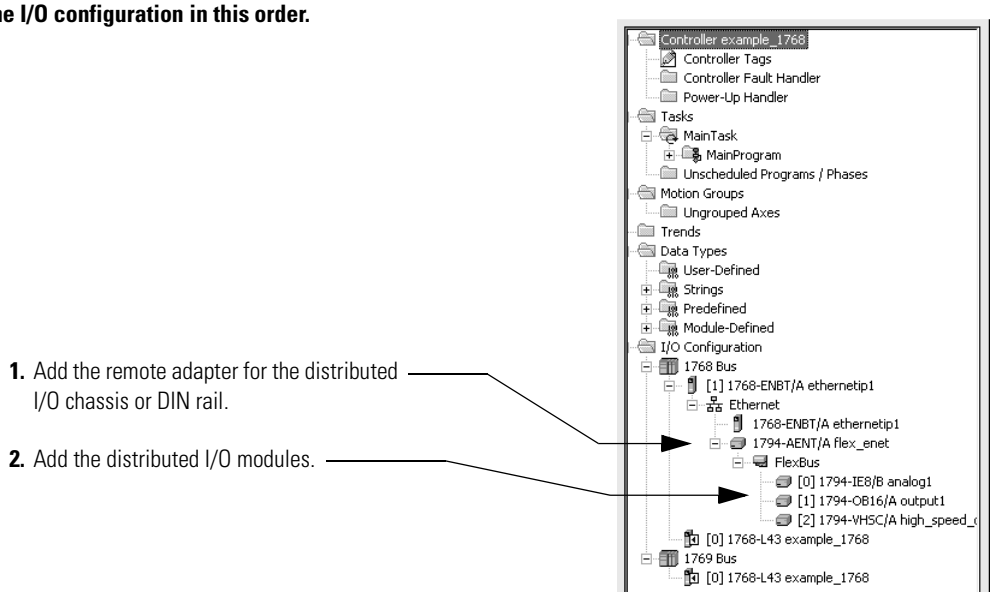
Within the I/O Configuration folder, organize the modules into a hierarchy of tree/branch and parent/child.

**Configuring I/O on EtherNet/IP Network**

**For a typical distributed I/O network…**




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




## Additional Resources

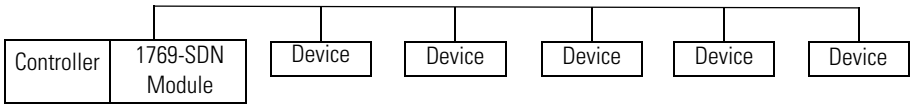
For additional information, consult EtherNet/IP Communication Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

## Configure Distributed I/O on a DeviceNet Network

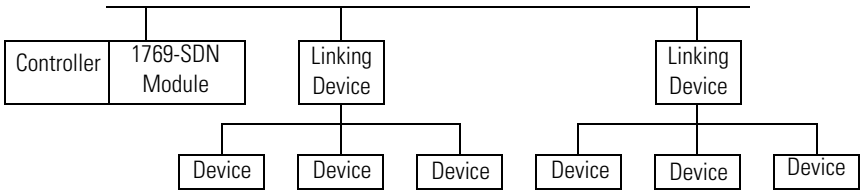
To communicate with the I/O modules over a DeviceNet network, add the DeviceNet scanner (1769-SDN) to the I/O Configuration folder of the controller. You define a scanlist within the DeviceNet scanner to communicate data between devices and the controller.

**For a typical distributed I/O network…**

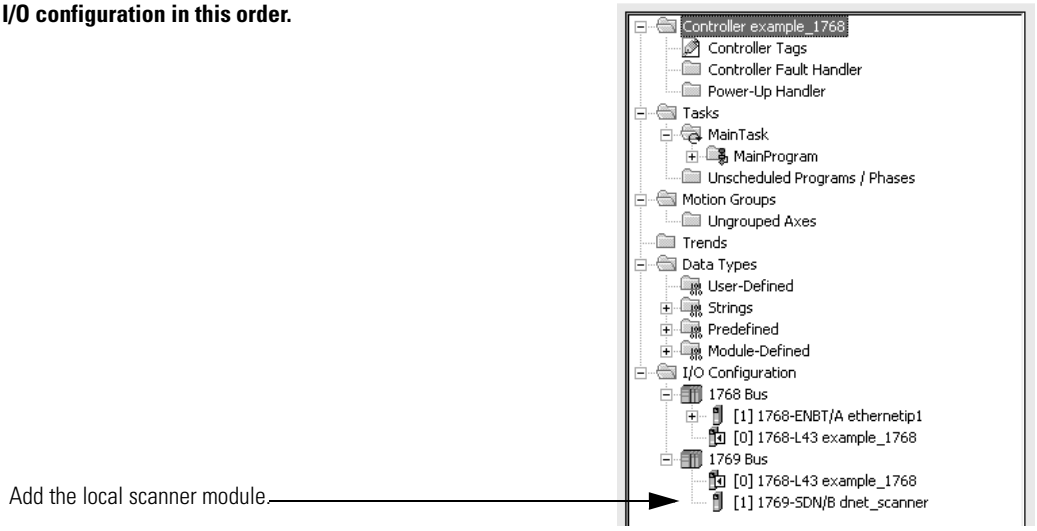
Single Network




Several Smaller Distributed Networks (subnets)




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




## Additional Resources

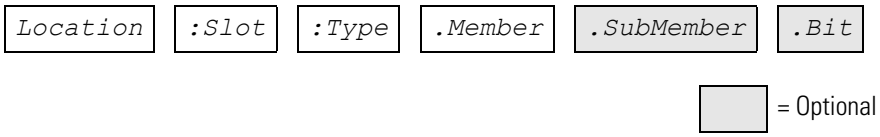
For additional information, consult DeviceNet Communication Modules in Logix5000 Control Systems User Manual, publication DNET-UM004.

## 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.



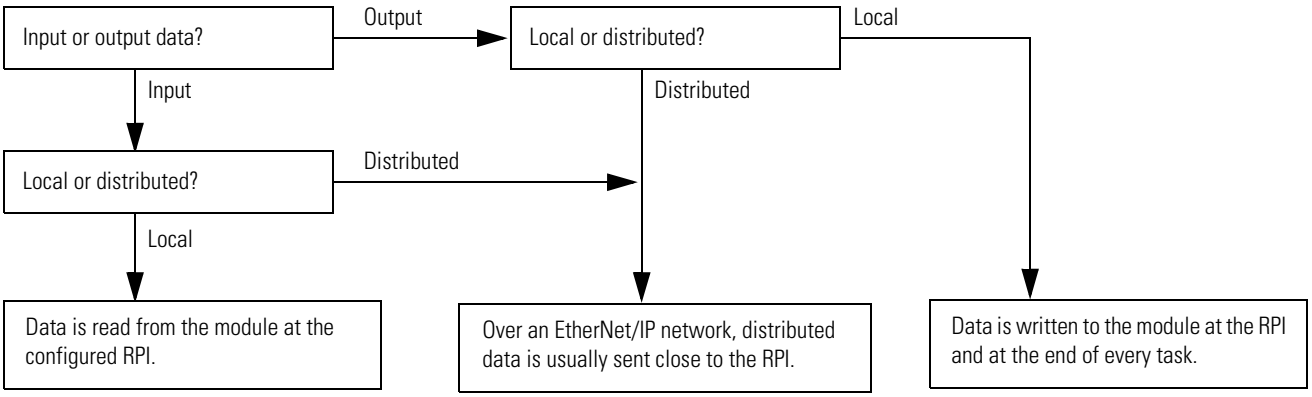

**I/O Address Components**

| Where | Is |
|---|---|
| Location | Network location<br>LOCAL = same chassis or DIN rail as the controller<br>*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<br>I = input<br>O = output<br>C = configuration<br>S = status |
| Member | Specific data from the I/O module, depending on what type of data the module can store<br>• For a digital module, a data member usually stores the input or output bit values<br>• 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.

**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.

The 1768 controller supports the CPS instruction with distributed I/O only. The 1768 controller does not support the CPS instruction for use with 1769 I/O.

### Additional Resources

For additional information, consult these publications:

- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
- Logix5000 Controllers General Instruction Set Reference Manual, publication 1756-RM003

## Monitor I/O Modules

To monitor I/O modules, you can:

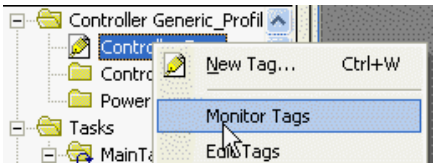
- use RSLogix 5000 programming software to display fault data.
- program logic to monitor fault data so you can take appropriate action.

## Display Fault Data

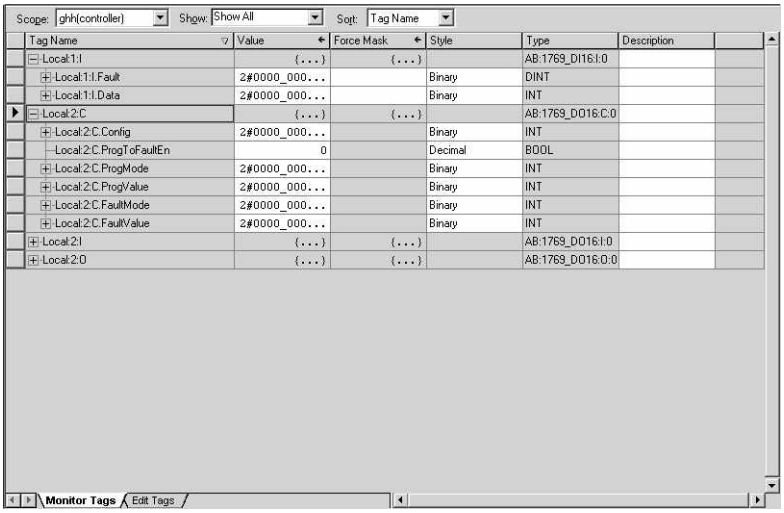
Fault data for certain types of module faults can be viewed through the programming software.

To display fault data, perform this procedure.

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



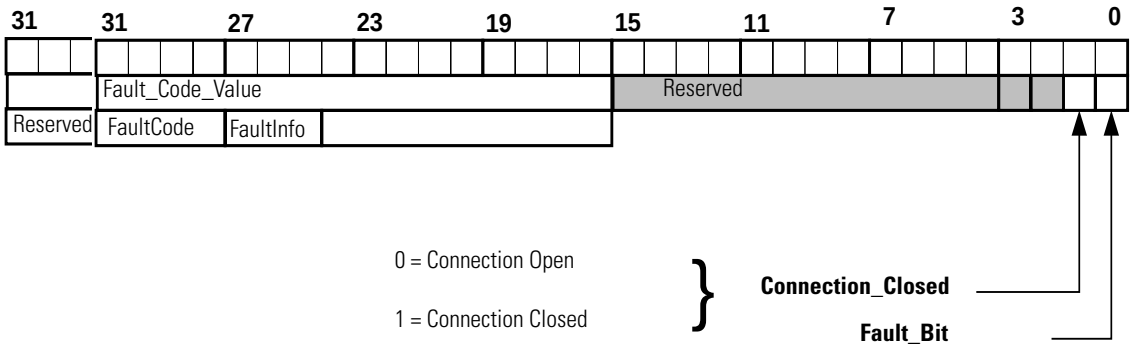

The Monitor Tags display appears.




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.



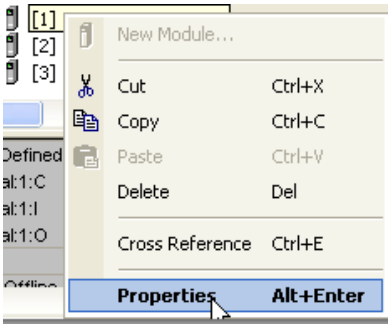

**Fault Word Bits**

| 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). |

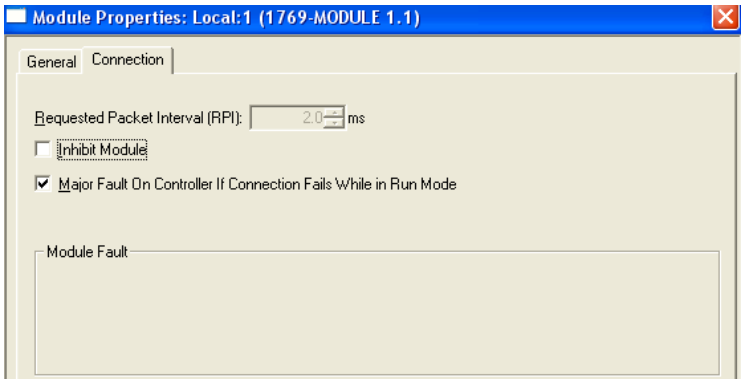
### *Display Fault Data via Module Properties Dialog*

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

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



The Module Properties dialog 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

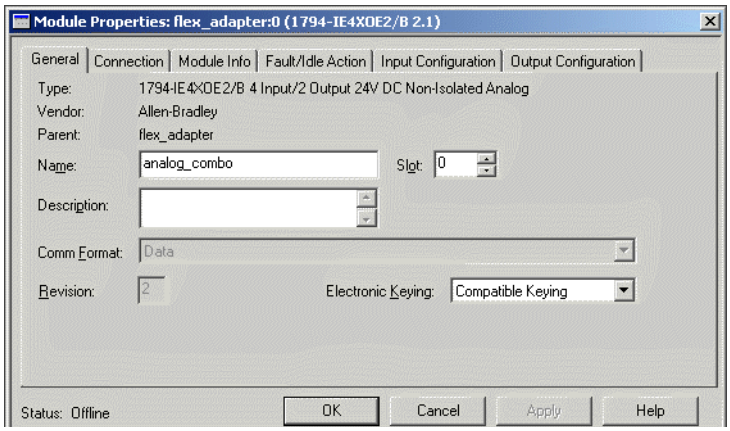
If an I/O module supports reconfiguration, you can reconfigure the module via:

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

### Reconfigure a Module via RSLogix 5000 Programming Software

To change the configuration of an I/O module via RSLogix 5000 programming software, right-click the module in the I/O Configuration tree and select Properties.

