Allen-Bradley

GuardLogix Controllers

Catalog Numbers 1756-L61S, 1756-L62S, 1756-LSP

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.

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

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

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

WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
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 consequence
SHOCK HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

The information below summarizes the changes to this manual since the last publication.

To help you find new and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

Topic	Page
Understanding GuardLogix controller's data flow capabilities	16
The controller does not support OS upgrades using CompactFlash	17
The safety task does not support Add-on Instructions or Alarms and Events	20
The maximum RPI for safety connections has changed from 500 ms to 100 ms.	52, 67
The list of illegal data types for safety programs has been replaced by a list of valid data types	70
The descriptions of safety produced and consumed connections has been revised.	72
The explanation of the effect of the safety-lock feature and the safety signature on download operation has been revised.	91
UL NRGF certification	110
Probability of failure on demand (PFD) and probability of failure per hour (PFH) values added to controller specifcations	110

Chapter 4

Add, Configure, Monitor, and Replace CIP Safety I/O on DeviceNet Networks

Chapter 5

Develop Safety Applications

Introduction

Read this preface to familiarize yourself with the rest of the manual.

Purpose of This Manual

This manual is a guide for using GuardLogix controllers. It describes the GuardLogix-specific procedures you use to configure, operate, and troubleshoot your controller.

For detailed information on related topics like programming your GuardLogix controller, SIL 3 requirements, or information on ControlLogix components, see the list of Additional Resources on page 10.

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use GuardLogix controllers.

You must have a basic understanding of electrical circuitry and familiarity with relay logic. You must also be trained and experienced in the creation, operation, and maintenance of safety systems.

Additional Resources

The table below provides a listing of publications that contain important information about GuardLogix controller systems.

Related Documentation

Resource	Description
GuardLogix Controller Installation Instructions, publication 1756-IN045	Provides information on installing the GuardLogix Controller
GuardLogix Controllers Systems Safety Reference Manual, publication 1756-RM093	Contains detailed requirements for achieving and maintaining SIL 3 with the GuardLogix Controller System
GuardLogix Safety Application Instruction Set Reference Manual, publication 1756-RM095	Provides information on the GuardLogix Safety Application Instruction Set
DeviceNet Safety I/O Installation Instructions, publication 1791DS-IN001	Provides information on installing DeviceNet Safety I/O Modules
DeviceNet Safety I/O User Manual, publication 1791DS-UM001	Provides information on using DeviceNet Safety I/O Modules
Logix5000 General Instruction Set Reference Manual, publication 1756-RM003	Provides information on the Logix5000 Instruction Set
Logix Common Procedures Programming Manual, publication 1756-PM001	Provides information on programming Logix5000 controllers, including managing project files, organizing tags, programming and testing routines, and handling faults
ControlLogix System User Manual, publication 1756-UM001	Provides information on using ControlLogix in non-safety applications
DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004	Provides information on using the 1756-DNB module in a Logix5000 control system
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Provides information on using the 1756-ENBT module in a Logix5000 control system
ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001	Provides information on using the 1756-CNB module in Logix5000 control systems
Logix5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087	Provides information on estimating the execution time and memory use for instructions
Logix Import Export Reference Manual, publication 1756-RM084	Provides information on using RSLogix 5000 Import/Export Utility

If you would like a manual, you can:

- download a free electronic version from the Internet at http://literature.rockwellautomation.com.
- purchase a printed manual by contacting your local Allen-Bradley distributor or Rockwell Automation sales office.

Conventions

These conventions are used throughout this manual:

- Bulleted lists, such as this one, provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- **Bold** type is used for emphasis.

Understanding Terminology

The following table defines terms used in this manual.

Terms and Definitions

Abbreviation	Full Term	Definition
1oo2	One Out of Two	Refers to the behavioral design of a multi-processor safety system.
CIP	Common Industrial Protocol	A communications protocol designed for industrial automation applications.
DC	Diagnostic Coverage	The ratio of the detected failure rate to the total failure rate.
EN	European Norm.	The official European Standard.
GSV	Get System Value	A ladder logic instruction that retrieves specified controller status information and places it in a destination tag.
PC	Personal Computer	Computer used to interface with, and control, a Logix-based system via RSLogix 5000 programming software.
PFD	Probability of Failure on Demand	The average probability of a system to fail to perform its design function on demand.
PFH	Probability of Failure per Hour	The probability of a system to have a dangerous failure occur per hour.
RPI	Requested Packet Interval	When communicating over a network, this is the expected rate in time for production of data.
SNN	Safety Network Number	A unique number that identifies a section of a safety network.
SSV	Set System Value	A ladder logic instruction that sets controller system data.
—	Standard	Any object, task, tag, program, or component in your project that is not a safety-related item (that is, standard controller refers generically to a ControlLogix controller).

GuardLogix System Overview

Introduction

Safety Application Requirements

The GuardLogix controller system is certified for use in safety applications up to and including Safety Integrity Level (SIL) 3 and Category (CAT) 4 in which the de-energized state is the safe state. Safety application requirements include evaluating probability of failure rates (PFD and PFH), system reaction time settings, and functional verification tests that fulfill SIL 3 criteria.

For SIL 3 and CAT 4 safety system requirements, including functional validation test intervals, system reaction time, and PFD/PFH calculations, refer to the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093. You must read, understand, and fulfill these requirements prior to operating a GuardLogix controller-based SIL 3 or CAT 4 safety system.

GuardLogix-based safety applications require the use of at least one safety network number (SNN) and a safety signature. Both affect controller and I/O configuration and network communications.

Safety Network Number

The safety network number (SNN) must be a unique number that identifies safety subnets. Each safety subnet that the GuardLogix controller uses for safety communications must have a unique SNN. Each CIP Safety device must also be configured with the safety subnet's SNN.

The SNN can be assigned automatically or manually.

For information on the safety network number, see Manage the Safety Network Number (SNN) on page 33 of this manual. Also refer to the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093.

Safety Signature

The safety signature consists of an ID number, date, and time that uniquely identifies the safety portion of a project. This includes all safety logic, data, and configuration. The GuardLogix system uses the safety signature to determine the project's integrity and to let you verify that the correct project is downloaded to the target controller.

See Generate a Safety Signature on page 81 for more information.

Creating, recording, and verifying the safety signature is a mandatory part of the safety application development process.

Refer to the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093, for details.

Distinguish Between Standard and Safety Components

Slots of a GuardLogix system chassis not used by the safety function may be populated with other ControlLogix modules that are certified to the Low Voltage and EMC Directives. Refer to http://ab.com/certification/ce to find the CE certificate for the Programmable Control – ControlLogix Product Family and determine which modules are certified.

You must create and document a clear, logical, and visible distinction between the safety and standard portions of the application. To aid in creating this distinction, RSLogix 5000 programming software features safety identification icons to identify the safety task, safety programs, safety routines, and safety components. In addition, the RSLogix 5000 software uses a safety class attribute that is visible whenever safety task, safety program, or safety routine properties are displayed.

The GuardLogix controller does not allow writes to safety tag data from external HMI devices or via message instructions from peer controllers. RSLogix 5000 software can write safety tags when the controller is Safety-unlocked, does not have a safety signature, and is operating without any safety faults.

The ControlLogix Systems User Manual, publication 1756-UM001, provides information on using ControlLogix devices in standard (non-safety) applications.

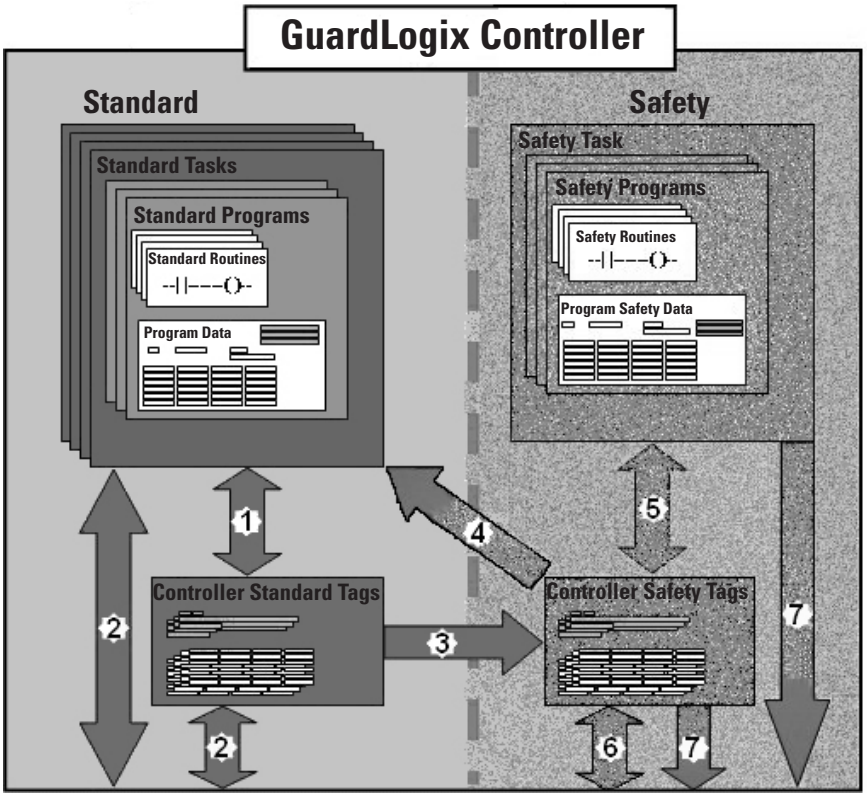
HMI Devices

HMI devices can be used with GuardLogix controllers. HMI devices can access standard tags just as with any ControlLogix controller. However, HMI devices cannot write to safety tags; safety tags are read-only for HMI devices.

GuardLogix Data Flow Capabilities

This illlustration explains the standard and safety data flow capabilities of the GuardLogix controller

Data Flow Capabilities



1	Standard tags and logic behave the same way they do in the ControlLogix platform.
2	Standard tag data, either program- or controller-scoped, can be exchanged with external HMI devices, personal computers, and other controllers.
3	GuardLogix controllers are integrated controllers with the ability to move (map) standard tag data into safety tags for use within the safety task.
	ATTENTION  This data must not be used to directly control a SIL 3 output.
4	Controller-scoped safety tags can be read directly by standard logic.
5	Safety tags can be read or written by safety logic.
6	Safety tags can be exchanged between GuardLogix controllers over Ethernet or ControlNet networks.
7	Safety tag data, either program- or controller-scoped, can be read by external devices, such as HMI devices, personal computers, or other standard controllers.
	IMPORTANT Once this data is read, it is considered standard data, not SIL 3 data.

Select GuardLogix System Hardware

The GuardLogix controller is made up of a primary controller (1756-L6*x*S) and a safety partner (1756-LSP), which function together in a 1oo2 architecture. The GuardLogix system supports SIL 3 and CAT 4 safety applications.

The safety partner must be installed in the slot immediately to the right of the primary controller. The firmware major and minor revisions of the primary controller and safety partner must match exactly to establish the control partnership required for safety applications.

Primary Controller

The primary controller, catalog number 1756-L6*x*S, is the processor that performs standard and safety functions and communicates with the safety partner for safety-related functions in the GuardLogix control system. Standard functions include:

- I/O control
- Logic
- Timing
- Counting
- Report generation
- Communications
- Arithmetic Computations
- Data file manipulation

The primary controller consists of a central processor, I/O interface, and memory. Two catalog numbers are available.

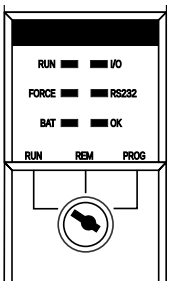
Memory Capacity

Catalog Number	User Memory (RAM Capacity)	
	Standard Tasks and Components	Safety Task and Components
1756-L61S	2 MB	1 MB
1756-L62S	4 MB	1 MB

The GuardLogix controller does not support OS upgrades or user program storage and retrieval using CompactFlash. However, in version 16 of RSLogix 5000 software, you will be able to view the contents of a CompactFlash card, if one is installed in the primary controller.

A three-position keyswitch on the front of the primary controller governs the controller operational modes. The following modes are available:

- RUN
- PROGram
- REMote - this software-enabled mode can be Program, Run, or Test



Safety Partner

The safety partner, catalog number 1756-LSP, is a coprocessor that provides redundancy for safety-related functions in the system.

The safety partner does not have a keyswitch or RS-232 communications port. Its configuration and operation are controlled by the primary controller.

The GuardLogix Controller Installation Instructions, publication 1756-IN045, provides detailed information on installing the primary controller and safety partner.

Chassis

The chassis provides physical connections between modules and the GuardLogix controller.

Chassis Catalog Numbers

Catalog Number	Available Slots	Series	Refer to These Installation Instructions
1756-A4	4	B	1756-IN080
1756-A7	7		
1756-A10	10		
1756-A13	13		
1756-A17	17		

Power Supply

These ControlLogix power supplies are suitable for use in SIL 3 applications. No extra configuration or wiring is required for SIL 3 operation of the power supplies.

Power Supply Catalog Numbers

Catalog Number	Description	Series	Refer to These Installation Instructions
1756-PA72	Power supply, ac	C	1756-IN596
1756-PB72	Power supply, dc		
1756-PA75	Power supply, ac	B	
1756-PB75	Power supply, dc		
1756-PA75R(1)	Power supply, ac (redundant)	A	1756-IN573
1756-PB75R(1)	Power supply, dc (redundant)		

(1) A 1756-PSCA or 1756-PSCA2 redundant power supply chassis adapter is required for use with redundant power supplies.

Select Safety I/O

Safety input and output devices can be connected to CIP Safety I/O on DeviceNet networks, allowing output devices to be controlled by the GuardLogix controller system via DeviceNet Safety communications.

For the most up-to-date information on available CIP Safety I/O catalog numbers, certified series and firmware revisions, see http://ab.com/certification/safety.

Select Communication Networks

The GuardLogix controller supports communication that lets it:

- distribute and control safety I/O on DeviceNet networks. The 1756-DNB DeviceNet module provides the interface between the GuardLogix controller and DeviceNet devices.
- distribute and control remote safety I/O on DeviceNet networks via Ethernet or ControlNet networks.
- produce and consume safety tag data between GuardLogix controllers across an Ethernet/IP or ControlNet network or within the same ControlLogix chassis. 1756-ENBT modules provide a communication bridge between controllers on the EtherNet/IP network. 1756-CN2 modules provide a communication bridge between controllers on the ControlNet network.
- access RSLogix 5000 programming software via a serial connection or an 1756-ENBT module or 1756-CNB module.
- support standard ControlNet communications.

Additional Resources

Resource	Description
DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004	Contains information on configuring a DeviceNet network, communicating with devices over the DeviceNet network, troubleshooting, and optimizing network performance
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Contains information on configuring the 1756-ENBT module, interlocking and data transfer between controllers on the EtherNet/IP network, managing connections, and diagnostics
ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001	Provides information on using the 1756-CN2 module

Programming Requirements

RSLogix 5000 software, version 14 and version 16 and later, is the programming tool for GuardLogix controller applications. RSLogix 5000, version 15, does not support Safety Integrity Level (SIL) 3. Programs scheduled under the safety task support only ladder logic.

TIP In RSLogix 5000 software, version 14, programs scheduled under the safety task, as well as programs in standard tasks, support only ladder logic.

The RSLogix 5000 software, version 16 safety task does not support the following items, but they are supported in version 16 standard tasks within a GuardLogix project:

- Function block diagrams (FBD)
- Sequential function chart (SFC) routines
- Structured text
- Integrated motion
- Event tasks
- Equipment phase routines
- Add-on instructions
- Alarms and events

Safety projects do not support redundancy.

Safety routines include safety instructions, which are a subset of the standard ladder logic instruction set, and safety application instructions.

Refer to Chapter 5 of this manual and the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093, for information on developing safety applications.

Additional Resources

Resource	Description
GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093	Provides a list of the Safety Application instructions and the subset of standard ladder logic instructions that are approved for safety applications. Also contains more information on developing safety applications
GuardLogix Safety Application Instruction Set Reference Manual, publication 1756-RM095	Provides detailed information on the safety application instructions
Logix5000 General Instruction Set Reference Manual, publication 1756-RM003	Provides details on the standard Logix instructions

Configure the GuardLogix Controller

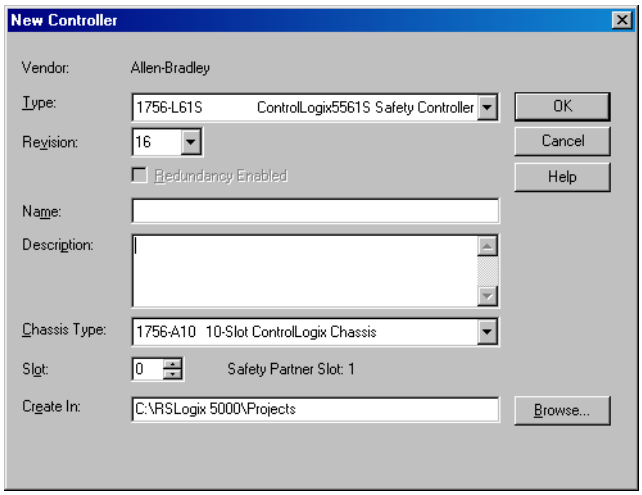
Introduction

Create a New Controller

To configure and program a GuardLogix controller, use RSLogix 5000 software to create and manage a project for the controller.

1. Create a new project in RSLogix 5000 software by clicking the New button on the main toolbar.

2. Select a GuardLogix controller from the Type pull-down menu.
   - 1756-L61S ControlLogix 5561S Controller
   - 1756-L62S ControlLogix 5562S Controller.



3. Enter the major revision of firmware for the controller.

4. Type a name for the controller.

   When you create a project, the project name is the same as the name of the controller. However, you can rename either the project or the controller.

5. Select the chassis size.

6. Enter the slot number of the controller.

   The New Controller dialog displays the slot location of the safety partner based on the slot number entered for the primary controller.

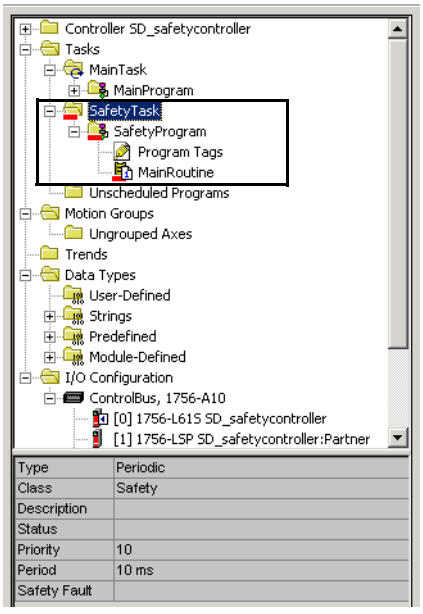
   If you select a slot number for the primary controller that does not accommodate placement of the safety partner immediately to the right of the primary controller, you will be prompted to re-enter a valid slot number.

7. Specify the folder in which to store the safety controller project.

8. Click OK.

RSLogix 5000 software automatically creates a safety task and a safety program.

A main ladder logic safety routine called MainRoutine is also created within the safety program.



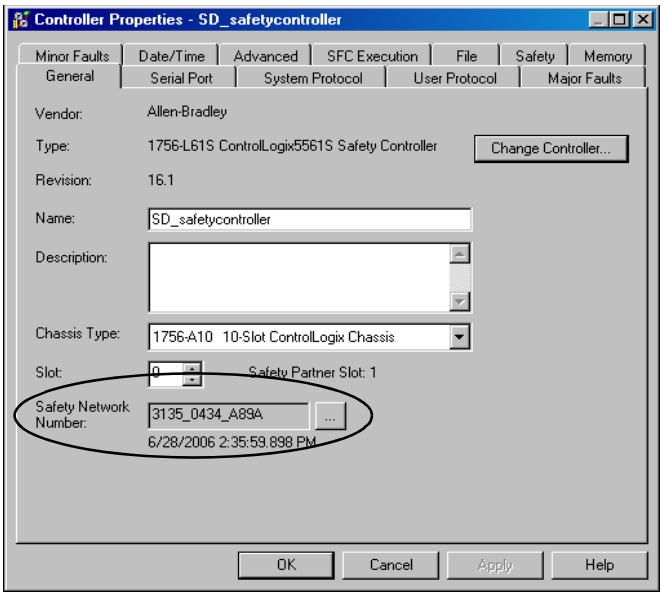
A red bar under the folder icon distinguishes safety components from standard components in the RSLogix 5000 Controller Organizer.

When a new safety project is created, RSLogix 5000 software also automatically creates a time-based safety network number (SNN).

This SNN defines the local chassis backplane as a safety subnet. It can be viewed and modified via the General tab on the Controller Properties dialog.

For most applications, this automatic, time-based SNN is sufficient. However, there are cases in which you might want to enter a specific SNN.

Safety Network Number



TIP

You can use the Controller Properties dialog to change the controller from standard to safety or vice versa by clicking Change Controller. However, standard and safety projects are substantially affected.

See Appendix C, Change Controllers, for details on the ramifications of changing controllers.

Additional Resources

Resource	Description
Chapter 5, Develop Safety Applications.	Contains more information on the safety task, safety programs, and safety routines
Chapter 3, Communicate Over Networks	Provides more information on managing the SNN

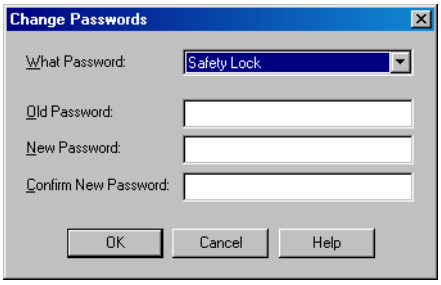
Set Passwords for Safety-locking and -unlocking

Safety-locking the controller protects safety control components from modification. Only safety components, such as the safety task, safety programs, safety routines, and safety tags are affected. Standard components are unaffected. You can safety-lock or -unlock the controller project either online or offline.

The safety-lock and -unlock feature uses two separate passwords. Passwords are optional.