The Module Properties dialog appears.




## Reconfigure a Module via a MSG Instruction

Use a MSG instruction of type Module Reconfigure to send new configuration information to an I/O module. During the reconfiguration:

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

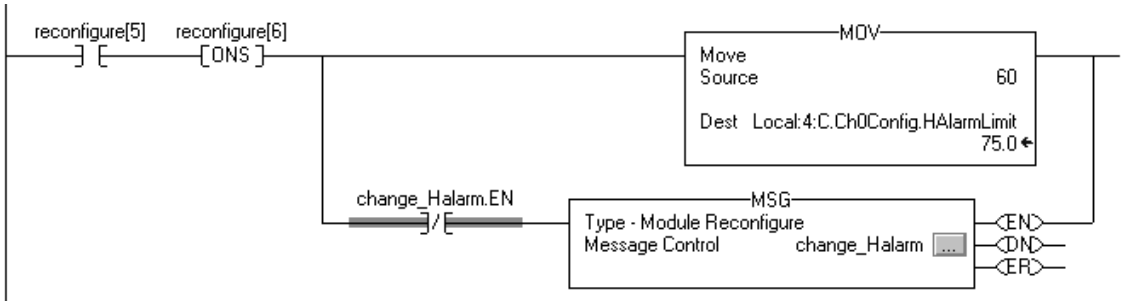
To reconfigure an I/O module, perform this procedure.

1. Set the required member of the configuration tag of the module to the new value.

2. Send a Module Reconfigure message to the module.

**EXAMPLE** Reconfigure an I/O module.

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



# Develop Applications

## Introduction

This chapter explains how to develop applications.



### Additional Resources

For additional general information, consult Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

## 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.

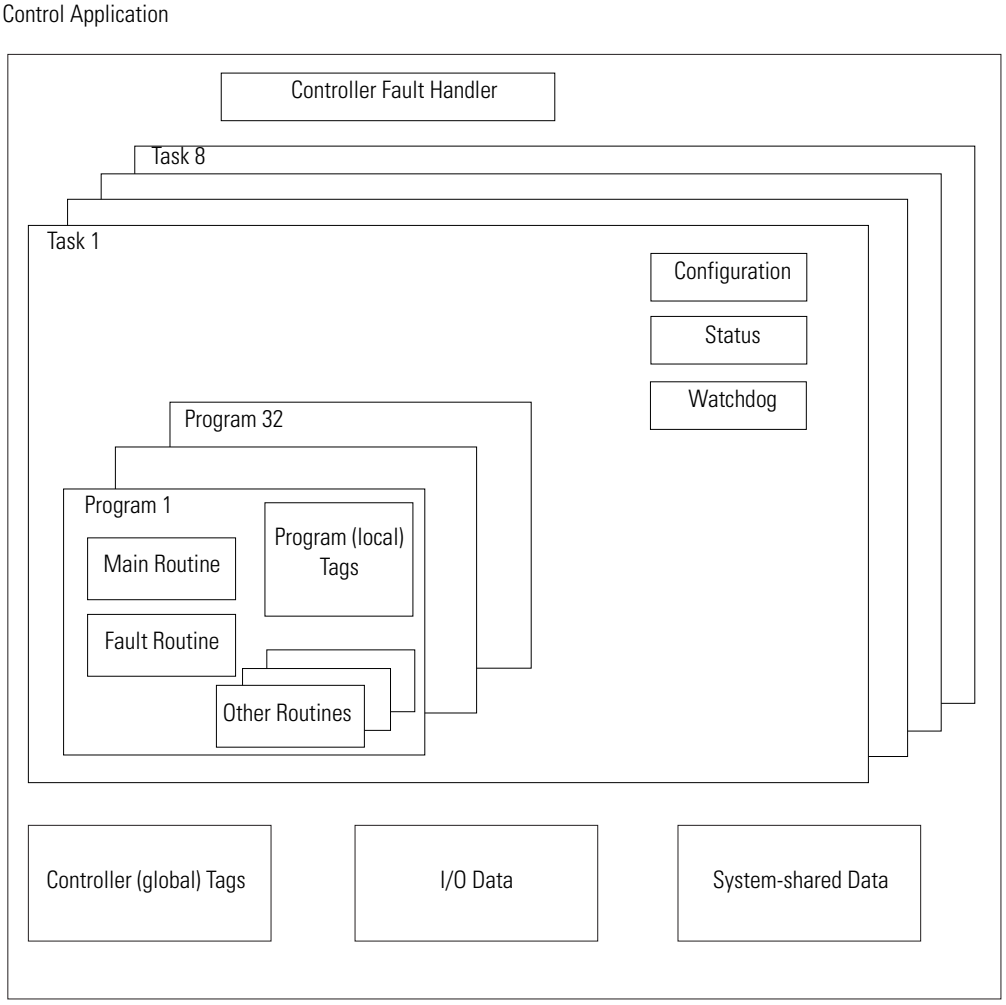
- The controller executes only one task at a time.
- One task can interrupt another executing and take control.
- In any given task, only one program executes at a time.

## Develop Programs

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

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

**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. Only one task can be continuous.

**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.<br>• The continuous task runs all of the time. When the continuous task completes a full scan, it restarts immediately.<br>• 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<br>• Multiple times within the scan of your other logic | Periodic | A periodic task performs a function at a specific interval.<br>• 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.<br>• You can configure the time period from 0.1...2000 μs. The default is 10 ms. It is also controller and configuration dependent.<br>• 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:<br>• a consumed tag trigger.<br>• an EVENT instruction.<br>• an axis trigger.<br>• a motion event trigger. |

The 1768-L43 controller supports 16 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. A higher-priority task will interrupt any lower-priority task. The continuous task has the lowest priority and is always interrupted by a periodic task.

The CompactLogix controller uses a dedicated periodic task at priority 6 to process I/O data. This periodic task executes at the RPI you configure for the CompactBus, which can be as fast as once every 1 ms. Its total execution time is as long as it takes to scan the configured I/O modules.

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

**Task Configuration**

| If you use this configuration | Then |
|---|---|
| I/O RPI = 1 ms | The dedicated I/O task 500 µs can scan the configured I/O. |
| A task of priority = 1...5 that requires 500 µs to execute and is scheduled to run every millisecond | |

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

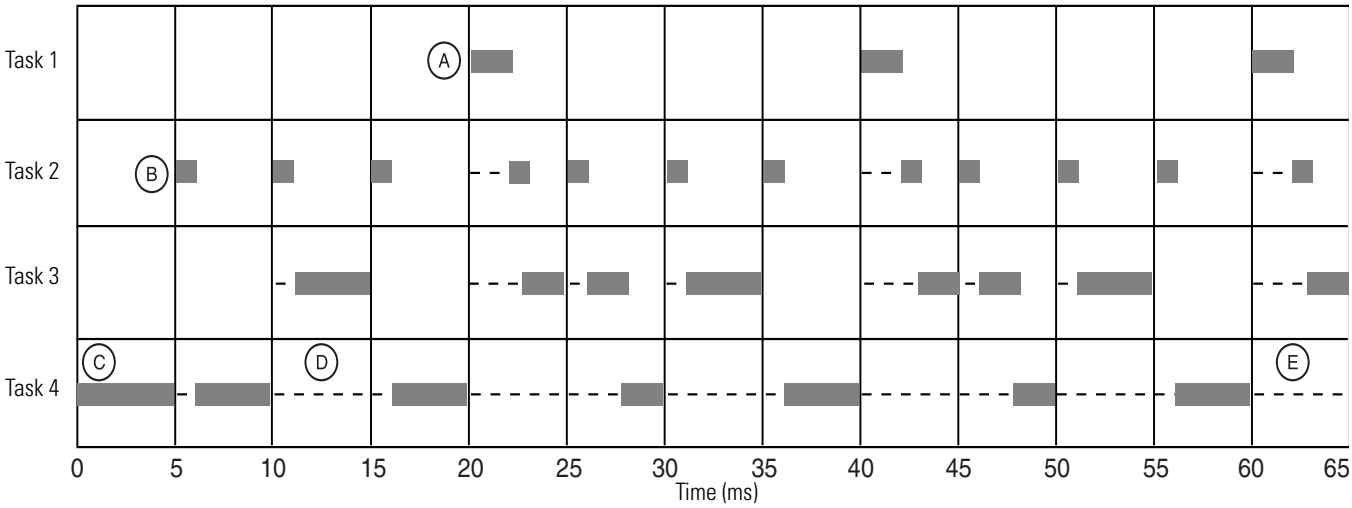
**EXAMPLE**

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

This example shows the task execution order for an application with periodic tasks and a continuous task.

**Task Execution Order**

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




**A.** The highest-priority task interrupts all lower priority tasks.

**B.** The dedicated I/O task can be interrupted by tasks with priority levels 1...5. The dedicated I/O task interrupts tasks with priority levels 7...15. This task runs at the selected RPI rate scheduled for the CompactLogix system (2 ms in this example).

**C.** The continuous task runs at the lowest priority and is interrupted by all other tasks.

**D.** A lower priority task can be interrupted multiple times by a higher priority task.

**E.** When the continuous task completes a full scan, it restarts immediately, unless a higher priority task is running.

## Define Programs

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

The scheduled programs within a task execute to completion from first to last. Programs 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.

## 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.

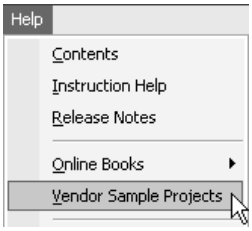
You can also specify an optional program fault routine. The controller executes this routine if it encounters an instruction-execution fault within any of the routines in the associated program.

## Sample Controller Projects

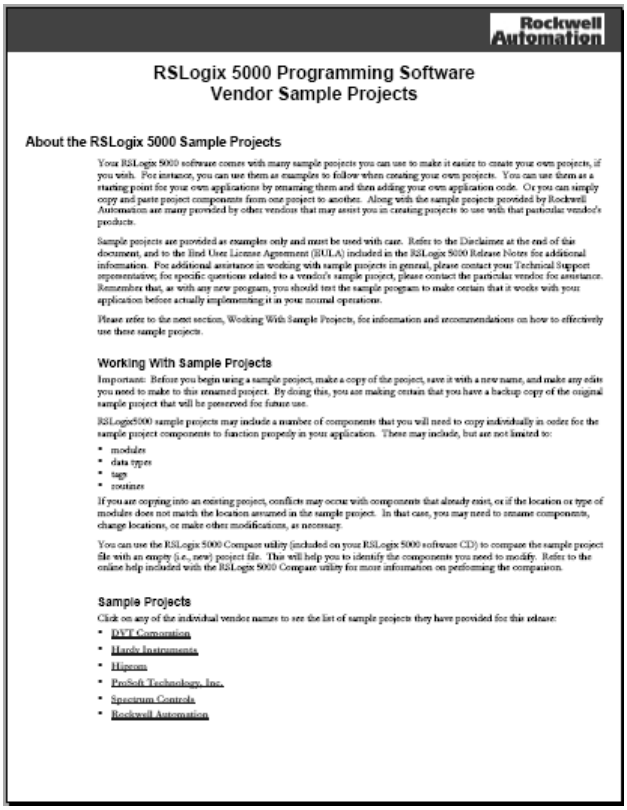
RSLogix 5000 programming software includes sample projects that you can copy and then modify to fit your application.

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

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




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




## Additional Resources

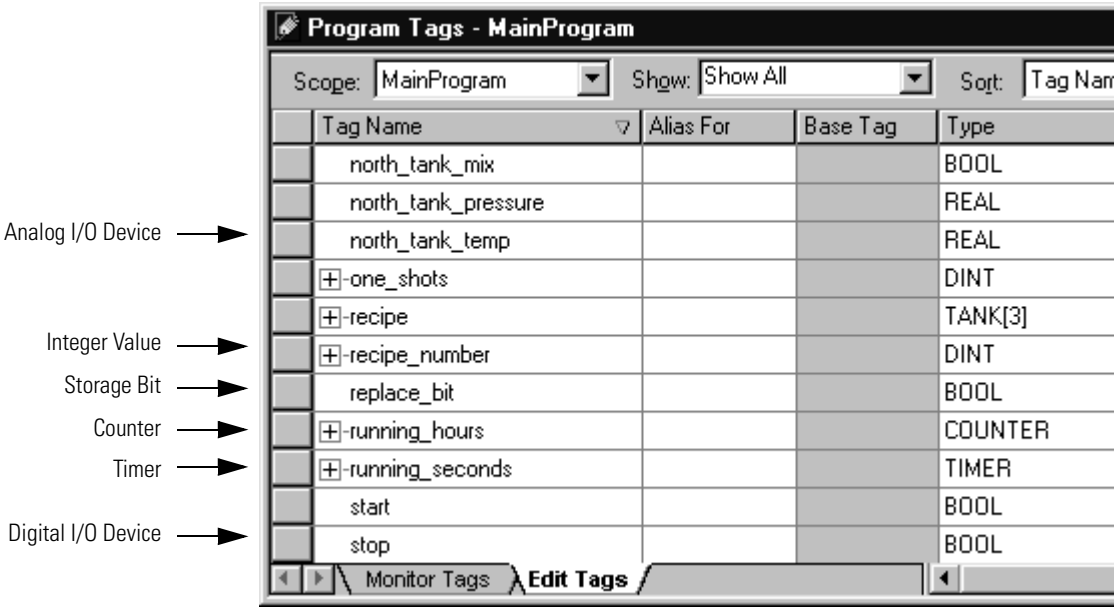
For more information, consult Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

## Organize Tags

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

- organize your data to mirror your machinery.
- document your application as you develop it.

**Tag Organization Overview**




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

- Tag type
- Data type
- Scope

### Additional Resources

For more information, consult Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

## Select a Programming Language

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

**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 version 16 of RSLogix 5000 programming software, you can design and configure sets of commonly used instructions to increase project consistency. Similar to the built-in instructions contained in Logix5000 controllers, these instructions you create are called Add-On Instructions. Add-On Instructions reuse common control algorithms. With them, you can:

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

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

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

### *Save Time*

With Add-On Instructions, you can combine your most commonly used logic into sets of reusable instructions. You save time when you create instructions for your projects and then share them with others. Add-On Instructions increase project consistency since commonly used algorithms all work in the same manner, regardless of who implements the project.