Follow these steps to set passwords:

1. From the Tools > Safety menu, choose Change Password.

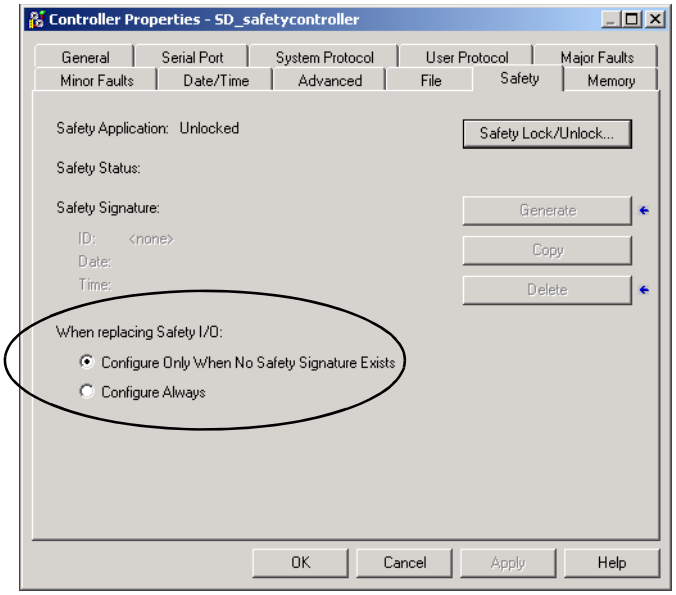


2. From the What Password pull-down menu, choose either Safety Lock or Safety Unlock.
3. Type the old password, if one exists.
4. Type and confirm the new password.
5. Click OK.

   Passwords may be from 1 to 40 characters in length and are not case-sensitive. Letters, numerals, and the following symbols may be used: ‘ ~ ! @ # $ % ^ & * ( ) _ + , - = { } | [ ] \ : ; ? / .

Handle I/O Module Replacement

The Safety tab of the Controller Properties dialog lets you define how the controller handles the replacement of an I/O module in the system. This option determines whether the controller sets the safety network number (SNN) of an I/O module to which it has a connection and for which it has configuration data when a safety signature(1) exists.



ATTENTION

Enable the Configure Always feature only if the entire routable CIP Safety Control System is not being relied on to maintain SIL 3 during the replacement and functional testing of a module.

See Replace a CIP Safety I/O Module on page 59 for more information.

Select the CST Master

One device in the local chassis must be designated as the coordinated system time (CST) master. The CST master is usually a GuardLogix controller or another ControlLogix controller.

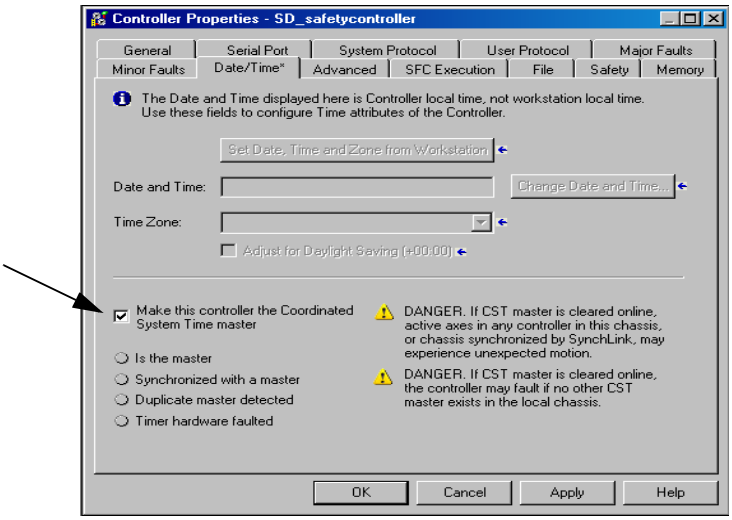
IMPORTANT

If a CST master does not exist, a nonrecoverable safety fault will occur when the controller is put into Run mode.

See GuardLogix Controller Faults on page 102 for more information on faults.

(1) The safety signature is a number used by the GuardLogix system to uniquely identify each project's logic, data, and configuration, thereby protecting the system's safety integrity level (SIL). See Safety Signature on page 14 and Generate a Safety Signature on page 81 for more information.

You can set the controller as the CST master using the Date/Time tab on the Controller Properties dialog.

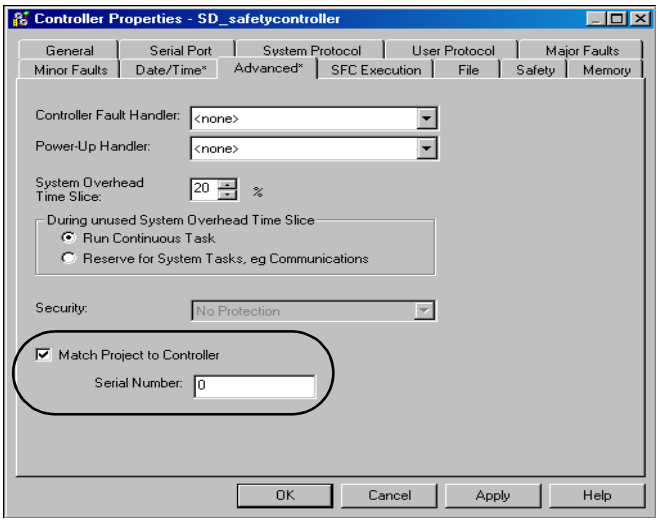


When online, this tab also indicates whether the controller is synchronized with a CST master.

Configure Project to Controller Matching

RSLogix 5000 software, version 14 and later, lets you link your project to a specific controller, for the purposes of going online, downloading, and uploading. If you enable this option, each time you initiate one of these activities, RSLogix 5000 software checks that the serial number configured in the project matches the serial number of the controller to which it is connected.

To enable this feature, check the Match Project to Controller option on the Advanced tab of the Controller Properties dialog and enter your controller's eight digit, hexidecimal serial number, found on the controller label.



Configure a Peer Safety Controller

You can add a peer safety controller to the I/O configuration folder of your GuardLogix safety project to allow standard or safety tags to be consumed.

The peer GuardLogix safety controller is subject to the same configuration requirements as the local GuardLogix safety controller.

The peer safety controller must also have a safety network number (SNN). The SNN of the peer safety controller depends upon its placement in the system.

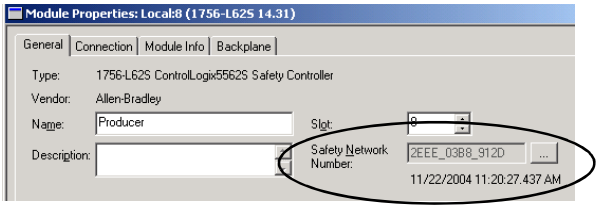
SNN and Controller Placement

Peer Safety Controller Location	SNN
Placed in the local chassis	GuardLogix controllers located in a common chassis should have the same SNN.
Placed in a different chassis	The controller must have a unique SNN.

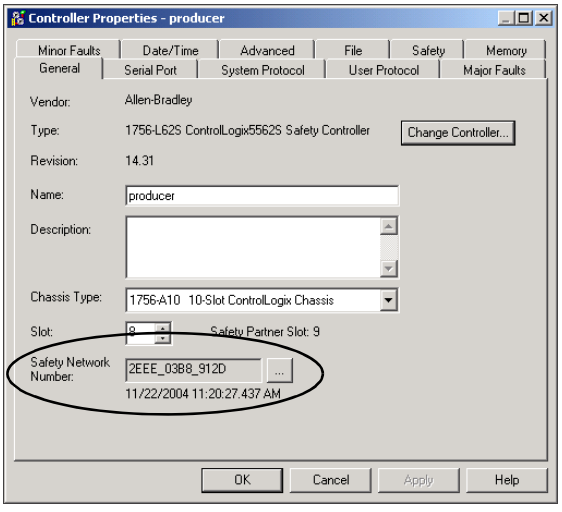
To share safety data between peer controllers, you produce and consume controller-scoped safety tags. Produced/consumed safety tag pairs must be of the same data type. To share data between peer safety controllers, the following additional requirements must be met:

- The SNN entered on the producer controller's Module Properties dialog in the consumer's safety project must match the SNN that is configured in the producer controller's project, as shown on the producer controller's Controller Properties dialog.

Producer Controller Properties Dialog in Consumer Project

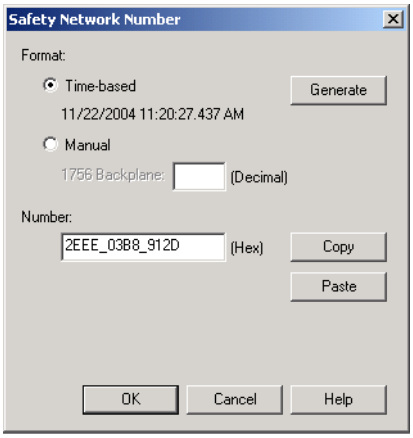


Producer Controller Properties in Producer Project

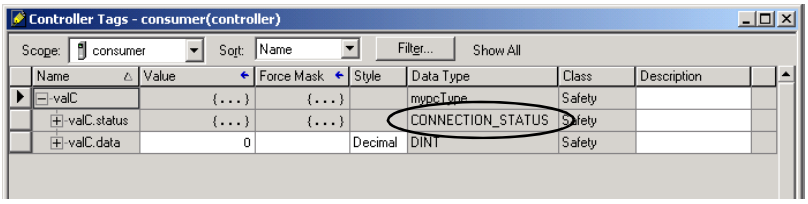


TIP

An SNN can be copied and pasted using the buttons on the Safety Network Number dialog. Open the respective Safety Network Number dialogs by clicking ... to the right of the SNN fields in the properties dialogs.

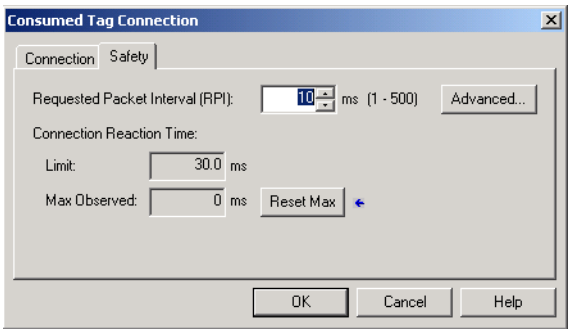


- For produced and consumed safety tags, you must create a user-defined data type. The first member of the tag structure must be a predefined data type called CONNECTION_STATUS.

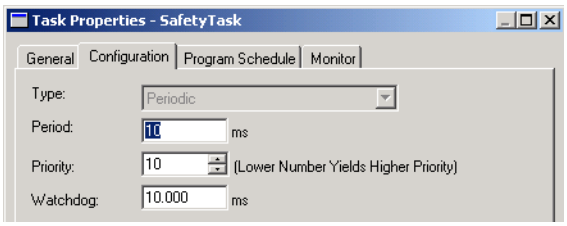


- The requested packet interval (RPI) of the consumed safety tag must match the safety task period of the producing safety project.

Consumer's Project



Producer's Project



Set the RPI via the Safety tab on the Consumed Tag Connection dialog. To open this dialog, right-click the consumed tag and choose Edit.

TIP In RSLogix 5000 software, version 16, the default Safety Task RPI was changed from 10 ms to 20 ms.

To view or edit the safety task period, right-click the producing safety task and choose Properties. Then, choose the Configuration tab.

Additional Resources

Resource	Description
Chapter 5, Develop Safety Applications	Contains more information on the safety task period and on configuring produced/consumed tags
Safety Connections on page 100	Provides more information on the CONNECTION_STATUS data type
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Contains more information on producing and consuming tags and on creating user-defined data types

Communicate Over Networks

Introduction

The Safety Network

The CIP Safety protocol is an end-node to end-node safety protocol that allows routing of CIP Safety messages to and from CIP Safety devices through bridges, switches, and routers.

To maintain high integrity when routing through standard bridges, switches, or routers, each end node within a routable CIP Safety Control System must have a unique reference. This unique reference is a combination of a safety network number (SNN) and the node address of the network device.