### *Use Standard Editors*

You create Add-On Instructions by using one of three RSLogix 5000 software programming editors.

- Standard Ladder
- Function Block Diagram
- Structured Text

Once you have created instructions, you can use them in any RSLogix 5000 editor.

### *Export Add-On Instructions*

You can export Add-On Instructions to other projects as well as copy and paste them from one project to another. Give each instruction a unique name so that you don't accidentally overwrite another instruction of the same name.

### *Use Context Views*

Context views let you visualize an instruction's logic for a specific instant, simplifying online troubleshooting of your Add-On Instructions. Each instruction contains a revision, a change history, and an auto-generated help page.

### *Create Custom Help*

When you create an instruction, you enter information for the description fields in software dialogs, information that becomes what is known as Custom Help. Custom Help makes it easier for users to get the help they need when implementing the instructions.

### *Apply Source Protection*

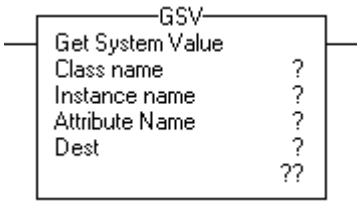
As the creator of Add-On Instructions, you can limit users of your instructions to read-only access, or you can bar access to the internal logic or local parameters used by the instructions. This source protection lets you prevent unwanted changes to your instructions and protects your intellectual property.

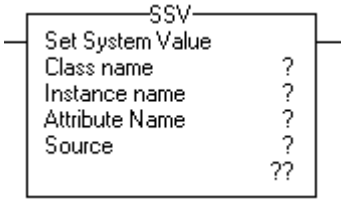
## Additional Resources

For more information, consult these publications:

- Logix5000 Controllers Common Procedures Manual, publication 1756-PM001
- Logix5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087

## Monitor Controller Status




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

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

When you enter a GSV/SSV instruction, the programming software displays the valid object classes, object names, and attribute names for each instruction. For the GSV instruction, you can get values for all of the available attributes. For the SSV instruction, the software displays only those 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

### Additional Resources

For more information, consult Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

## Monitor Connections

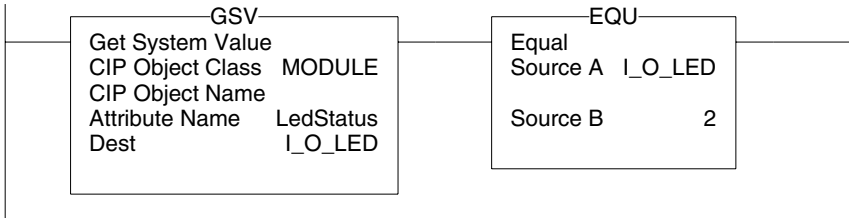
If communication with a device in the I/O configuration of the controller does not occur for 100 ms or 4 times the RPI, whichever is less, the communication times out and the controller produces these warnings.

- The I/O LED 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 via:
  - the Module Properties dialog.
  - a 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 LED indicator on the front of the controller flashes green.

- The GSV instruction gets the status of the I/O LED 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



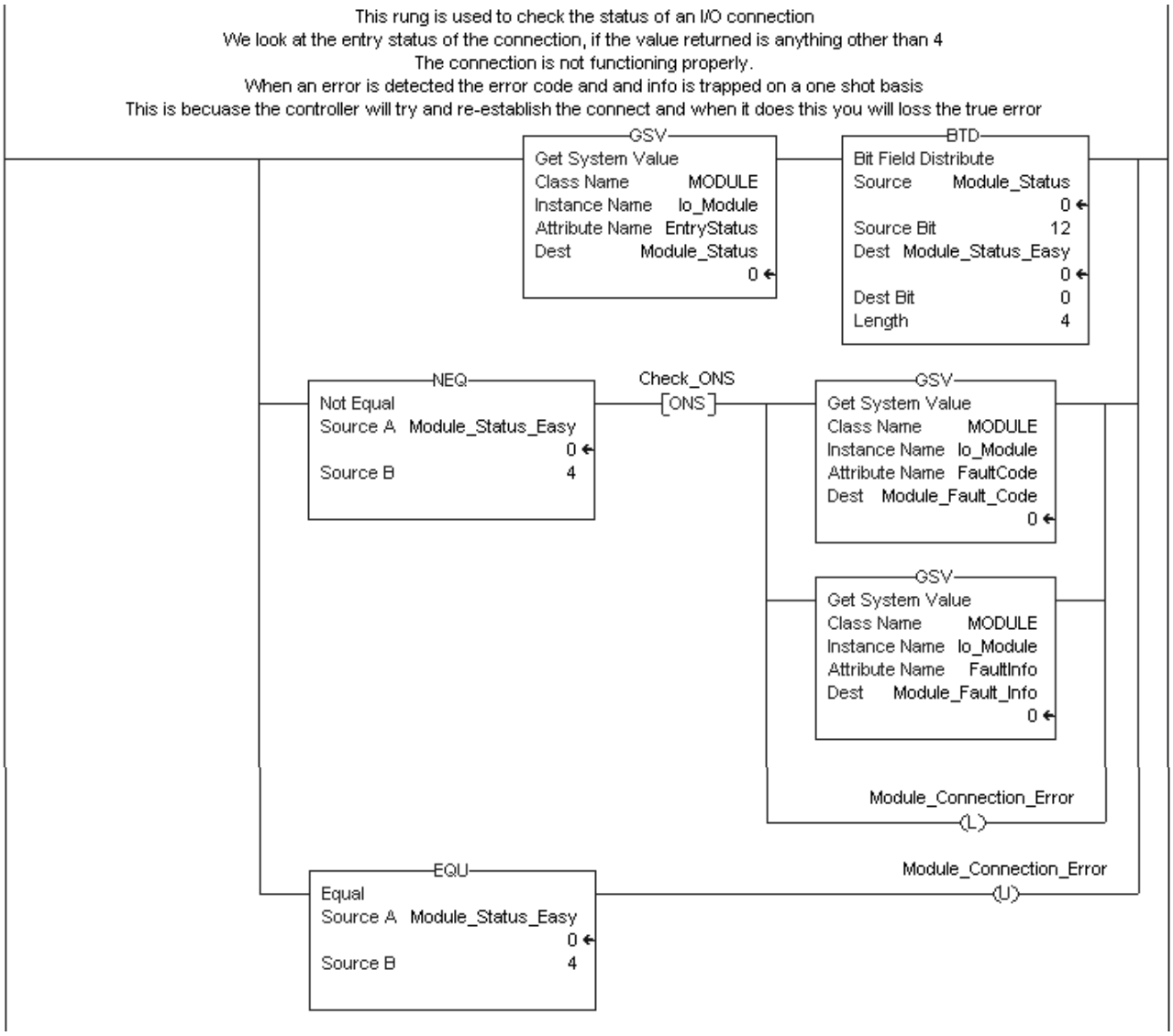

where:

I_O_LED is a DINT tag that stores the status of the I/O LED 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.

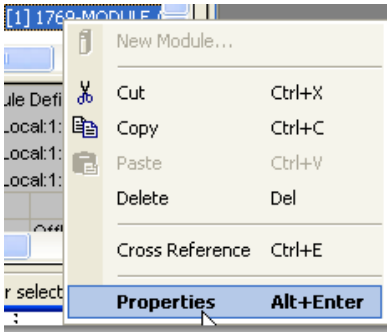
- The GSV instruction gets the fault code for Io_Module and stores it in the Module_Status tag.
- If Module_Status is any value other than 4, the controller is not communicating with the module.



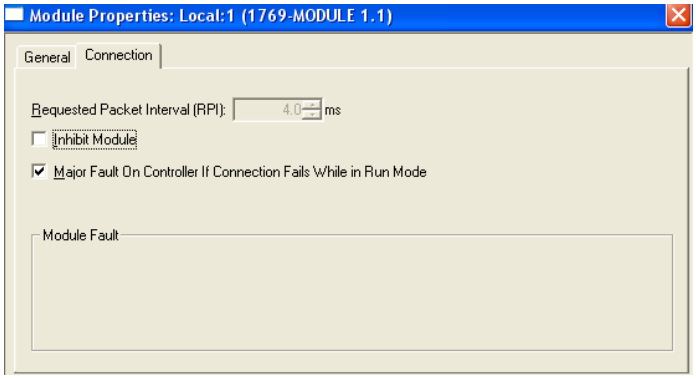
## Interrupt the Execution of Logic and Execute the Fault Handler

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

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




The Module Properties dialog appears.




2. Click the Connection tab.

3. Check the Major Fault On Controller If Connection Fails While in Run Mode check box.

4. Develop a routine for the Controller Fault Handler.

## Additional Resources

For more information, consult Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

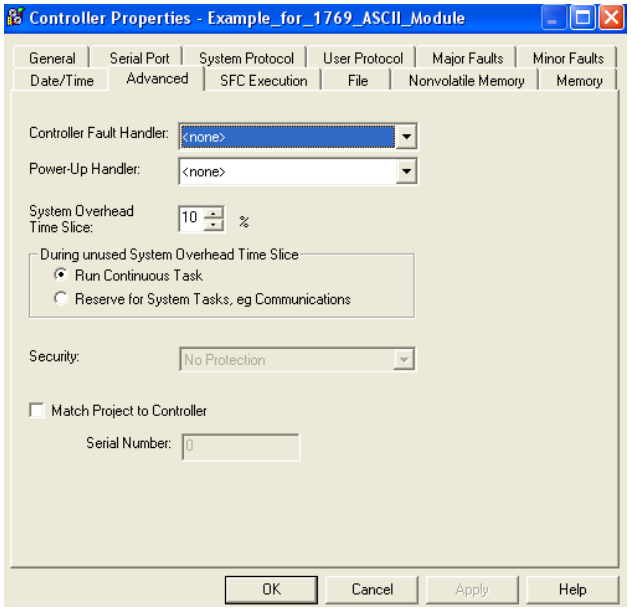
## Select a System Overhead Percentage

The Controller Properties dialog lets you specify a percentage for the system overhead, or time slice. The system overhead time slice specifies the percentage of controller time, excluding the time for periodic tasks, devoted to communication and background functions.

To select a system overhead percentage slice, perform this procedure.

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


The Controller Properties dialog appears.




2. Click the Advanced tab.

3. Specify system overhead settings.

System overhead functions include:

- communication with programming and HMI devices (such as RSLogix 5000 programming software).
- responding to messages.
- transmission of messages.

4. Click OK.

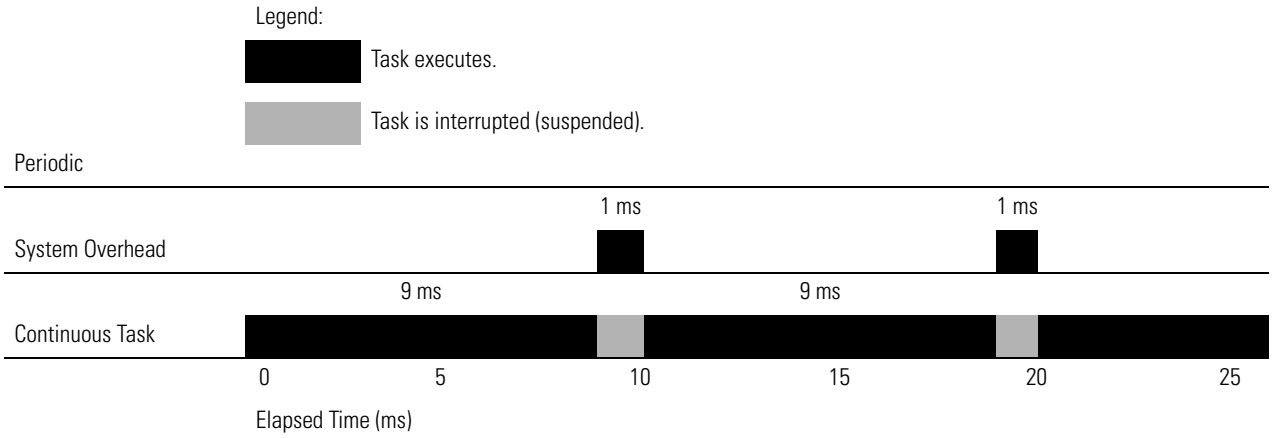
The controller performs system overhead functions for up to 1 ms at a time. If the controller completes the overhead functions in less than 1 ms, it resumes the continuous task.

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.

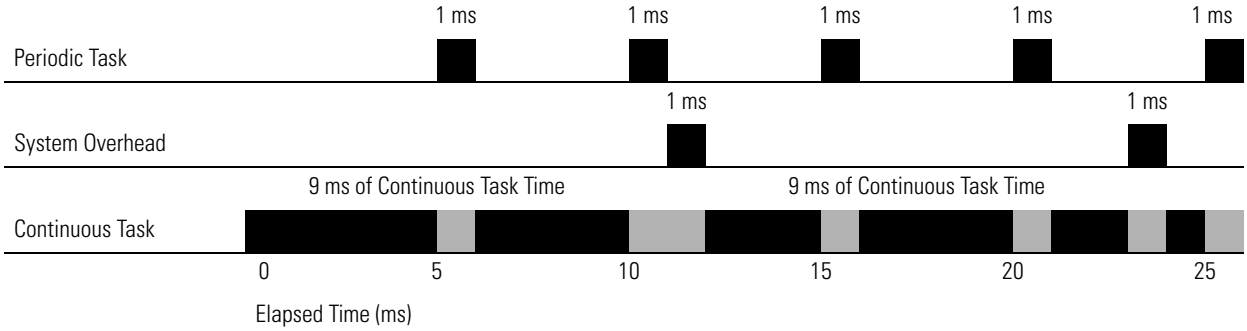
**Ratio between the Continuous Task and System Overhead Functions**

| Time Slice | Continuous Task Length | Max Overhead Function Time |
|---|---|---|
| 10% | 9 ms | 1 ms |
| 20% | 4 ms | 1 ms |
| 33% | 2 ms | 1 ms |
| 50% | 1 ms | 1 ms |

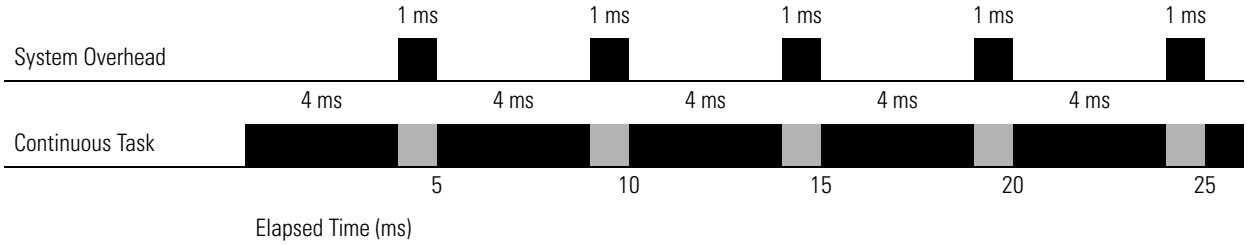
At a time slice of 10%, system overhead interrupts the continuous task every 9 ms (of continuous task time).