Manage the Safety Network Number (SNN)

The SNN assigned to safety devices on a network segment must be unique. You must be sure that a unique SNN is assigned to:

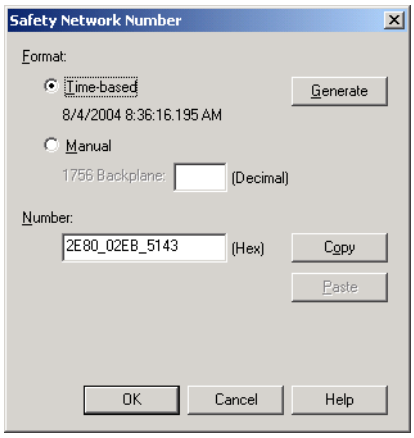
- all safety devices on each DeviceNet network. All safety devices on a DeviceNet subnet can have the same SNN.
- each chassis that contains one or more GuardLogix controllers.

TIP Multiple safety network numbers can be assigned to a CIP Safety subnet or a ControlBus chassis that contains more than one safety device. However, for simplicity, we recommend that each CIP Safety subnet have one, and only one, unique SNN.

The SNN can be either software-assigned (time-based) or user-assigned (manual). These two formats of the SNN are described in the following sections.

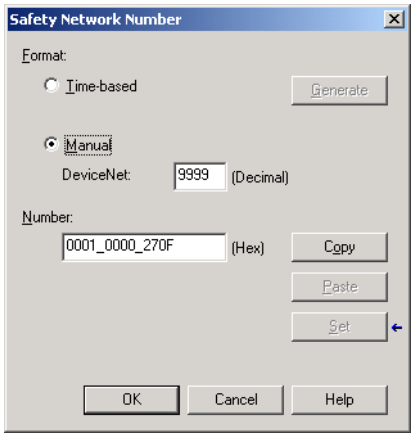
Time-based Safety Network Number

If the time-based format is selected, the SNN value that is generated represents the date and time at which the number was generated, according to the personal computer running the configuration software.



Manual Safety Network Number

If the manual format is selected, the SNN represents entered values from 1 through 9999 decimal.



Assign the Safety Network Number (SNN)

You can allow RSLogix 5000 software to automatically assign an SNN, or you can assign the SNN manually.

Automatic Assignment

When a new controller or module is created, a time-based SNN is automatically assigned via the configuration software. Subsequent new safety-module additions to the same CIP Safety network are assigned the same SNN defined within the lowest node address on that CIP Safety network.

Manual Assignment

The manual option is intended for routable CIP Safety systems where the number of DeviceNet subnets and interconnecting networks is small, and where users might like to manage and assign the SNN in a logical manner pertaining to their specific application.

See Change the Safety Network Number (SNN) on page 35.

IMPORTANT If you assign an SNN manually, take care to ensure that system expansion does not result in duplication of SNN and node address combinations.

Automatic Versus Manual

For typical users, the automatic assignment of an SNN is sufficient. However, manual manipulation of the SNN is required:

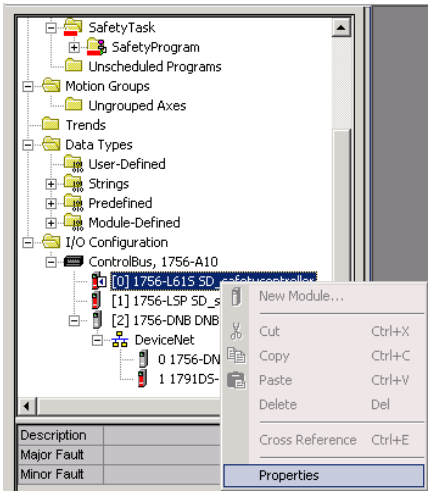
- if safety consumed tags are used.
- if the project will consume safety input data from a module whose configuration is owned by some other device.
- if a safety project is copied to a different hardware installation within the same routable CIP Safety system.

Change the Safety Network Number (SNN)

Before changing the SNN you must:

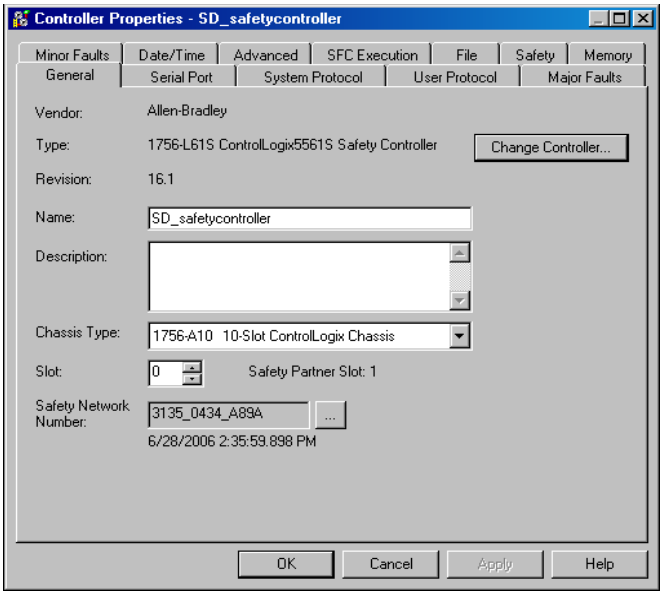
- unlock the project, if it is safety-locked.
  See Safety-lock the Controller on page 79.
- delete the safety signature, if one exists.
  See Delete the Safety Signature on page 82.

Change the Safety Network Number (SNN) of the Controller

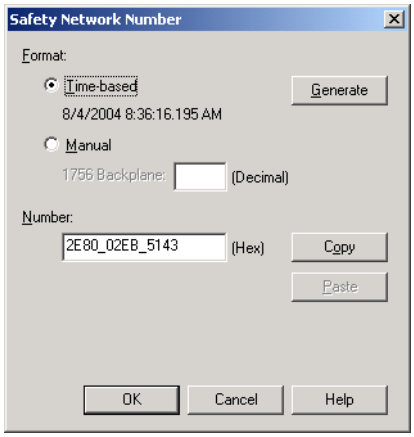


1. In the Controller Organizer, right-click the GuardLogix controller and choose Properties.

2. On the General tab of the Controller Properties dialog, click ... to the right of the safety network number to open the Safety Network Number dialog.



3. Choose Time-based and click Generate.

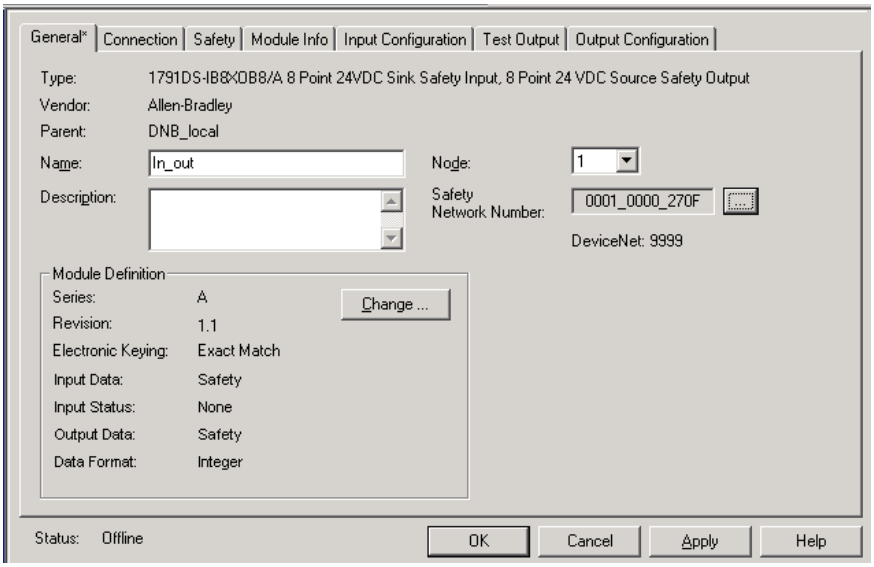


4. Click OK.

Change the Safety Network Number (SNN) of Safety I/O Modules on the CIP Safety Network

This example uses the DeviceNet network.

1. Find the first DeviceNet Scanner (1756-DNB) module in the I/O Configuration tree.
2. Expand the I/O modules available through the 1756-DNB.
3. Double-click the first safety I/O module to view the General tab.



4. Click ... to the right of the safety network number to open the Safety Network Number dialog.
5. Choose Time-based and click Generate to generate a new SNN for that DeviceNet network.
6. Click OK.
7. Click Copy to copy the new SNN to the Windows Clipboard.
8. Open the General Tab of the Module Properties dialog of the next safety I/O module under that 1756-DNB module.
9. Click ... to the right of the safety network number to open the Safety Network Number dialog.
10. Choose Time-based and click Paste to paste that DeviceNet network's SNN into that device.

11. Click OK.

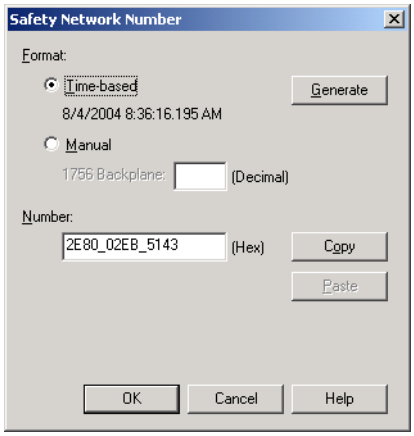
12. Repeat Steps 8, 9, and 10 for the remaining safety I/O modules under that 1756-DNB module.

13. Repeat Steps 2 through 10 for any remaining 1756-DNB modules under the I/O Configuration tree.

Copy and Paste an Safety Network Number (SNN)

If the module's configuration is owned by a different controller, you may need to copy and paste the SNN from the configuration owner into the module in your I/O configuration tree.

1. In the software configuration tool of the module's configuration owner, open the Safety Network Number dialog for the module.



2. Click Copy.

3. Go to the General tab on the Module Properties dialog of the I/O module in the I/O Configuration tree of the consuming controller project.

   This consuming controller is not the configuration owner.

4. Click ... to the right of the safety network number to open the Safety Network Number dialog.

5. Click Paste.

6. Click OK.

EtherNet/IP Communications

For EtherNet/IP communications, choose either a 1756-ENBT or 1756-EWEB module.

If your application	Select
• controls I/O modules. • requires an adapter for distributed I/O on EtherNet/IP links. • communicates with other EtherNet/IP devices (messages). • shares data with other Logix5000 controllers (produce/consume). • bridges EtherNet/IP links to route messages to devices on other networks.	1756-ENBT
• requires remote access via Internet browser to tags in a local ControlLogix controller. • communicates with other EtherNet/IP devices (messages). • bridges EtherNet/IP links to route messages to devices on other networks. • does **not** support I/O or produced/consumed tags.	1756-EWEB

In addition to communication hardware for EtherNet/IP networks, these software products are available.

Software for EtherNet/IP Modules

Software	Purpose
RSLogix 5000 Programming Software	This software is required to configure the GuardLogix project and define EtherNet/IP communications.
BOOTP/DHCP Utility	This utility comes with RSLogix 5000 software. You can use this utility to assign IP addresses to devices on an EtherNet/IP network.
RSNetWorx for EtherNet/IP Software	You can use this software to configure EtherNet/IP devices by IP addresses and/or host names

The EtherNet/IP communication modules:

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

Produce and Consume Data via the EtherNet/IP Network

The GuardLogix controller supports the ability to produce (broadcast) and consume (receive) system-shared tags over the EtherNet/IP network. Produced and consumed tags each require connections. The total number of tags that can be produced or consumed is limited by the number of available connections.