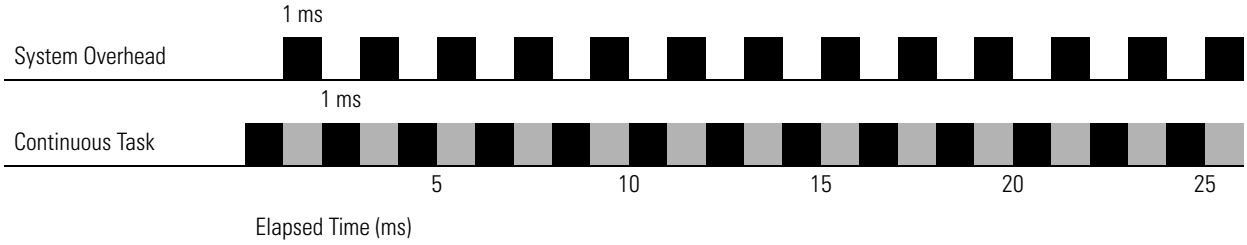
The interruption of a periodic task increases the elapsed time (clock time) between the execution of system overhead functions.



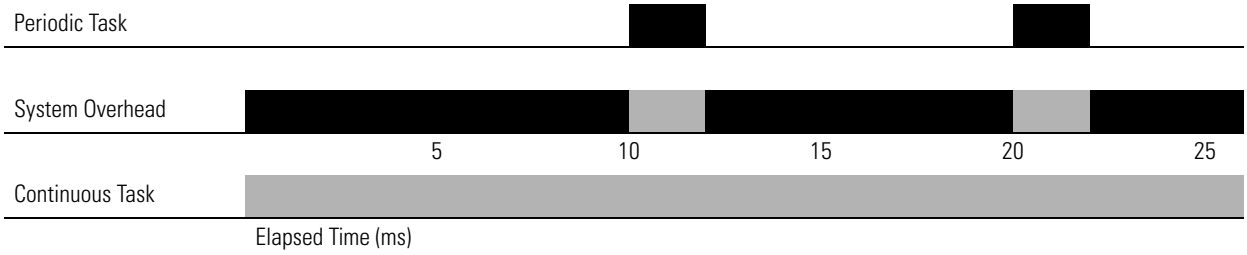

If you use the default time slice of 20%, the system overhead interrupts the continuous task every 4 ms.




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.



# Develop Motion Applications

## Introduction

This chapter explains how to develop motion control applications.



### Additional Resources

For additional information, consult these publications:

- Motion Modules in Logix5000 Control Systems User Manual, publication LOGIX-UM002
- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
- Logix5000 Controllers Motion Instructions Reference Manual, publication 1756-RM007
- Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003

## Motion Performance

The 1768 CompactLogix controller supports two 1768-M04SE SERCOS interface modules per 1768 backplane. Each SERCOS module supports:

- up to four Kinetix drives and motors.
- up to two feedback axes.
- up to six virtual axes.

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

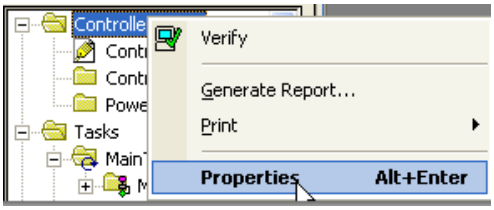
## Make the Controller the Master Clock

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.

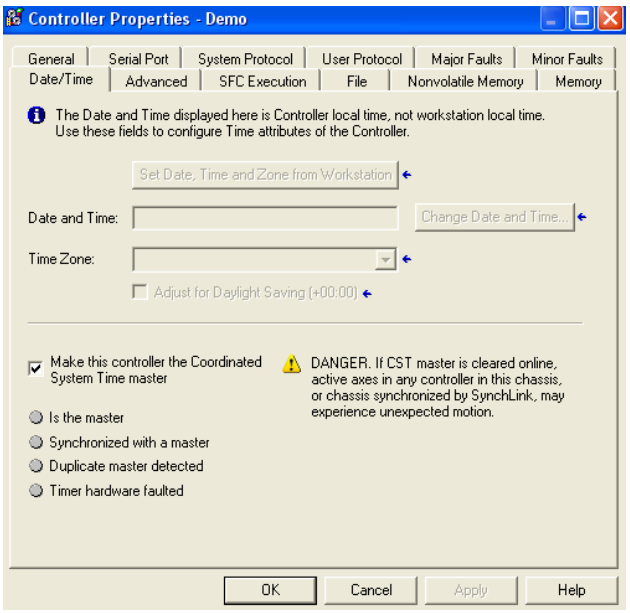
In most cases, make the controller the CST master.

To make the controller the master clock for a motion control application, perform this procedure.

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




The Controller Properties dialog appears.




2. Click the Date/Time tab.

3. Check the Make This Controller the Coordinated System Time Master check box.

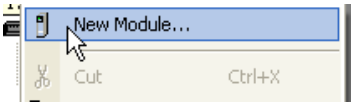
4. Click OK.

## Add the Motion Modules

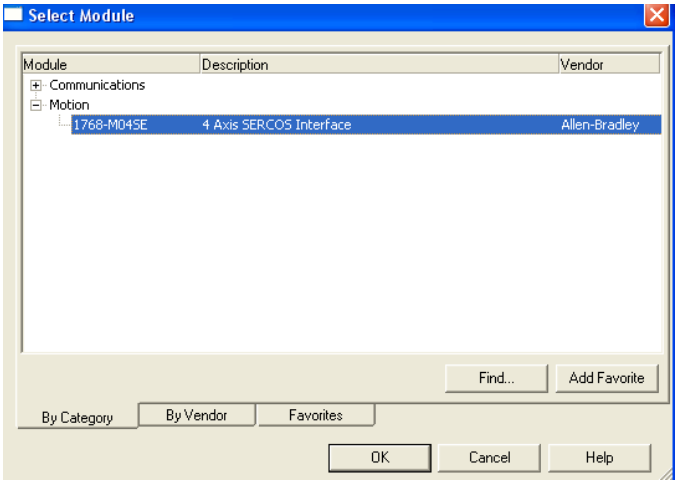
**IMPORTANT** For your motion modules, use the firmware revision that goes with the firmware revision of your controller. See the release notes for your controller's firmware revision.

To add motion modules, perform this procedure.

1. In the I/O configuration tree in RSLogix 5000 programming software, right-click your module and select New Module.

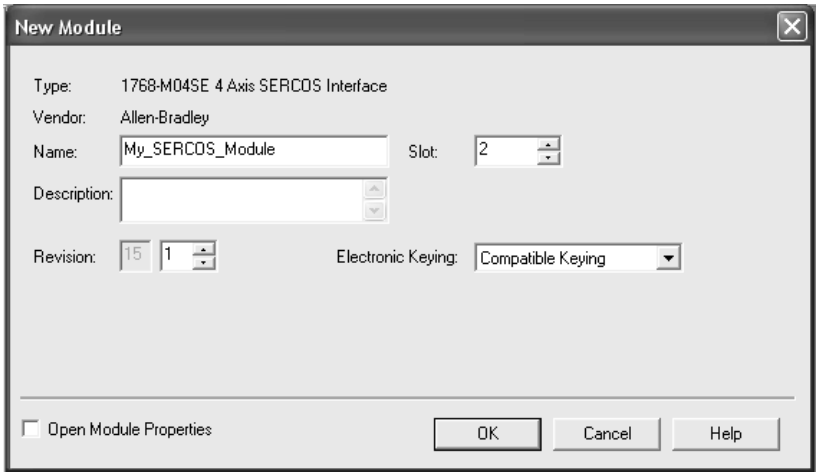



The Select Module dialog appears.




2. Double-click Motion.
3. Select the 1768-M04SE interface.
4. Click OK.

The New Module dialog appears.



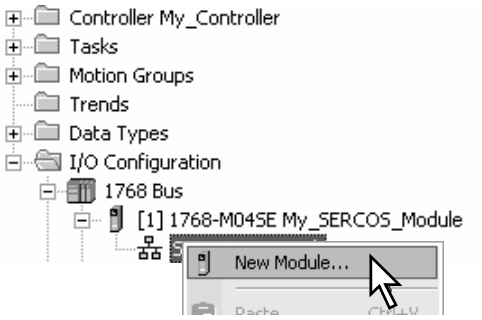

5. In the Slot box, enter the slot the new module will occupy.
6. Leave Open Module Properties unchecked.
7. Click OK.

## Add SERCOS interface Modules

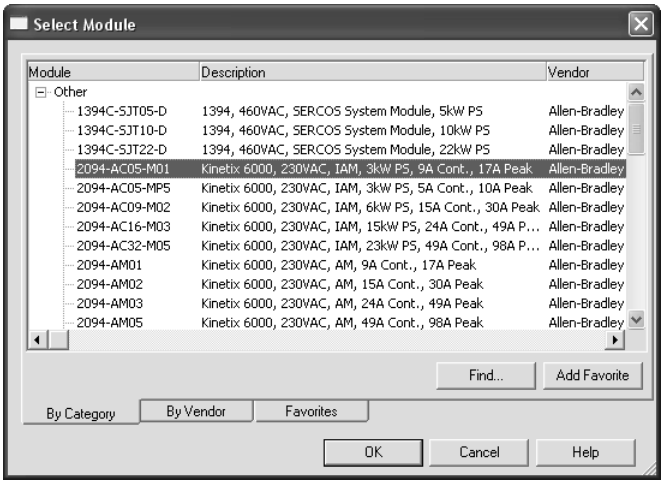
With the addition of SERCOS interface modules to a controller's I/O configuration, you can use RSLogix 5000 programming software to set up the modules.

To add SERCOS interface modules, perform this procedure.

1. In the I/O configuration tree in RSLogix 5000 programming software, right-click your module and select New Module.

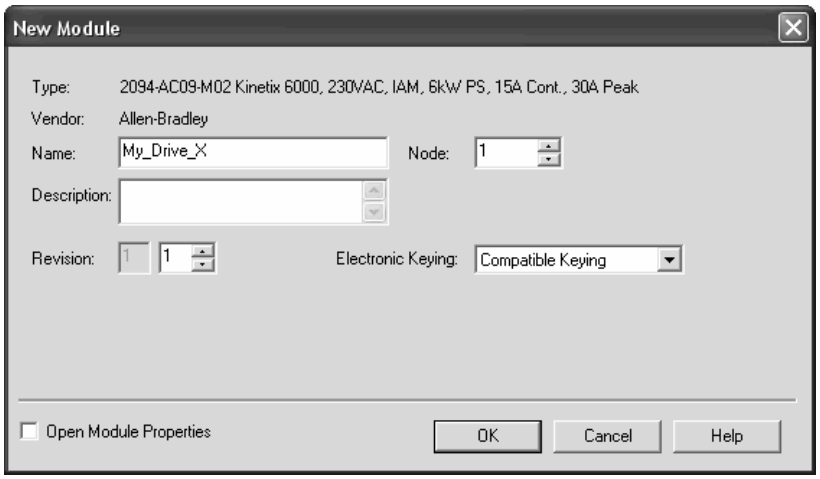


The Select Module dialog appears.




2. Double-click By Category.
3. Double-click Other.
4. Select a module.
5. Click OK.

The New Module dialog appears.

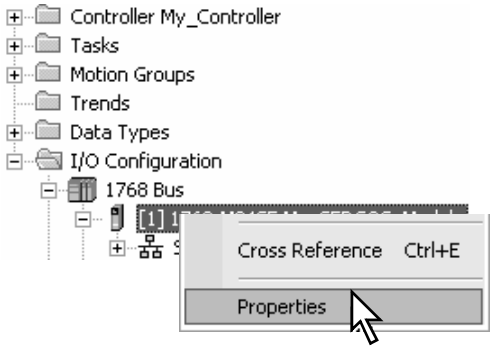



6. In the Name box, enter a module name.
7. In the Node box, enter the node number of the drive on the SERCOS ring.
8. Leave Open Module Properties unchecked.
9. Click OK.

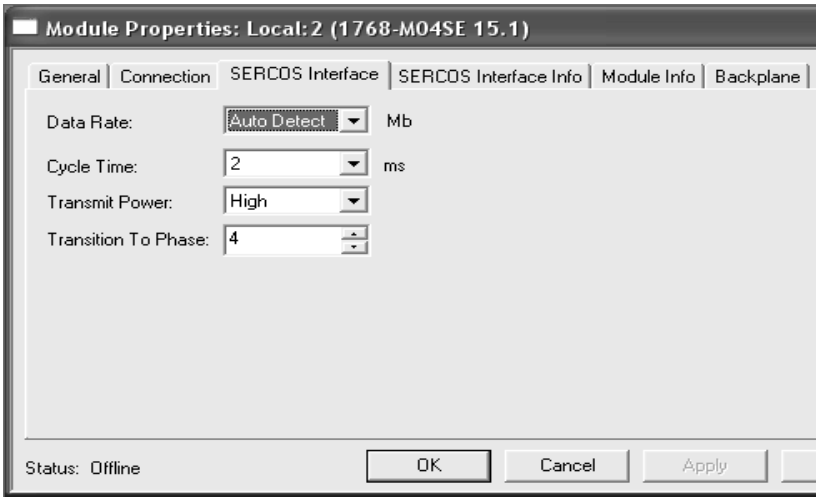
## Set Up Each SERCOS interface Module

To set the data rate and cycle time for each SERCOS interface module in your project, perform this procedure.