Connections Over the EtherNet/IP Network

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

All EtherNet/IP connections are unscheduled. An unscheduled connection is triggered by the requested packet interval (RPI) for I/O control or the program (such as a MSG instruction). Unscheduled messaging lets you send and receive data when needed.

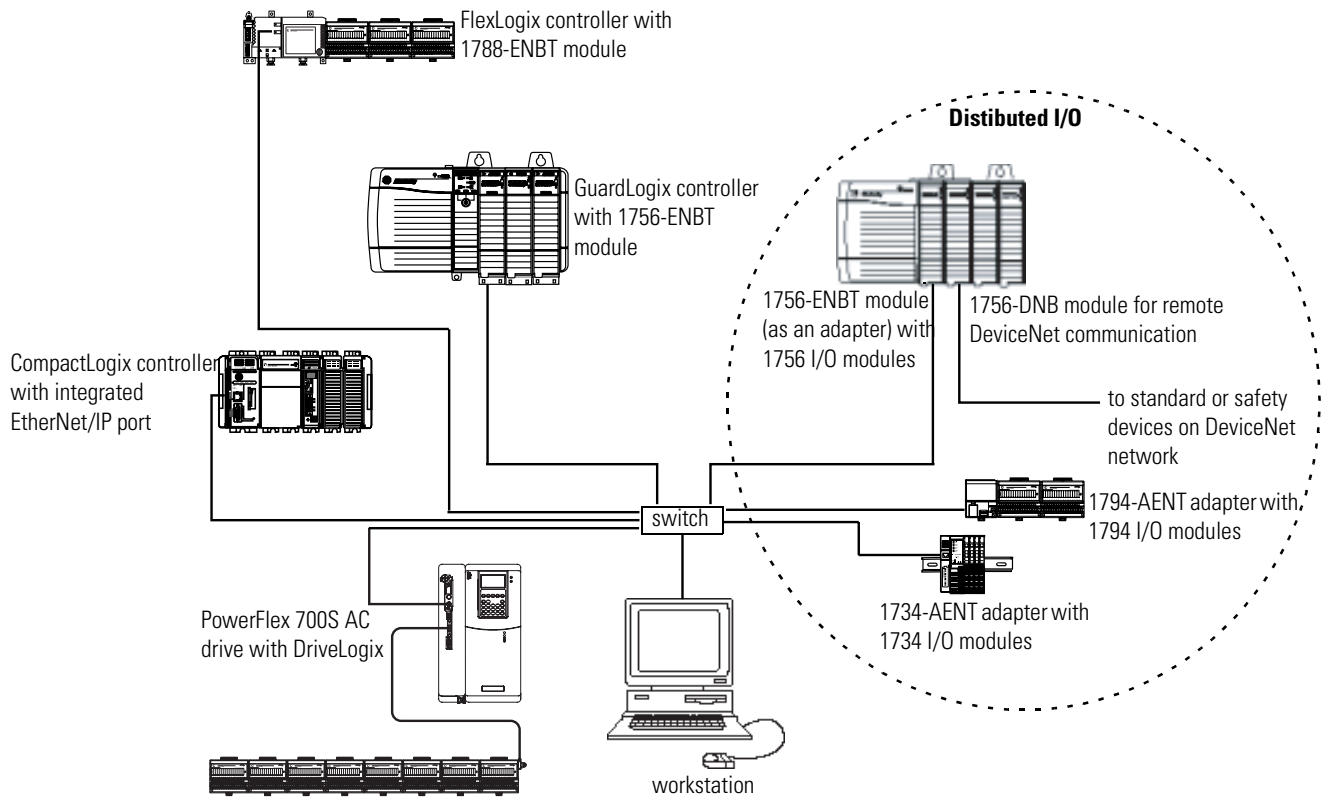
The 1756 EtherNet/IP communication modules support 128 Common Industrial Protocol (CIP) connections over an EtherNet/IP network.

EtherNet/IP Communication Example

In this example:

- the controllers can produce and consume standard or safety tags between each other.
- the controllers can initiate MSG instructions that send/receive standard data or configure devices.
- the 1756-ENBT module can be used as a bridge, letting the GuardLogix controller produce and consume standard and safety data to and from I/O devices.
- the personal computer can upload/download projects to the controllers.
- the personal computer can configure devices on the EtherNet/IP network.

EtherNet/IP Communication Example



EtherNet/IP Modules in a GuardLogix System

To use an EtherNet/IP module with the GuardLogix controller, you must configure the module's communication parameters, add the module to the GuardLogix controller project, and download the project to the GuardLogix controller.

Configure the EtherNet/IP Module

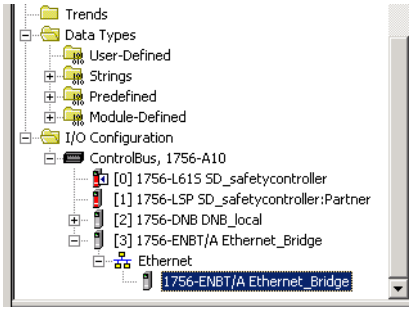
To configure the module, define the IP address, subnet mask, and gateway.

EtherNet/IP Parameters

EtherNet/IP Parameter	Description
IP Address	The IP address uniquely identifies the module. The IP address is in the form xxx.xxx.xxx.xxx. where each xxx is a number between 0 and 255. The following reserved values cannot be used: • 127.0.0.1 • 0.0.0.0 • 255.255.255.255
Subnet Mask	Subnet addressing is an extension of the IP address scheme that allows a site to use a single network ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom network ID portion and host ID portion. This field is set to 0.0.0.0 by default. If you change the subnet mask of an already-configured module, you must cycle power for the change to take effect.
Gateway	A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. This field is set to 0.0.0.0 by default.

Add the Module to the Project

After you physically install an EtherNet/IP module and set its IP address, you must add the module to the Controller Organizer in your GuardLogix controller project.



Download the Project

Use RSLogix 5000 software to download the project. When the controller begins operation, it establishes connections with the EtherNet/IP modules.

Additional Resources

Resource	Description
Chapter 5, Develop Safety Applications	Provides information on configuring produced and consumed safety tags
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Contains guidelines and specific details on interlocking and data transfer between controllers on the EtherNet/IP network using the 1756-ENBT module
EtherNet/IP Web Server Module User Manual, publication ENET-UM527	Provides information on using the 1756-EWEB module
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Contains more information on how to produce and consume tags between controllers
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Provides guidelines on optimizing a control application on an EtherNet/IP network

ControlNet Communications

For ControlNet communications, choose a 1756-CNB or 1756-CNBR module for standard communications, or a 1756-CN2 module for safety communications.

If your application	Select
• controls standard I/O modules. • requires an adapter for distributed I/O on ControlNet links. • communicates with other ControlNet devices (messages). • shares standard data with other Logix5000 controllers (produce/consume). • bridges ControlNet links to route messages to devices on other networks.	1756-CNB
• performs same functions as a 1756-CNB. • also supports redundant ControlNet media.	1756-CNBR
• performs the same functions supported by the 1756-CNB module with higher performance. • supports CIP Safety communication.	1756-CN2

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

Software for ControlNet Modules

Software	Purpose
RSLogix 5000 Programming Software	This software is required to configure the GuardLogix project and define ControlNet communications.
RSNetWorx for ControlNet Software	This software is required to configure the ControlNet network, define the network update time (NUT), and schedule the ControlNet network.

The ControlNet communications modules:

- support messaging, produced/consumed safety and standard tags, and distributed I/O.
- support the use of coax and fiber repeaters for isolation and increased distance.

Produce and Consume Data via the ControlNet Network

The GuardLogix controller supports the ability to produce (broadcast) and consume (receive) system-shared tags over the ControlNet network. Produced and consumed tags each require connections. The total number of tags that can be produced or consumed is limited by the number of available connections in the GuardLogix controller.

Connections Over the ControlNet Network

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

ControlNet connections can be either scheduled or unscheduled.

ControlNet Connections

Connection Type	Description
Scheduled (unique to the ControlNet network)	A scheduled connection is unique to ControlNet communications. A scheduled connection lets you send and receive data repeatedly at a predetermined interval, which is the requested packet interval (RPI). For example, a connection to an I/O module is a scheduled connection because you repeatedly receive data from the module at a specified interval. Other scheduled connections include connections to: • communication devices. • produced/consumed tags. On a ControlNet network, you must use RSNetWorx for ControlNet software to enable all scheduled connections and establish a network update time (NUT). Scheduling a connection reserves network bandwidth to specifically handle the connection.
Unscheduled	An unscheduled connection is a message transfer between controllers that is triggered by the requested packet interval (RPI) or the program (such as a MSG instruction). Unscheduled messaging lets you send and receive data when needed. Unscheduled connections use the remainder of network bandwidth after scheduled connections are allocated. Safety produced/consumed connections are unscheduled.

The 1756-CNB and 1756-CNBR communication modules support 64 CIP connections over a ControlNet network.

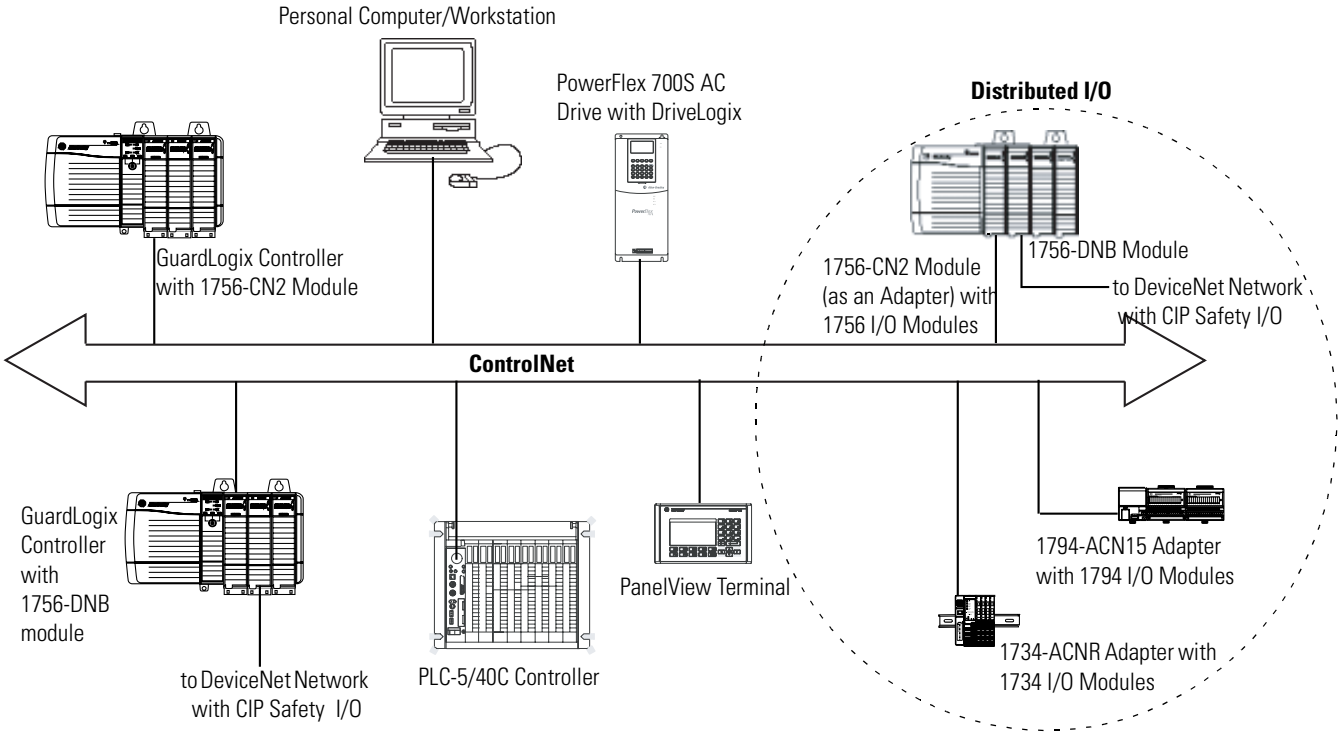
The 1756-CN2 module supports 100 CIP connections over the ControlNet network. However, we recommend that you configure only 97 connections for each module to maintain optimal performance.