1. In the I/O configuration tree in RSLogix 5000 programming software, right-click your module and select Properties.




The Module Properties dialog appears.




2. Click the SERCOS interface tab.

3. From the Data Rate pull-down menu, choose Auto Detect.

4. From the Cycle Time pull-down menu, choose the cycle time.

| Baud Rate of Drives | Number of Drives on Ring | Type of Drive | Cycle Time |
|---|---|---|---|
| 4 MB | 1...2 | Kinetix 2000 or 6000 | 0.5 ms |
| | 3...4 | → | 1 ms |
| 8 MB | 1…4 | Kinetix 2000 or 6000 | 0.5 ms |

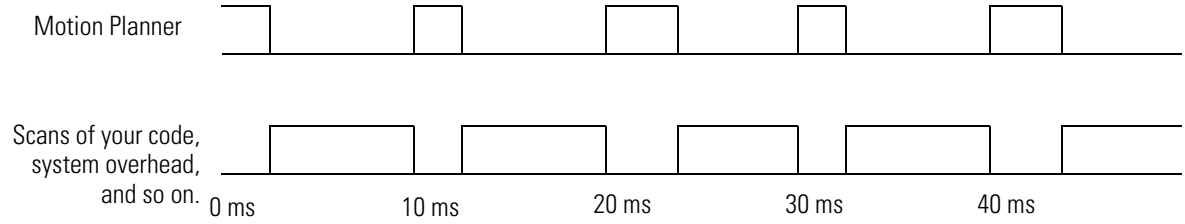
5. Click OK.

## Add the Motion Group

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

**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.

**IMPORTANT** Add only one motion group for the project. RSLogix 5000 programming software doesn't let you add more than one motion group.

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.

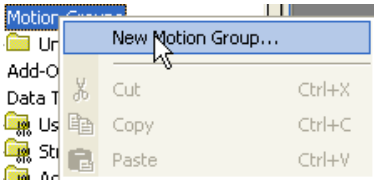
a. Set the coarse update period to 10 ms.

b. Leave at least half the controller's time for the scanning of all your code.

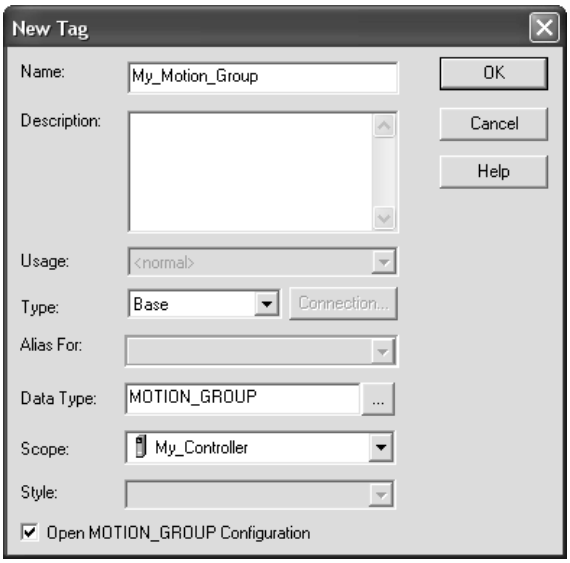
c. Set the coarse update period to a multiple of the cycle time of the motion module.

**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 RSLogix 5000 programming software, right-click Motion Groups and select New Motion Group.



The New Tag dialog appears.

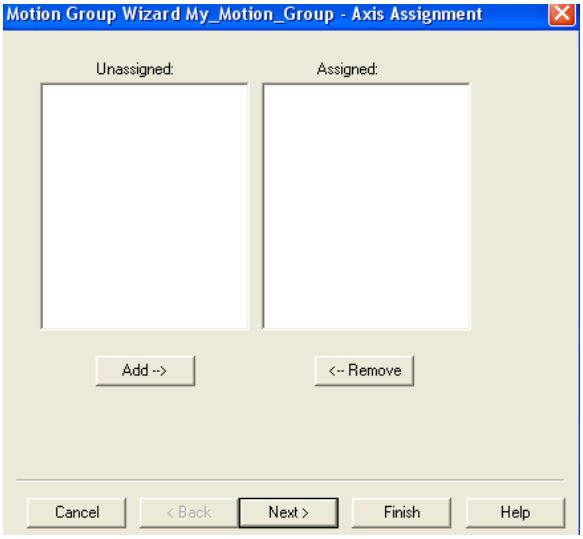



3. In the Name box, enter the tag name.

4. From the Data Type pull-down menu, choose MOTION_GROUP.

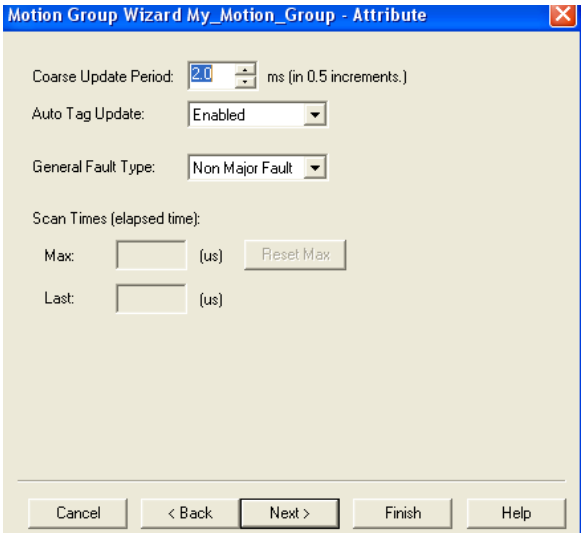
5. Click OK.

The Motion Group Wizard dialog appears.




6. Click Next.

The Motion Group Wizard Attributes dialog appears.




7. In the Coarse Update Period box, enter the intervals at which you want to run your motion planner.

8. Click Finish.

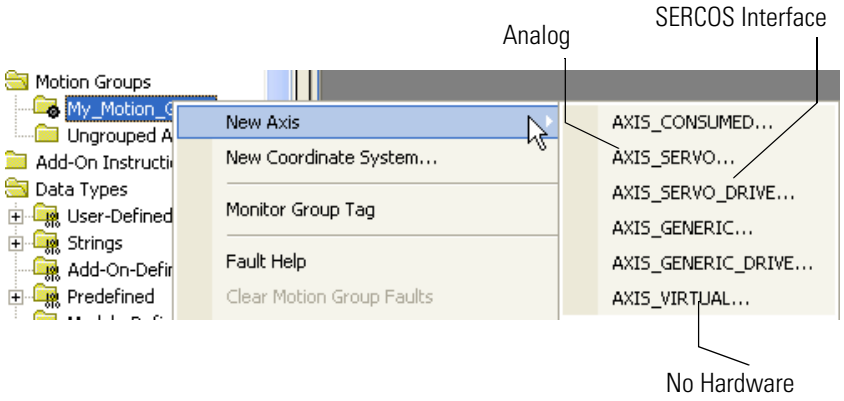
## Add Your Axes

To add an axis for each of your drives, perform this procedure.

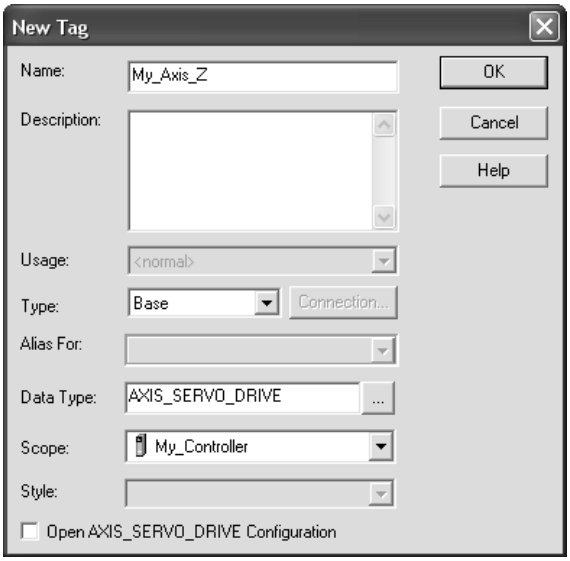
1. Decide which data type to use.

| Motion Module | Data Type |
|---|---|
| 1768-M04SE | AXIS_SERVO_DRIVE |
| No hardware | AXIS_VIRTUAL |

2. In Motion Groups within RSLogix 5000 programming software, right-click My Motion Group and select New Axis and then the type of axis you want to add.




The New Tag dialog appears.




3. In the Name box, enter the name of your new axis.

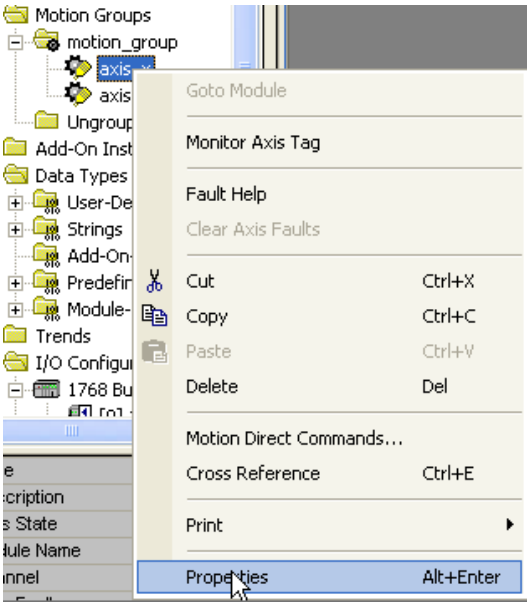
4. Leave Open AXIS_SERVO_DRIVE Configuration unchecked.

5. Click OK.

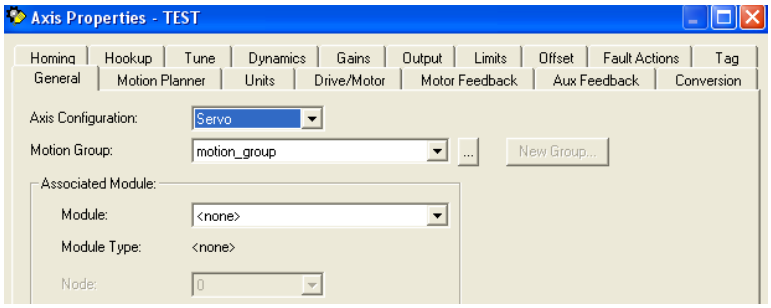
## Set Up Each Axis

To set up the axis of a SERCOS interface drive, perform this procedure.

1. In Motion Groups within RSLogix 5000 programming software, click Motion_Group, and then right-click an axis and select Properties.

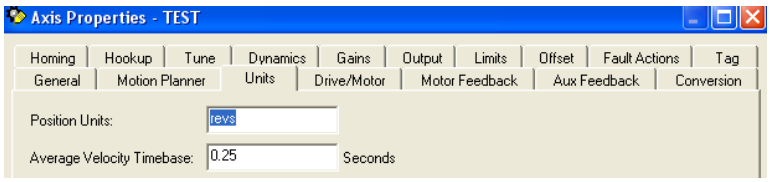



The Axis Properties Dialog appears.



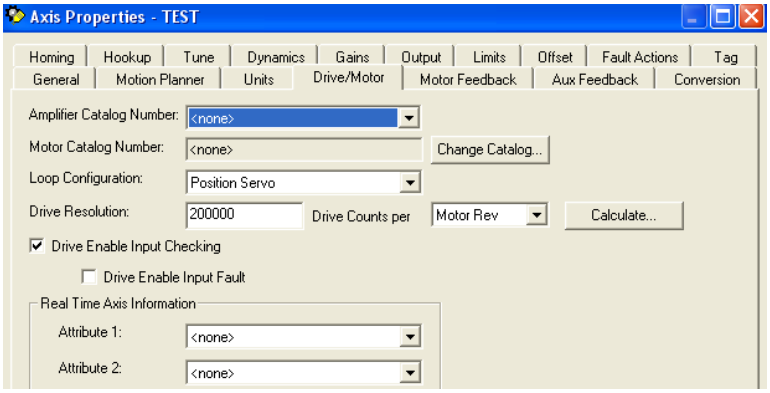

2. From the Module pull-down menu, choose the name that you gave to the drive for this axis.

3. Click the Units tab.




4. In the Position Units box, enter the units of measure, such as revolutions (revs), degrees, inches, or millimeters.

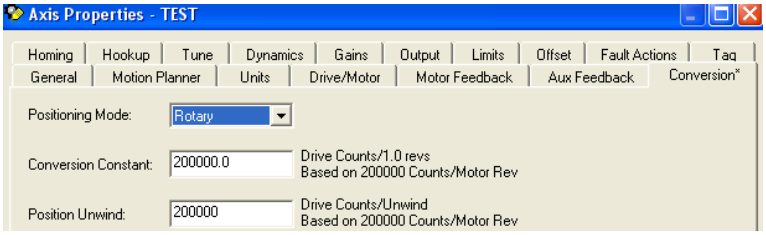
5. Click the Drive/Motor tab.




6. From the Amplifier Catalog Number pull-down menu, choose the catalog number of your drive.

7. To select your motor's catalog number, click Change Catalog.

8. Click the Conversion tab.

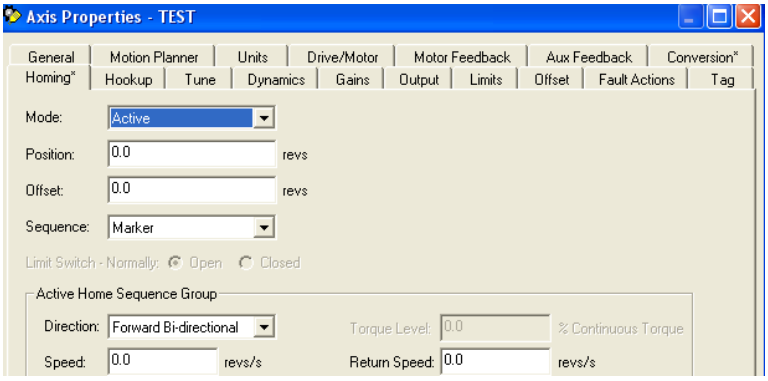



9. From the Positioning Mode pull-down menu, choose between the axis as either rotary or linear.

10. In the Conversion Constant box, specify the number of drive counts per rotary or linear revolution.

11. For a rotary axis only, in the Position Unwind box, enter the number of feedback counts needed to automatically unwind the axis.

**12.** Click the Homing tab.




**13.** From the Sequence pull-down menu, choose one of these types of homing sequences:

- Immediate
- Switch
- Marker
- Switch-Marker

**14.** Within Active Home Sequence Group, in the Speed and Return Speed boxes, enter the homing speeds.

**15.** Click OK.

## Check the Wiring of Each Drive

Use these tests to check a drive's wiring.

| Test | Function | Notes |
|---|---|---|
| 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. | |

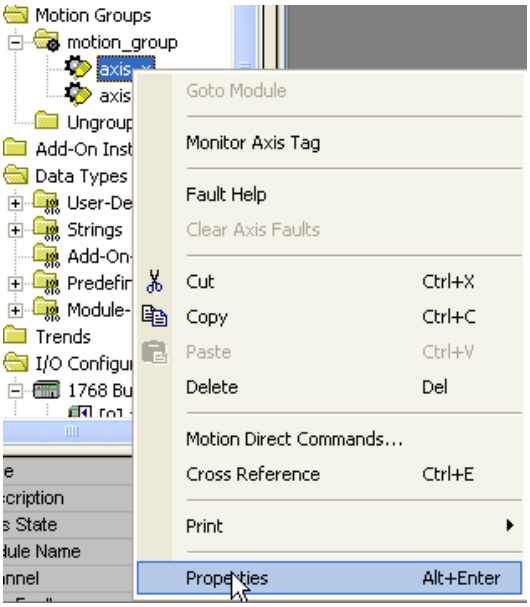
**ATTENTION**

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

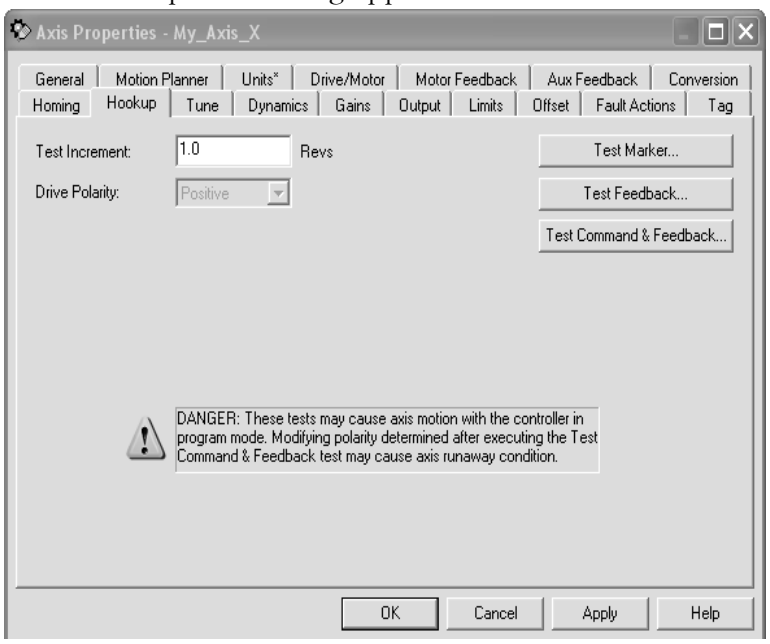
- Before you do the tests, make sure no one is in the path of the axis.
- Do not change the polarity after you do the tests, or you may cause an axis-runaway condition.

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

1. In Motion Groups within RSLogix 5000 programming software, click Motion_Group, and then right-click an axis and select Properties.



The Axis Properties Dialog appears.




2. Click the Hookup tab.

3. In the Test Increment box, specify how many revolutions you want the axis to turn during each test.

4. Click Test Marker to check the channels for proper connection and phasing.

5. Click Test Feedback to test the polarity of the feedback.

6. Click Test Command & Feedback to test the drive's polarity.

7. Click OK.

## Tune Each Axis

You need to tune each axis.

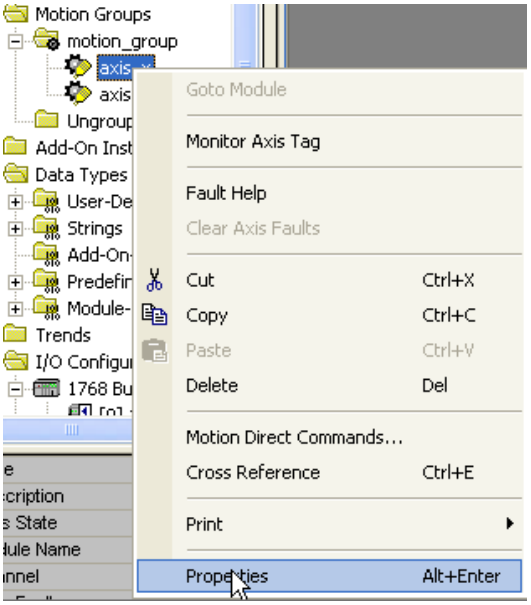
**ATTENTION**

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.

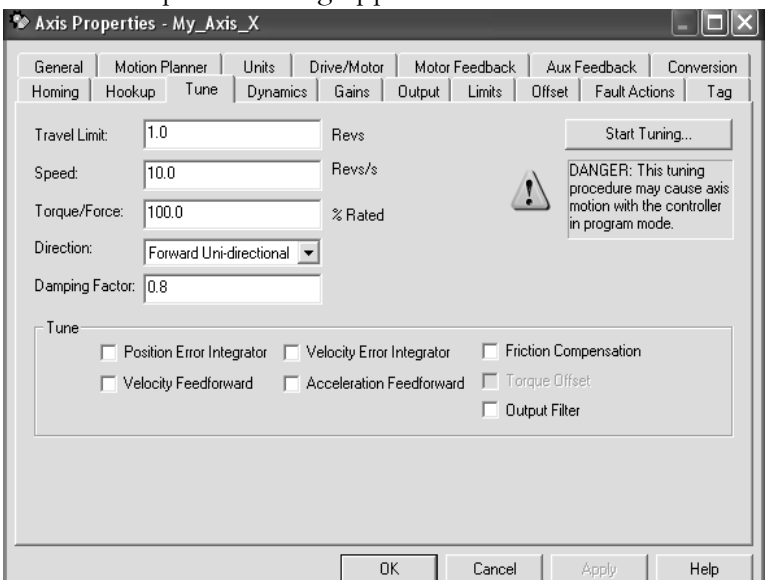
Before you tune an axis, make sure no one is in its path.

To tune each axis, perform this procedure.

1. In Motion Groups within RSLogix 5000 programming software, click Motion_Group, and then right-click an axis and select Properties.




The Axis Properties dialog appears.



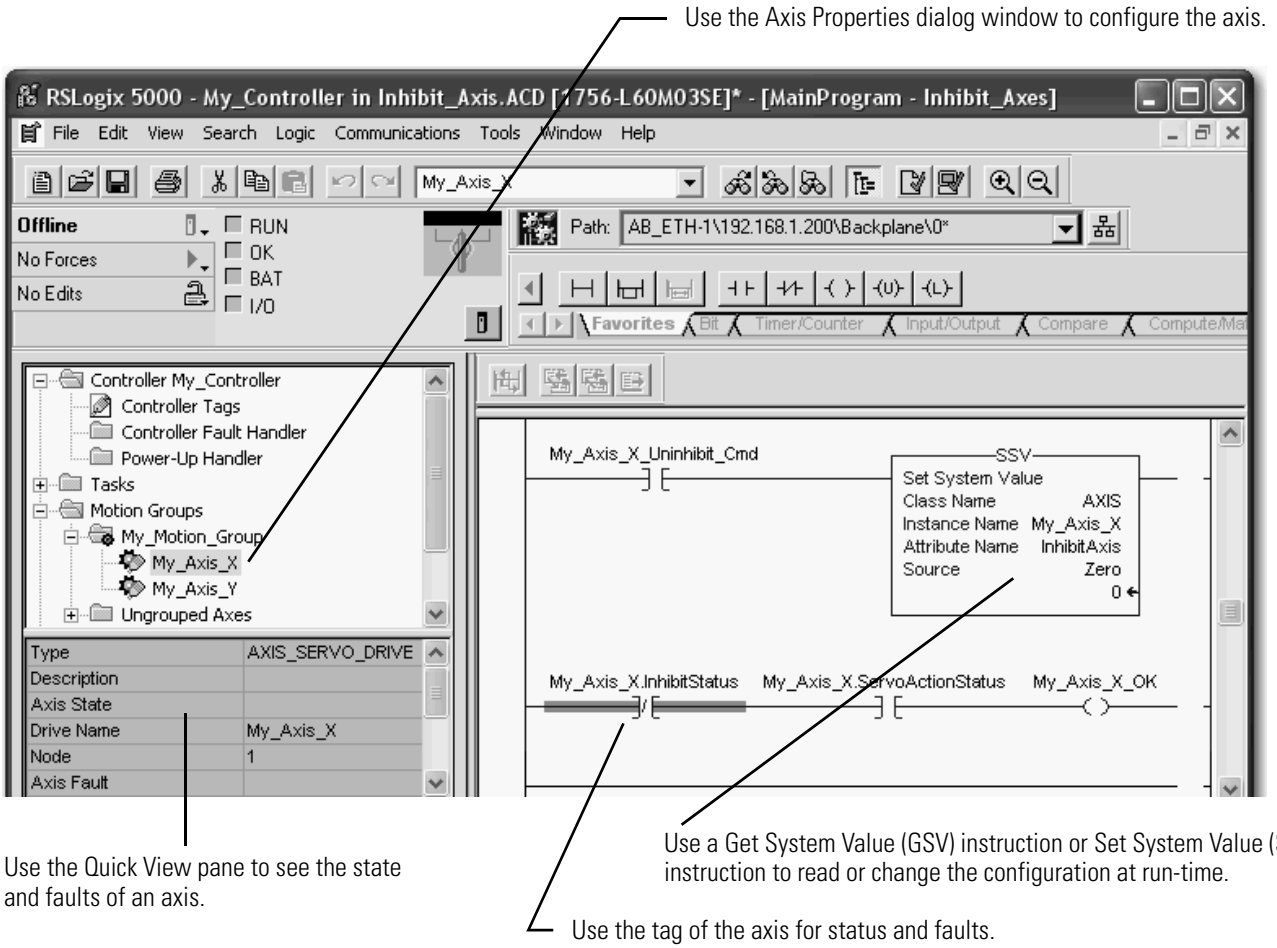
2. Click the Tune tab.
3. In the Travel Limit box, enter the number of revolutions to which you want to limit your axis during its tuning.
4. In the Speed box, enter the number of revolutions per second to which you want to limit your axis during its tuning.
5. Click Start Tuning.
6. Click OK.

## 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.

**Obtaining Axis Information**



## Program Motion Control

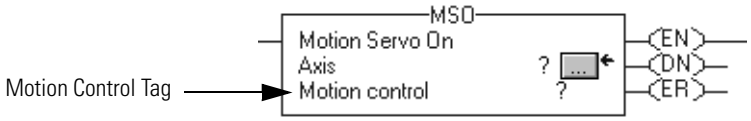
The controller gives you a set of motion control instructions for your axes and:

- 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.

**Motion Control Instruction**




**ATTENTION**

Use the tag for the motion control operand of motion instruction only once. Unintended operation of the control variables may happen if you reuse of the same motion control tag in other instructions.

*Example*

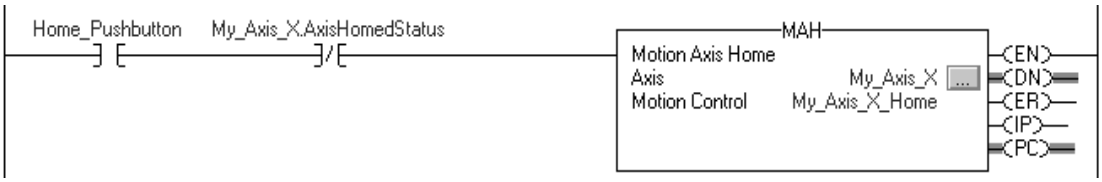
Here's an example of a simple ladder diagram that homes, jogs, and moves an axis.

If Initialize_Pushbutton = on and the axis = off (My_Axis_X.ServoActionStatus = off) then

The MSO instruction turns on the axis.

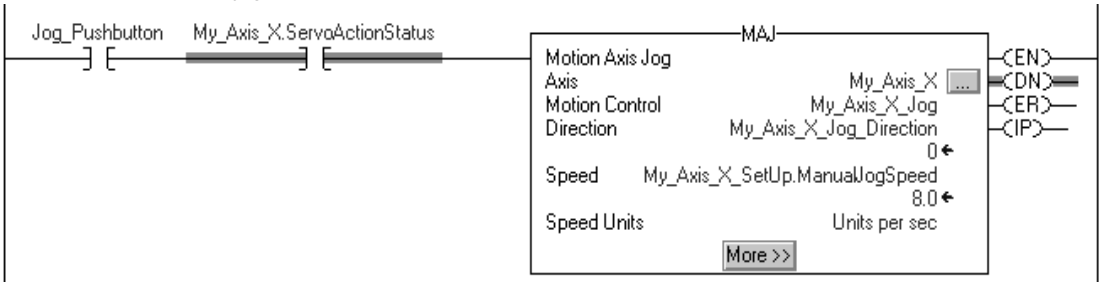

If Home_Pushbutton = on and the axis hasn't been homed (My_Axis_X.AxisHomedStatus = off) then

The MAH instruction homes the axis.