ControlNet Communication Example

In this example:

- GuardLogix controllers can produce and consume standard or safety tags between each other.
- GuardLogix controllers can initiate MSG instructions that send/receive standard data or configure devices.
- the 1756-CN2 module can be used as a bridge, letting the GuardLogix controller produce and consume standard and safety data to and from I/O devices.
- the personal computer can upload/download projects to the controllers.
- the personal computer can configure devices on the ControlNet network, and it can configure the network itself.

ControlNet Communication Example



Additional Resources

Resource	Description
ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001	Contains information on how to: • configure a ControlNet communication module. • control I/O over the ControlNet network. • send a message over the ControlNet network. • produce/consume a tag over the ControlNet network. • calculate controller connections over the ControlNet network
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Provides guidelines on optimizing a control application on a ControlNet network

DeviceNet Communications

To communicate and exchange data with CIP Safety I/O modules on DeviceNet networks, you need a 1756-DNB module in the local chassis.

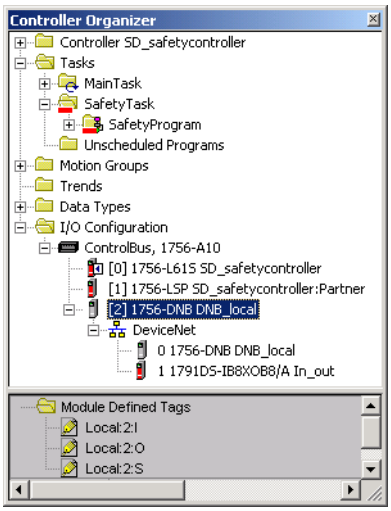
For information on how to install your 1756-DNB module, refer to the ControlLogix DeviceNet Scanner Module Installation Instructions, publication 1756-IN566.

The 1756-DNB module supports communication with DeviceNet Safety devices and standard DeviceNet devices. You can use both types.

DeviceNet Safety Connections

To access CIP Safety devices on DeviceNet networks, add a 1756-DNB to the I/O Configuration tree of the GuardLogix controller project.

CIP Safety I/O modules on DeviceNet networks are added to the project under the 1756-DNB module, as described in Chapter 4, Add, Configure, Monitor, and Replace CIP Safety I/O on DeviceNet Networks. When you add a CIP Safety I/O module, RSLogix 5000 software automatically creates controller-scoped safety data tags for that module.



Standard DeviceNet Connections

If you use standard DeviceNet I/O with your GuardLogix controller, you will need to allocate two connections for each 1756-DNB module. One connection is for module status and configuration. The other connection is a rack-optimized connection for the DeviceNet I/O data.

To use the 1756-DNB module to access standard data via the DeviceNet network, you must use RSNetWorx for DeviceNet software to:

- create a configuration file for the network.
- configure each standard device on the network.
- configure the 1756-DNB.
- add the standard I/O devices to the 1756-DNB scan list.

When you add the 1756-DNB module to the I/O Configuration of the controller, RSLogix 5000 software automatically creates a set of standard tags for the input, output, and status data of the network.

Additional Resources

Resource	Description
Chapter 4, Add, Configure, Monitor, and Replace CIP Safety I/O on DeviceNet Networks	Provides more information on DeviceNet Safety I/O and addressing Safety I/O data
DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004	Contains detailed information on configuring and using the 1756-DNB in a Logix5000 control system

Serial Communications

To operate the GuardLogix controller on a serial network, you need:

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

For the controller to communicate to a workstation or other device over the serial network, you must:

1. Configure the serial communication driver for the workstation.
2. Configure the serial port of the controller.

Serial Communication Modes

Use this mode	For
DF1 Point-to-point	Communication between the controller and one other DF1-protocol-compatible device. This is the default System mode. 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. 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. A master/slave network can have node numbers from 0…254. Each node must have a unique node address. Also, at least 2 nodes must exist to define your link as a network (1 master and 1 slave station are the two nodes).
DF1 Slave	Using a controller as a slave station in a master/slave serial communication network. 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. One node is designated as the master and it controls who has access to the link. All the other nodes are slave stations and must wait for permission from the master before transmitting.
DH-485	Communicating with other DH-485 devices multi-master, token passing network allowing programming and peer-to-peer messaging.

Add, Configure, Monitor, and Replace CIP Safety I/O on DeviceNet Networks

Introduction

For more information on installation, configuration, and operation of CIP Safety I/O on DeviceNet networks, refer to the DeviceNet Safety I/O User Manual, publication 1791DS-UM001.

Add CIP Safety I/O Modules

When you add a module to the system, you must define a specific configuration for the module, including:

- Node address

  You cannot set the node address of an CIP Safety I/O module on DeviceNet networks via RSLogix 5000 software. Module node addresses are set via rotary switches on the modules.

  For information on how to set the node address, refer to the DeviceNet Safety I/O User Manual, publication 1791DS-UM001.

- Safety network number (SNN)

  See page 51 for information on setting the SNN.

- Configuration signature

  See page 56 for information on when the configuration signature is set automatically and when you need to set it.

- Reaction time limit

  See page 52 or refer to the DeviceNet Safety I/O User Manual, publication 1791DS-UM001, for information on setting the reaction time limit.

- Safety input, output, and test parameters

  Refer to the DeviceNet Safety I/O User Manual, publication 1791DS-UM001, and to RSLogix 5000 online help for more information on configuring these parameters.

You can configure CIP Safety I/O modules on DeviceNet networks via the GuardLogix controller using RSLogix 5000 software.

TIP Safety I/O modules support standard as well as safety data. Module configuration defines what data is available.

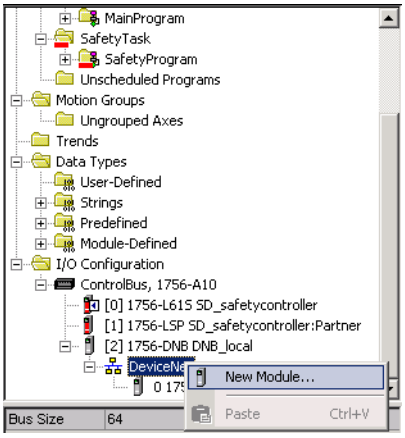
Refer to the DeviceNet Safety I/O User Manual, publication 1791DS-UM001, for details.

Configure CIP Safety I/O Modules via RSLogix 5000 Software

To communicate with a CIP Safety I/O module in your system, you add the module to the 1756-DNB under the I/O Configuration folder of the RSLogix 5000 project.

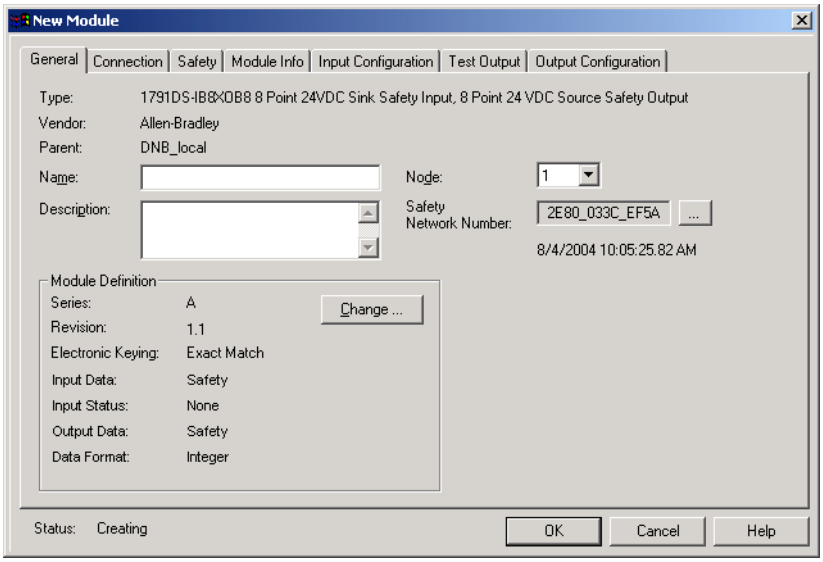
TIP You cannot add or delete a CIP Safety I/O module on DeviceNet networks while online.

1. Right-click the DeviceNet network and choose New Module.



2. Expand the Safety category and choose a CIP Safety I/O module.

3. Specify the module properties.



   a. Modify the Module Definition settings, if required, by clicking Change.

   b. Type a name for the new module.

   c. Enter the node address of the module on its connecting network.

      Only unused node numbers are included in the pull-down list.

   d. Modify the safety network number (SNN), if required, by clicking the ... button.

      See page 51 for details.

   e. Set module configuration parameters using the Input Configuration, Test Output, and Output Configuration tabs.

      Refer to RSLogix 5000 online help for more information on CIP Safety I/O module configuration.

   f. Set the Connection Reaction Time Limit using the Safety tab.

      See page 52 for details.

Set the Safety Network Number (SNN)

The assignment of a time-based SNN is automatic when adding new Safety I/O modules. Subsequent safety module additions to the same DeviceNet network are assigned the same SNN as the node with the lowest node address on that DeviceNet network.

The CIP Safety I/O module SNN is set in the module the first time that an out-of-box module is connected to the system and prior to the safety signature being applied to the controller project.

For most applications, the automatic, time-based SNN is sufficient. However, there are cases in which manipulation of an SNN is required.

See Assign the Safety Network Number (SNN) on page 34.

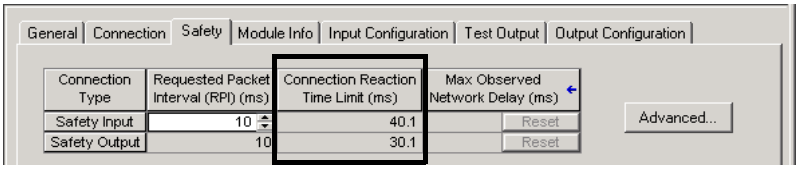
Set the Connection Reaction Time Limit

The Connection Reaction Time Limit is the maximum age of safety packets on the associated connection. If the age of the data used by the consuming device exceeds the Connection Reaction Time Limit, a connection fault occurs. The Connection Reaction Time Limit is determined by the following equations:

Input Connection Reaction Time Limit =
Input RPI x [Timeout Multiplier + Network Delay Multiplier]

Output Connection Reaction Time Limit =
Safety Task Period x [Timeout Multiplier + Network Delay Multiplier - 1]

The Connection Reaction Time Limit is shown on the Safety tab of the Module Properties dialog.