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

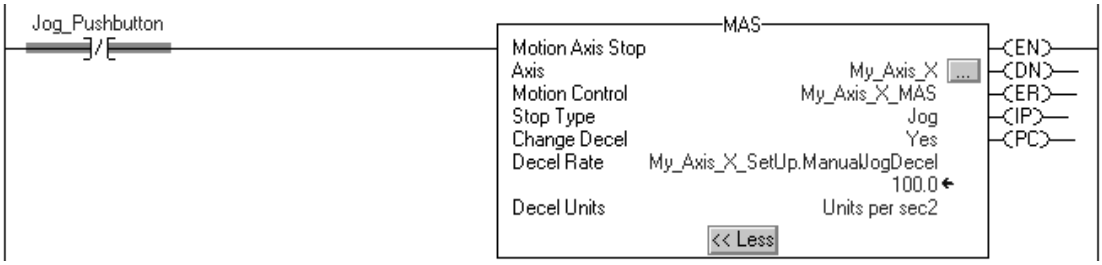
The MAJ instruction jogs the axis forward at 8 units/second.




If Jog_Pushbutton = off then

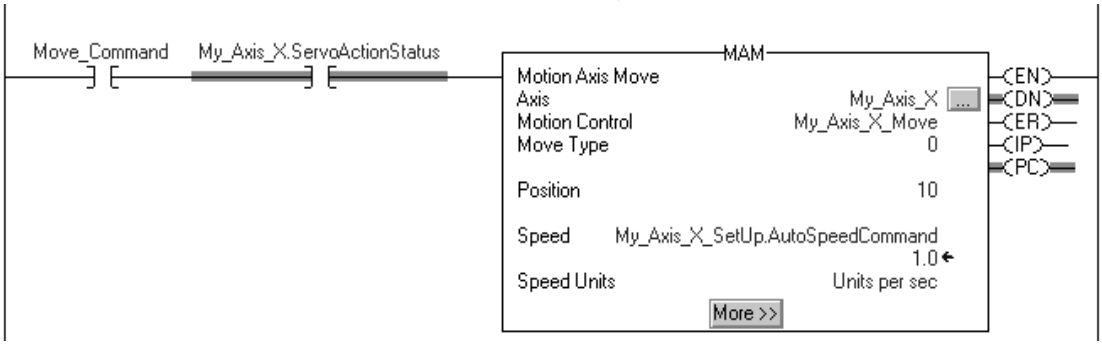
The MAS instruction stops the axis at 100 units/second$^2$

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.



## Notes:

# Configure PhaseManager

## Introduction

This chapter explains how to configure PhaseManager.

Within RSLogix 5000 programming software, PhaseManager provides a state model for your equipment.



### Additional Resources

For more information consult, PhaseManager User Manual, publication LOGIX-UM001.

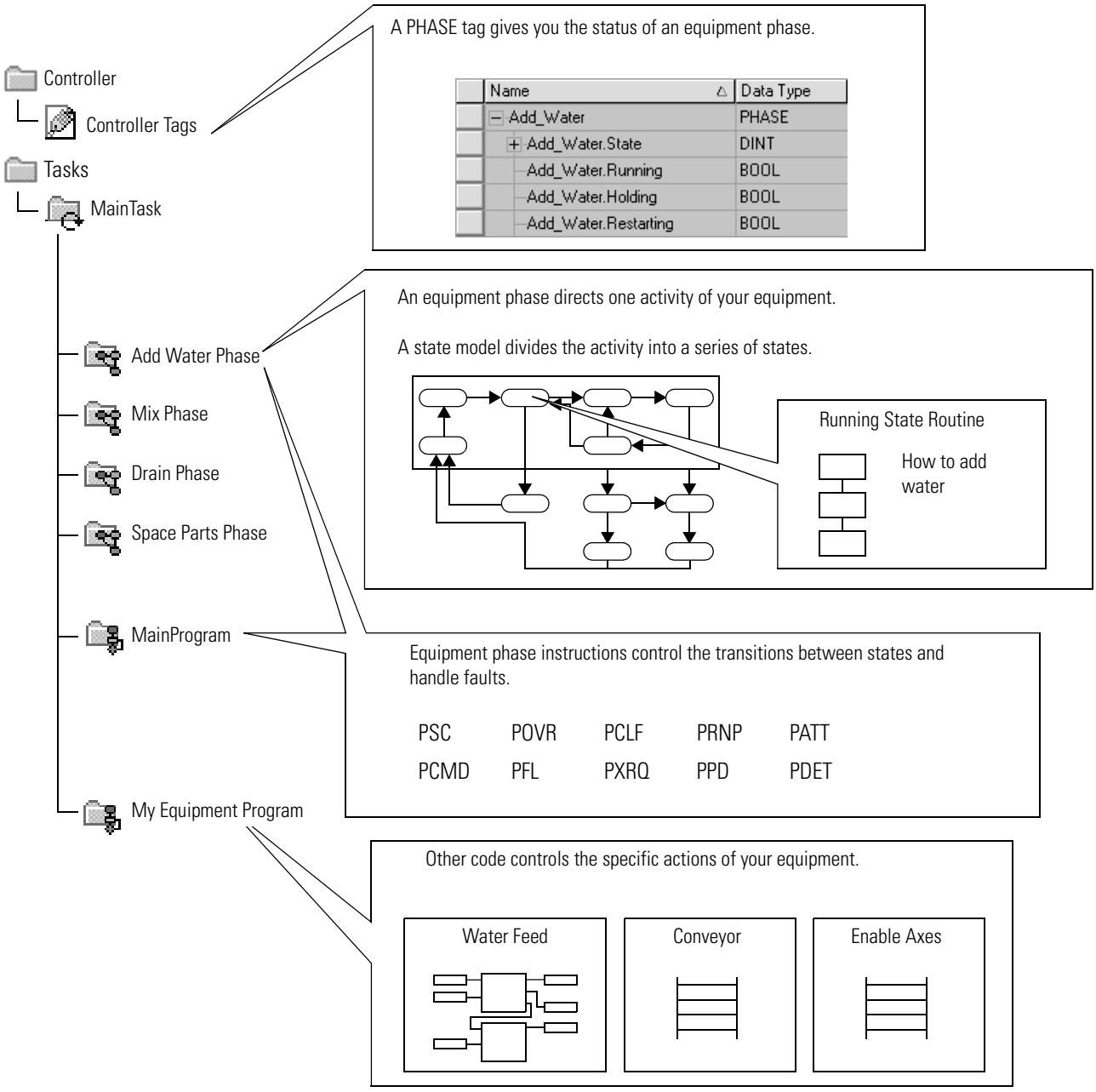
## PhaseManager Overview

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

**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.<br>• 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.<br>• 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:<br>• calls the main routine (state routine) for an acting state.<br>• manages the transitions between states with minimal coding.<br>• makes sure that the equipment goes from state to state along an allowable path. |
| PHASE tag | When you add an equipment phase, RSLogix 5000 programming software makes a tag for the equipment phase. The tag uses the PHASE data type. |

**PhaseManager Overview**



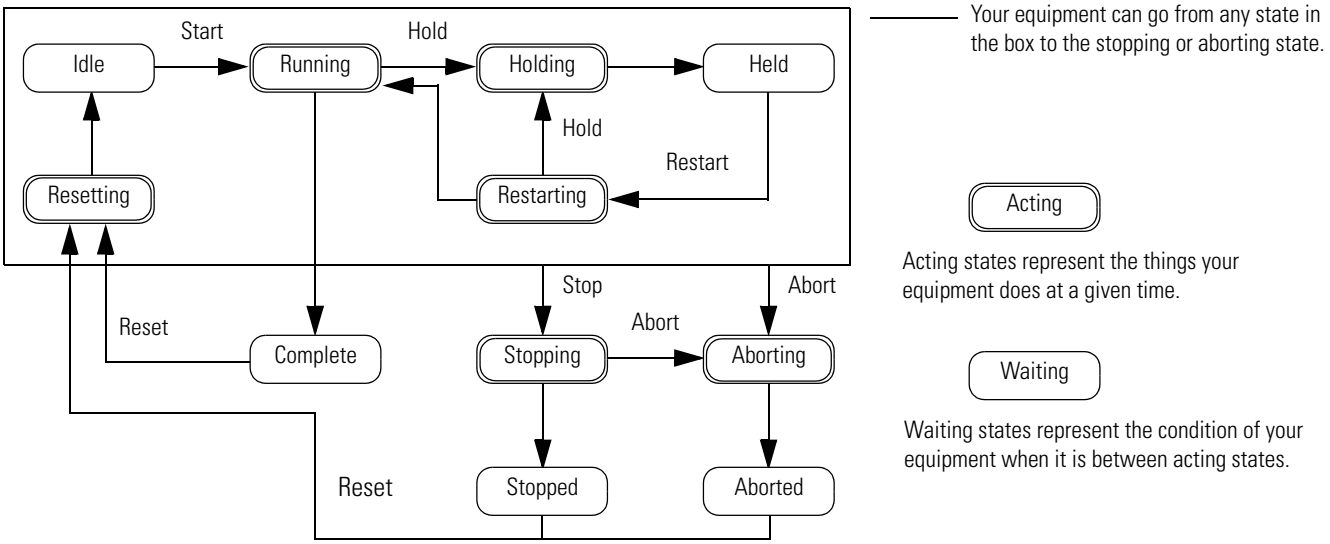
## State Model Overview

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

**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. |

**PhaseManager State Transitions**




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

**PhaseManager State Models**

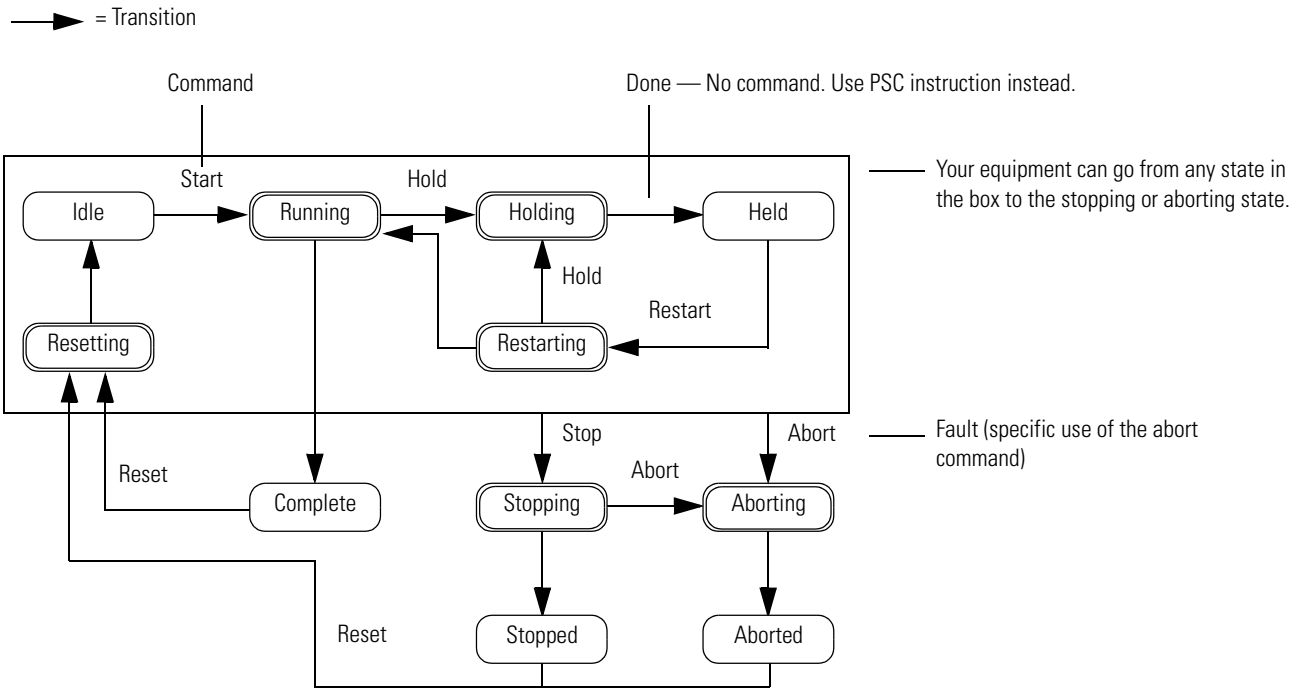
| State | Question to be asked |
|---|---|
| Stopped | What happens when you turn on power? |
| Resetting | How does the equipment get ready to run? |
| Idle | How do you tell that the equipment is ready to run? |
| Running | What does the equipment do to make product? |
| Holding | How does the equipment 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.

**PhaseManager Transition Commands**

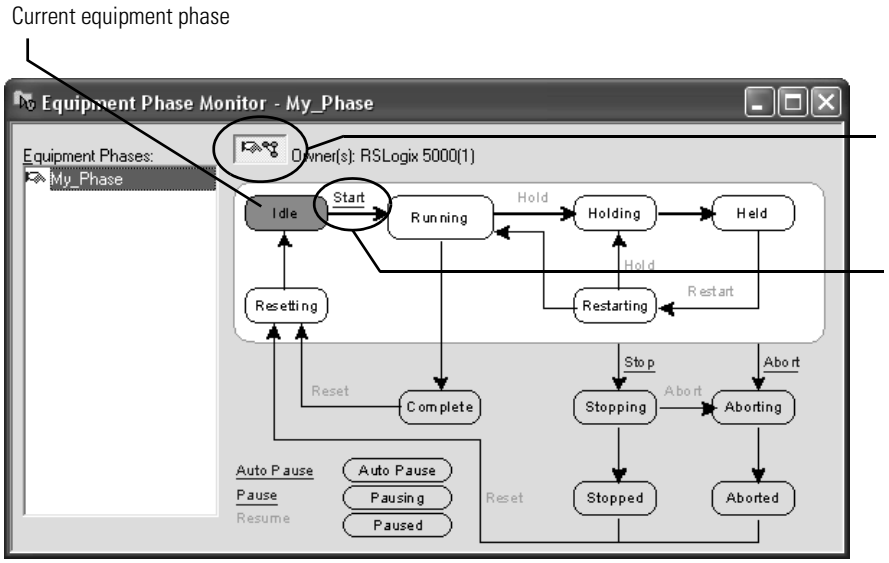



| Type of Transition | Description | | |
|---|---|---|---|
| Command | A command tells the equipment to do something. For example, the operator pushes the start button to start production and the stop button to halt production.<br><br>PhaseManager uses these commands: | | |
| | Reset | Stop | Restart |
| | Start | Hold | Abort |
| Done | Equipment goes to a waiting state when it's finished with what it's doing. You don't 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 programming software, you can manually change an equipment phase.