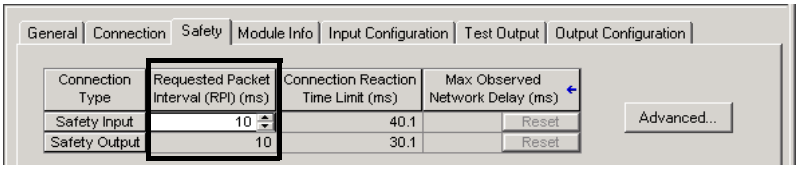


Specify the Requested Packet Interval (RPI)

The RPI specifies the period at which data updates over a connection. For example, an input module produces data at the RPI that you assign.

For safety input connections, you can set the RPI on the Safety tab of the Module Properties dialog. The RPI is entered in 1 ms increments, with a valid range of 1 through 100 ms and a default of 10 ms.

The Connection Reaction Time Limit is adjusted immediately when the RPI is changed via RSLogix 5000 software.



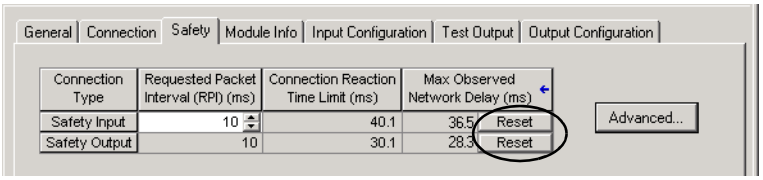
For safety output connections, the RPI is fixed at the GuardLogix safety task period. If the corresponding Connection Time Reaction Limit is not satisfactory, you can adjust the safety task period via the Safety Task Properties dialog.

See Safety Task Period Specification on page 66 for more information on the safety task period.

For simple timing constraints, setting the RPI is usually sufficient. For more complex requirements, use the Advanced button to set the Connection Reaction Time Limit parameters, as described on page 54.

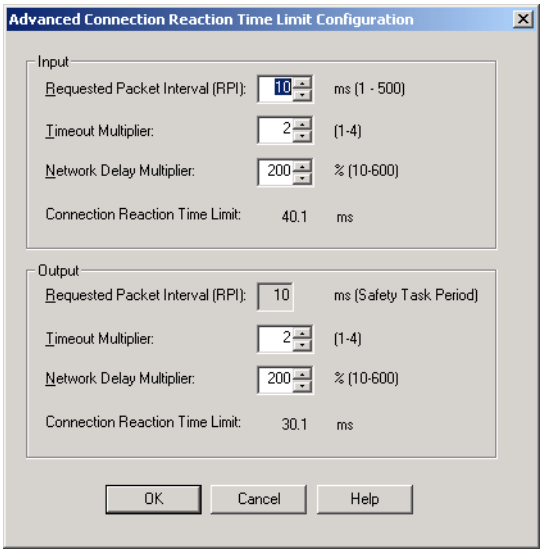
Understand the Maximum Observed Network Delay

When the GuardLogix controller receives a safety packet, the software records the maximum observed transport delay. The Maximum Observed Network Delay specifies the round-trip delay from the producer to the consumer and the acknowledge back to the producer. This Maximum Observed Network Delay value is the result of capturing the age of the data upon the arrival of the message. The Maximum Observed Network Delay is shown on the Safety tab of the Module Properties dialog. When online, you can reset the Maximum Observed Network Delay by clicking Reset.



IMPORTANT The actual Maximum Network Delay time from the producer to the consumer will always be less than the value displayed in the Maximum Network Delay field on the Safety tab. Since the CIP Safety time coordination is based on a message from the producer to the consumer and all calculations are done in a conservative manner, the actual message delay will be less than the Maximum Network Delay. In general, the actual maximum message delay will be approximately one-half the Maximum Network Delay observed.

Set the Advanced Connection Reaction Time Limit Parameters



Timeout Multiplier

The Timeout Multiplier determines the number of RPIs to wait for a packet before declaring a connection timeout. This translates into the number of messages that may be lost before a connection error is declared.

For example, a Timeout Multiplier of 1 indicates that messages must be received during every RPI interval. A Timeout Multiplier of 2 indicates that 1 message may be lost as long as at least 1 message is received in 2 times the RPI (2 x RPI).

Network Delay Multiplier

The Network Delay Multiplier defines the message transport time that is enforced by the CIP Safety protocol. The Network Delay Multiplier specifies the round-trip delay from the producer to the consumer and the acknowledge back to the producer. You can use the Network Delay Multiplier to reduce or increase the Connection Reaction Time Limit in cases where the enforced message transport time is significantly less or more than the RPI. For example, adjusting the Network Delay Multiplier may be helpful when the RPI of an output connection is the same as a lengthy safety task period.

For cases where the input RPI or output RPI are relatively slow or fast as compared to the enforced message delay time, the Network Delay Multiplier can be approximated using one of the two methods.

Method 1: Use the ratio between the input RPI and the safety task period. Use this method only under the following conditions:

- if the path or delay is approximately equal to the output path or delay, and
- the input RPI has been configured so that the actual input message transport time is less than the input RPI, and
- the safety task period is slow relative to the Input RPI.

Under these conditions, the Output Network Delay Multiplier can be approximated as follows:

Input Network Delay Multiplier x [Input RPI ÷ Safety Task Period]

EXAMPLE **Calculate the Approximate Output Network Delay Multiplier**

If:
Input RPI = 10 ms
Input Network Delay Multiplier = 200%
Safety Task Period = 20 ms

Then, the Output Network Delay Multiplier equals:
200% x [10 ÷ 20] = 100%

Method 2: Use the Maximum Observed Network Delay. If the system is run for an extended period of time through its worst-case loading conditions, the Network Delay Multiplier can be set from the Maximum Observed Network Delay. This method can be used on an input or output connection. After the system has been run for an extended period of time through its worst-case loading conditions, record the Maximum Observed Network Delay. The Network Delay Multiplier can be approximated by the following equation:

[Maximum Observed Network Delay + Margin_Factor] ÷ RPI

EXAMPLE **Calculate the Network Delay Multiplier from Maximum Observed Network Delay**

If:
RPI = 50 ms
Maximum Observed Network Delay = 20 ms
Margin_Factor = 10

Then, the Network Delay Multiplier equals:
[20 + 10] ÷ 50 = 60%

Additional Resources

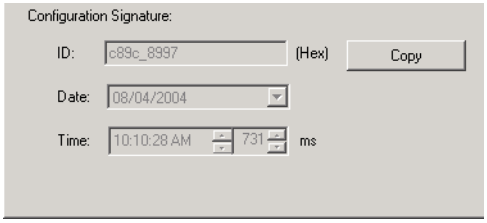
Resource	Description
GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093	Provides information on calculating reaction times
DeviceNet Safety I/O Users Manual, publication 1791DS-UM001	

Understand the Configuration Signature

Each safety device has a unique configuration signature, which identifies the module configuration to verify the integrity of configuration data during downloads, connection establishment, and module replacement. The configuration signature is composed of an ID number, a date, and a time.

Configured via RSLogix 5000 Software

When the I/O module is configured using RSLogix 5000 software, the configuration signature is generated automatically. You can view and copy the configuration signature via the Safety tab on the Module Properties dialog.



Different Configuration Owner (Listen Only Connection)

When the I/O module configuration is owned by a different controller, you need to copy the module configuration signature from its owner's project and paste it into the Safety tab of the Module Properties dialog.

TIP If the module is configured for inputs only, you can copy and paste the configuration signature. If the module has safety outputs, they are owned by the controller that owns the configuration, and the configuration signature text box is unavailable.

Reset Safety I/O Module Ownership

When RSLogix 5000 software is online, the Safety tab of the Module Properties dialog displays the current configuration ownership. When the opened project owns the configuration, Local is displayed. When a second device owns the configuration, Remote is displayed, along with the safety network number (SNN), and node address or slot number of the configuration owner. Communication error is displayed if the module read fails.

When online, you can reset the module to its out-of-box configuration by clicking Reset Ownership.

TIP You cannot reset ownership when there are pending edits to the module properties, when a safety signature exists, or when safety-locked.

Address Safety I/O Data

When you add a module to the I/O configuration folder, RSLogix 5000 software automatically creates controller-scoped tags for the module.

I/O information is presented as a set of tags. Each tag uses a structure of data, depending on the type and features of the I/O module. The name of a tag is based on its name in the system.

A CIP Safety I/O device on a DeviceNet network follows this format:

Modulename:Type.Member

CIP Safety I/O Module Address Format

Where	Is	
Modulename	The name of the CIP Safety I/O module	
Type	Type of data	
	Input Module: I	
	Output Module: O	
Member	Specific data from the I/O module	
	Input-only Module:	Modulename:I.RunMode Modulename:I.ConnectionFaulted Modulename:I.Input Members
	Output-only Module:	Modulename:I.RunMode Modulename:I.ConnectionFaulted Modulename:O.Output Members
	Combination I/O:	Modulename:I.RunMode Modulename:I.ConnectionFaulted Modulename:I.Input Members Modulename:O.Output Members

Additional Resources

Resource	Description
Chapter 7, Monitor Status and Handle Faults	Contains information on monitoring safety tag data
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides information on addressing standard I/O modules

Monitor Safety I/O Module Status

You can monitor system status via the LED indicators on the I/O modules and via input and output status codes.

Monitor via LED Indicators

LED indicators on the safety I/O modules indicate system status.

LED Indicator Operation

LED	Color/State	Description
Module Status (MS)	Off	No power.
	Green, On	Operating under normal conditions.
	Green, Flashing	Device is idle.
	Red, Flashing	A recoverable fault exists.
	Red, On	An unrecoverable fault exists.
	Red/Green, Flashing	Self-tests in progress.
Network Status (NS)	Off	Device is not online or may not have power.
	Green, On	Device is online; connections are established.
	Green, Flashing	Device is online; no connections established.
	Red, Flashing	Communication timeout.
	Red, On	Communication failure. The device has detected an error that has prevented network communication.
	Red/Green, Flashing	Device is in Communication Faulted state or safety network number (SNN) is being set.
Input Points (INx)	Off	Safety input is OFF.
	Yellow, On	Safety input is ON.
	Red, On	An error has occurred in the input circuit.
	Red, Flashing	When dual-channel operation is selected, an error has occurred in the input circuit.

LED Indicator Operation

LED	Color/State	Description
Output Points (Ox)	Yellow, Off	Safety output is OFF.
	Yellow, On	Safety output is ON.
	Red, Flashing	When dual-channel operation is selected, an error has occurred in the output circuit.
	Red, On	An error has occurred in the output circuit.
LOCK	Yellow, On	Device configuration is locked.
	Yellow, Flashing	Device configuration is valid, but device is not locked.
	Yellow, Off	Invalid or no configuration data.
IN PWR	Green, On	Input power normal.
	Green, Off	No input power.
OUT PWR	Green, On	Output power normal.
	Green, Off	No output power or output power exceeds the upper/lower limit of the power range.

Monitor Input and Output Status Data

You can monitor Safety I/O module status data via explicit messaging.

The DeviceNet Safety I/O User Manual, publication 1791DS-UM001, provides information on explicit messaging and I/O module troubleshooting.