To manually change a PhaseManager state, perform this procedure.




**1.** Take ownership of the equipment phase.

**2.** Give a command.

## Compare PhaseManager to Other State Models

You can compare PhaseManager state models to other state models.

| S88 | Pack*ML* | PhaseManager |
|---|---|---|
| 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:

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

To enable PhaseManager support, you need the full or professional editions of RSLogix 5000 programming software or RSLogix 5000 with PhaseManager software (9324-RLDPMENE).

## Equipment Phase Instructions

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

**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 **either**:<br>• prevent another program or RSBizWare Batch software from commanding a phase.<br>• make sure another program or RSBizWare Batch software does not already own a phase. |
| PDET | Relinquish ownership of a phase. |
| POVR | Override a command. |

# Maintain Nonvolatile Memory

## Introduction

This chapter explains how to maintain nonvolatile memory.

CompactLogix controllers support the 1784-CF64 CompactFlash card for nonvolatile memory. Nonvolatile memory lets you keep a copy of your project on the controller. The controller does not need power to keep this copy.



You can load the copy from nonvolatile memory to the controller's user memory:

- each time you apply power.
- whenever there is no project in the controller and you apply power.
- at any time via RSLogix 5000 programming software.

**IMPORTANT** Nonvolatile memory stores the contents of the user memory when you store the project.

- Changes made after storing a project are not reflected in nonvolatile memory.
- If you change the project but do not store those changes, you overwrite them when you load the project from nonvolatile memory. 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.

## Additional Resources

For additional information, consult Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

## No Battery is Required

The 1768 controller does not require a battery. The controller uses internal flash memory to store its program during shutdown. Energy stored in the 1768 power supply maintains controller power long enough to store the program to internal flash memory, not the external CompactFlash card.

## Prevent a Major Fault During a Load

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

## Use a CompactFlash Reader

All CompactLogix controllers support the FAT16 file system used with the CompactFlash card.

Typically, you do not have to manage the files on a CompactFlash card. The card automatically loads the project that you most recently stored. For additional flexibility, the file system also lets you:

- manually change which project loads from the CompactFlash card.
- manually change a project's load parameters.

# 1768 CompactLogix Controller Specifications

## Introduction

This appendix contains the specifications for the 1768-L43 CompactLogix controller.

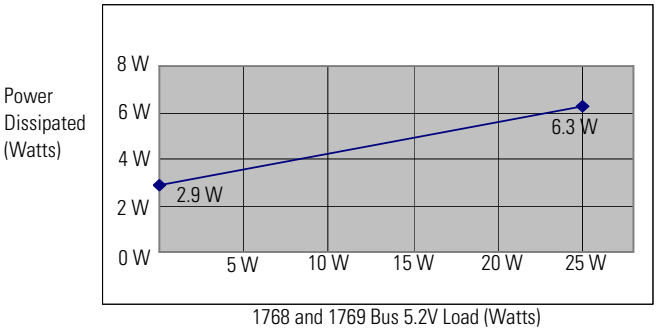


### 1768-L43 CompactLogix Controller General Specifications

| User Memory | Nonvolatile Memory | Communication Options | Number of Tasks Supported | Number of Local I/O Modules Supported |
|---|---|---|---|---|
| 2 MB | CompactFlash | • EtherNet/IP (1768-ENBT and 1768-EWEB modules)<br>• ControlNet (1768-CNB and 1768-CNBR modules)<br>• DeviceNet (1769-SDN scanner module)<br>• Serial (built-in)<br>• Modbus via ladder routine<br>• DH-485 | • 16 tasks (only 1 continuous)<br>• Event tasks: supports consumed tag trigger, EVENT instruction, axis, and motion event triggers | • Max of two 1768 modules in the 1768 backplane<br>• Max of 16 1769 I/O modules (in 3 banks) in the 1769 backplane |

## 1768-L43 CompactLogix Controller General Specifications, Cont'd

| Attribute | Value |
|---|---|
| Backplane current at 24 V | 1.3 A |
| Backplane current output | 1769 Backplane: 2.0 A @ 5.2V<br>1.0 A @ 24V (sourced by 1768 power supply)<br><br>1768 Backplane: 2.8 A @ 5.2V |
| Power consumption | 31.3 W |
| Power dissipation | 6.3 W |




1768 and 1769 Bus 5.2V Load (Watts)

| | |
|---|---|
| Max number of 1769-series I/O modules | 16 |
| Max number of additional 1768-series modules | 2 |
| Max number of I/O banks | 3 |
| Isolation (continuous-voltage rating) | 30V, functional insulation type, tested @ 710V dc for 60 s, RS-232 to system |
| Wiring category[1] | 2 - on communication ports |
| North american temperature code | T4 |
| Mounting screw torque | 1.16 Nm (10 lb-in), using M4 or #8 screws |
| Dimensions (HxWxD), approx. | 131.6 x 67.4 x 121.8 mm (5.18 x 2.65 x 4.80 in.) |
| Weight, approx. | 0.34 kg (11.9 oz) |

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

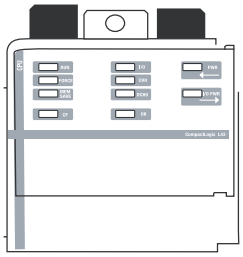
## 1768-L43 CompactLogix Controller Environmental Specifications

| Attribute | Value |
|---|---|
| Temperature, operating | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0...60 °C (32...140 °F) |
| Temperature, nonoperating | IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold),<br>IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat),<br>IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock):<br>-40...85 °C (-40...185 °F) |
| Relative humidity | IEC 60068-2-30 (Test Db, Unpackaged Damp Heat):<br>5...95% noncondensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>5 g @ 10...500 Hz |
| Shock, operating | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30 g |
| Shock, nonoperating | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50 g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD immunity | IEC 61000-4-2:<br>4 kV contact discharges<br>8 kV air discharges |
| Radiated RF immunity | IEC 61000-4-3:<br>10V/m with 1 kHz sine-wave 80%AM from 30…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100%AM @ 900 MHz<br>10V/m with 200 Hz 50% Pulse 100%AM @ 1890 MHz<br>1V/m with 1 kHz sine-wave 80%AM from 2000…2700 MHz |
| EFT/B immunity | IEC61000-4-4:<br>±4 kV @ 5 kHz on communication ports |
| Surge transient immunity | IEC 61000-4-5:<br>±2 kV line-earth (CM) on communication ports |
| Conducted RF immunity | IEC 61000-4-6:<br>10V rms with 1 kHz sine-wave 80%AM from 150 kHz…80 MHz |
| Enclosure type rating | None (open-style) |

## Notes:

# LED Indicators

## Introduction



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



## CompactLogix Controller LED Indicators

CompactLogix controllers have many LED indicators.

**Controller LED Indicators**

| Indicator | Condition | Interpretation |
|---|---|---|
| RUN | Off | The controller is in Program or Test mode. |
| | Steady green | The controller is in Run mode. |
| FORCE | Off | • No tags contain I/O force values.<br>• I/O forces are inactive (disabled). |
| | Steady amber | • I/O forces are active (enabled).<br>• 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. |
| MEM SAVE | Off | The user program and configuration data are not actively being saved to flash memory. |
| | 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.<br>• 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. |
| | Flashing green | One or more devices in the controller's I/O configuration are not responding. |
| | Flashing red | The controller is not communicating with any of the devices in its I/O configuration. |

**Controller LED Indicators**

| Indicator | Condition | Interpretation |
|---|---|---|
| OK | Off | • No power is applied.<br>• If MEM SAVE is green, the user program and configuration data are being saved to flash memory. |
| | Flashing red | • The controller requires a firmware update.<br>• A major recoverable fault occurred on the controller.<br>To clear the fault, perform this procedure.<br>1. Turn the controller keyswitch from PROG to RUN to PROG.<br>2. Go online with RSLogix 5000 programming software.<br>• A nonrecoverable major fault occurred on the controller. In this case, the controller:<br>• initially displays a steady red LED indicator.<br>• resets itself.<br>• clears the project from its memory.<br>• sets the LED indicator to flashing red.<br>• produces a major recoverable fault.<br>• generates a fault code in the RSLogix 5000 project.<br>• The fault code displayed in RSLogix 5000 programming software, and the subsequent fault recovery method, depend on whether you have installed a CompactFlash card in the controller.<br>Fault Code 60 means that the CompactFlash card is not installed. Perform this procedure.<br>1. Clear the fault.<br>2. Download the project.<br>3. Change to Remote Run/Run mode.<br>4. If the problem persists:<br>a.before you cycle power to the controller, record the state of the OK and RS232 LED indicators.<br>b.contact Rockwell Automation. See the back cover of this publication.<br>• Fault Code 61 means that the CompactFlash card is installed. Perform this procedure.<br>1. Clear the fault.<br>2. Download the project.<br>3. Change to Remote Run/Run mode.<br>If the problem persists, contact Rockwell Automation. See the back cover of this publication. |

**Controller LED Indicators**

| Indicator | Condition | Interpretation |
|---|---|---|
| OK | Steady red | The controller detected a nonrecoverable major fault, so it cleared the project from memory. To recover from this fault, perform this procedure.<br>1. Cycle power to the chassis.<br>2. Download the project.<br>3. Change to Run mode.<br>If the OK LED indicator remains steady red, contact Rockwell Automation. |
| | Steady green | Controller is OK. |
| | Flashing green | The controller is storing or loading a project to or from nonvolatile memory. |
| PWR | Off | • The 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.<br>• The supply needs to be replaced. Replace the power supply. |
| | Steady green | The power supply is operating properly. |
| PWR | Steady red | The power supply cannot produce valid 24V power to the 1768 modules. To supply 24V power, perform this procedure.<br>1. Disconnect all modules from the system.<br>2. Reapply power.<br>3. Check the PWR LED indicator.<br>a. If the LED indicator remains red, replace the power supply.<br>b. If the LED indicator is green, one of the other modules in the system is causing the red indicator. Move to the next step.<br>4. Reinstall any 1768 motion or communication modules.<br>5. Reapply power.<br>a. If the LED indicator is green, either the 1768 controller or one of the 1769 I/O modules is causing the red indicator.<br>b. If the LED indicator remains red, one of the 1768 communication or motion modules is causing the red indicator. Move to the next step.<br>6. Disconnect the 1768 communication or motion modules from the system one at a time.<br>7. After each module is removed from the system, reapply power to the power supply and check the PWR LED indicator.<br>a. If the LED indicator is green, the most recently-removed 1768 module caused the red indicator and should be replaced.<br>b. If the LED indicator remains red, continue disconnecting 1768 modules one at a time until the PWR LED indicator turns green. |

**Controller LED Indicators**

| Indicator | Condition | Interpretation |
|---|---|---|
| I/O PWR | Off | Either the controller or the power supply is not operating properly. Perform this procedure.<br>1. Make sure all modules in the system are installed properly and fully engaged with each other.<br>a. If the controller PWR LED indicator remains off, move to the next step.<br>2. Disconnect any 1768 communication or motion modules from the system.<br>3. Reinstall the controller directly next to the power supply and reapply power.<br>4. If the controller PWR LED indicator remains off, replace the controller.<br>5. If the controller PWR LED indicator on the new controller remains off, replace the power supply. |
| | Steady green | The controller is operating properly with respect to sending power to the 1768 modules. |
| | Steady red | • The controller needs to be replaced.<br>• If 1768 communication and motion modules are installed in the system, one of the 1768 modules needs to be replaced.<br>Perform this procedure.<br>1. Disconnect all of the 1768 communication and motion modules from the system.<br>2. Reapply power.<br>3. Check the controller PWR LED indicator.<br>a. If the LED indicator is green, the controller is operating properly and one of the other 1768 modules needs to be replaced.<br>b. To troubleshoot the 1768 modules, see their respective installation instructions.<br>c. If the LED indicator remains red, replace the controller. |

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

**CompactFlash LED Indicators**

| Indicator | Condition | Interpretation |
|---|---|---|
| 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. |

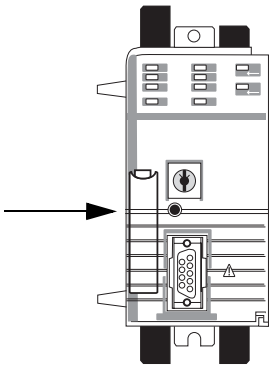
## RS-232 Serial Port LED Indicators

The RS-232 serial port has two LED indicators.

**RS-232 LED Indicators**

| Indicator | Condition | Interpretation |
|---|---|---|
| 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 Pushbutton



On the faceplate of the controller, there is a recessed pushbutton.

| If you access the pushbutton | 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 |

## Notes:

## Numerics



## A



## B



## C

## L



## M



## N



## O



## P

## R



## S



## T



## U

# How Are We Doing?

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Pub. Title/Type CompactLogix Controllers

Cat. No. 1768-L43 Pub. No. 1768-UM001B-EN-P Pub. Date January 2007 Part No. 953030-35

Please complete the sections below. Where applicable, rank the feature (1=needs improvement, 2=satisfactory, and 3=outstanding).

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|---|---|---|
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## Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, 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.

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

## Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running.

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|---|---|
| United States | 1.440.646.3223<br>Monday – Friday, 8am – 5pm EST |
| Outside United States | Please contact your local Rockwell Automation representative for any technical support issues. |

## New Product Satisfaction Return

Rockwell tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning, it may need to be returned.

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

**www.rockwellautomation.com**

**Power, Control and Information Solutions Headquarters**

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Allen-Bradley

1768 CompactLogix Controllers

User Manual