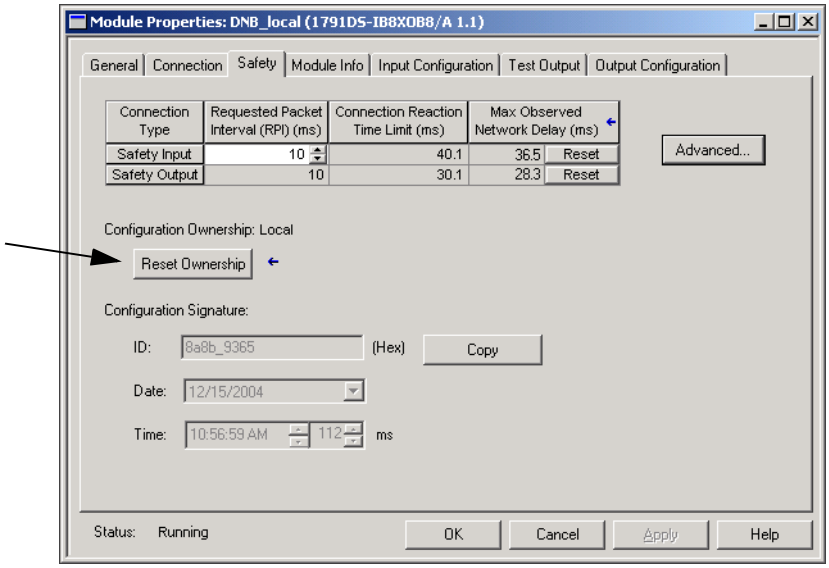
Replace a CIP Safety I/O Module

To replace a CIP Safety I/O module on DeviceNet networks, you must prepare the new module for installation and determine whether you need to use the Configure Always feature.

Prepare the I/O Module

1. Set the node address of the replacement module.
2. Be sure that the replacement module is of the correct type and in out-of-box condition.

3. Return the module to the out-of-box condition, if necessary, by clicking Reset Ownership on the Safety tab of the Module Properties dialog.

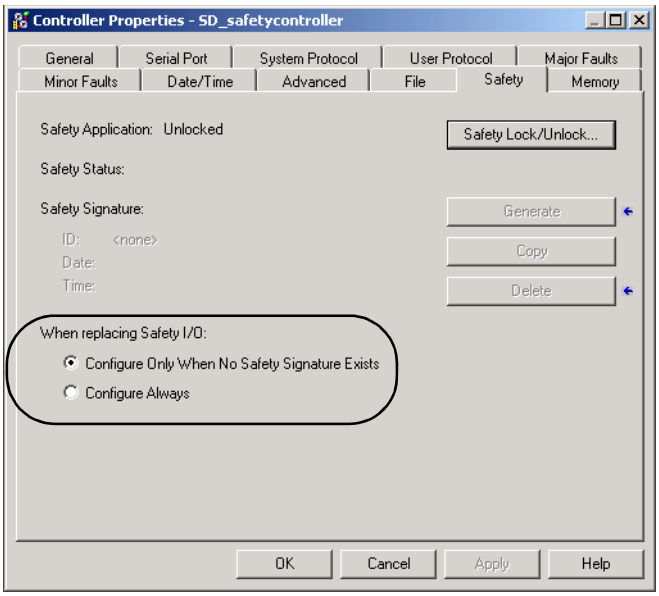


IMPORTANT You must clear any pre-existing configuration from a safety device prior to installing it on a safety network.

If you are relying on a portion of the CIP Safety system to maintain SIL 3 behavior during module replacement and functional testing, the Configure Always feature may not be used. Follow the I/O Replacement with Configure Always Disabled procedure on page 61.

If the entire routable CIP Safety Control System is not being relied on to maintain SIL 3 during the replacement and functional testing of a module, the Configure Always feature may be used. Follow the I/O Replacement With Configure Always Enabled procedure on page 63.

TIP The Configure Always option is located on the Safety tab of the Controller Properties dialog. The default setting is Configure Only When No Safety Signature Exists.



I/O Replacement with Configure Always Disabled

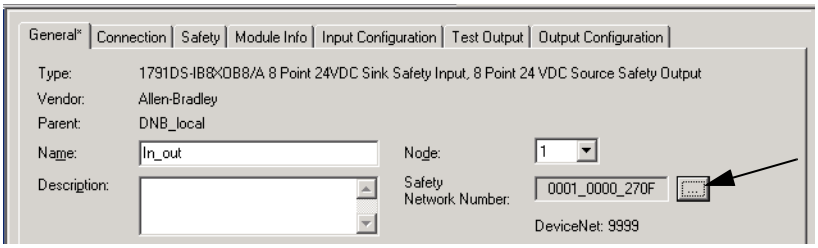
ATTENTION If other parts of the CIP Safety Control Systems are being relied upon to maintain SIL 3 behavior during the replacement and functional testing of a module, be sure that the Configure Always feature is disabled.

If the project has a safety signature and the Configure Always feature is disabled, follow the procedure below to replace a module.

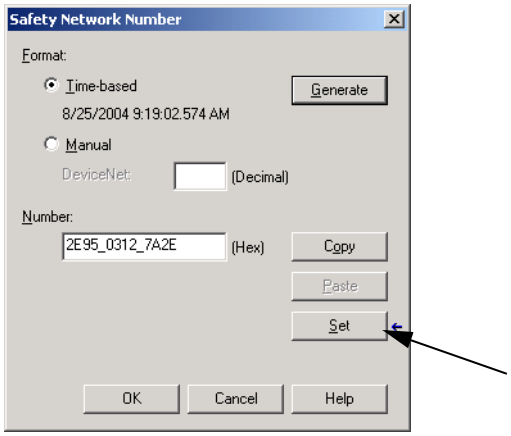
1. Remove the old I/O module and install the new module.
2. Restore power to the system if it was removed during replacement.

   The controller will recognize the replacement module, and annunciate an out-of-box error.
3. Go online to the controller using RSLogix 5000 software to set the safety network number (SNN).
4. Go to the General tab of the Module Properties dialog for the replaced module.

5. Click ... to the right of the safety network number to open the Safety Network Number dialog.

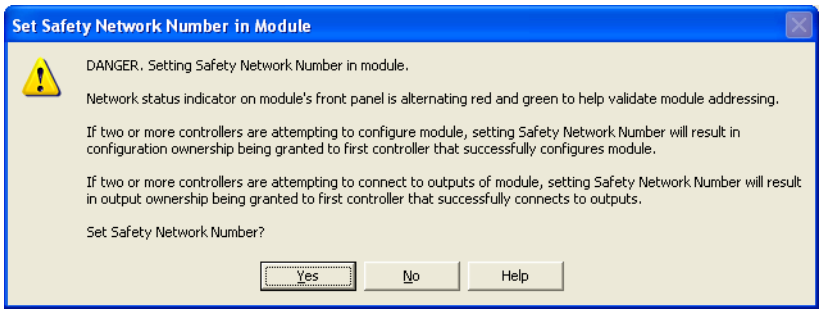


6. Click Set.



The Set Safety Network Number in Module confirmation dialog appears.

7. Verify that the Network Status (NS) LED indicator is alternating red/green on the correct module before clicking Yes to set the SNN and accept the replacement module.



8. Follow your company-prescribed procedures to functionally test the replaced I/O module and system and to authorize the system for use.

I/O Replacement With Configure Always Enabled

ATTENTION

Enable the Configure Always feature only if the entire CIP Safety Control System is not being relied on to maintain SIL 3 behavior during the replacement and functional testing of a module.

Do not place any modules that are in the out-of-box condition on any CIP Safety network when the Configure Always feature is enabled, except while following the module replacement procedure using Configure Always.

When the Configure Always feature is enabled in RSLogix 5000 software, the controller automatically checks for and accepts a replacement module that meets all of the following requirements:

- The controller has configuration data for a compatible module at that network address.
- The module is in out-of-box condition.

When a safety signature exists and the Configure Always feature is enabled, follow the procedure below to replace an I/O module.

1. Remove the old I/O module and install the new module.

   The controller will recognize, accept, and configure the replacement module.

2. Follow your company-prescribed procedures to functionally test the replaced I/O module and system and to authorize the system for use.

Develop Safety Applications

Introduction

This chapter explains the components that make up a safety project, including the safety task, safety programs, safety routines, and safety tags. It also provides information on using features that help protect safety application integrity, such as the safety signature and safety-locking.

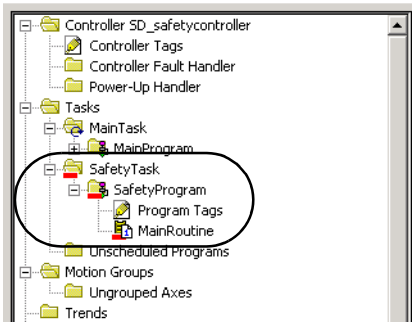
For guidelines and requirements for developing and commissioning SIL 3 and CAT 4 safety applications, refer to the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093.

The Safety Reference Manual addresses:

- creating a detailed project specification.
- writing, documenting, and testing the application.
- generating the safety signature to identify and protect the project.
- confirming the project by printing or displaying the uploaded project and manually comparing the configurations, safety data, and safety program logic.
- verifying the project through test cases, simulations, functional verification tests, and an independent safety review, if required.
- locking the safety application.

The Safety Task

When you create a new safety controller project, RSLogix 5000 software automatically creates a safety task with a safety program and a main (safety) routine.

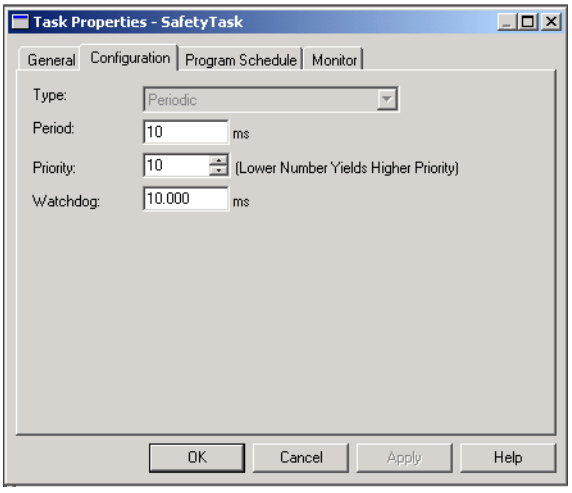


Within the safety task, you can use multiple safety programs, composed of multiple safety routines. The GuardLogix controller supports a single safety task. The safety task cannot be deleted.

You cannot schedule standard programs or execute standard routines within the safety task.

Safety Task Period Specification

The safety task is a periodic/timed task. You select the task priority and watchdog time via the Task Properties - Safety Task dialog. Open the dialog by right-clicking the Safety Task and choosing Properties.



The safety task should be the controller's top priority. You specify both the safety task period (in ms) and the safety task watchdog (in ms). The safety task period is the period at which the safety task executes. The safety task watchdog is the maximum time allowed from the start of safety task execution to its completion.

The safety task period is limited to a maximum of 100 ms and cannot be modified online. Be sure that the safety task has enough time to finish before it is triggered again. Safety task watchdog timeout, a nonrecoverable safety fault in the GuardLogix controller, occurs if the safety task is triggered while it is still executing from the previous trigger.

The safety task period and safety task watchdog affect the system reaction time.

The GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093, provides detailed information on calculating system reaction time.

Safety Task Execution

The safety task executes in the same manner as a standard periodic task, with the following exceptions.

- The safety task does not begin executing until the primary controller and safety partner have established their control partnership and the coordinated system time (CST) is synchronized. However, standard tasks begin executing as soon as the controller transitions to Run mode.
- Safety input tags and safety-consumed tags are updated at the beginning of safety task execution.
- Safety input values are updated and then frozen at the start of each safety task execution.
- For standard tags that are mapped to safety tags, the standard tag values are copied into safety memory at the start of safety task execution.

  See page 77 for information on safety tag mapping.
- Safety-produced tags are produced at the conclusion of safety task execution.
- Safety output tag values are sent to safety outputs at the conclusion of safety task execution.

Safety Programs

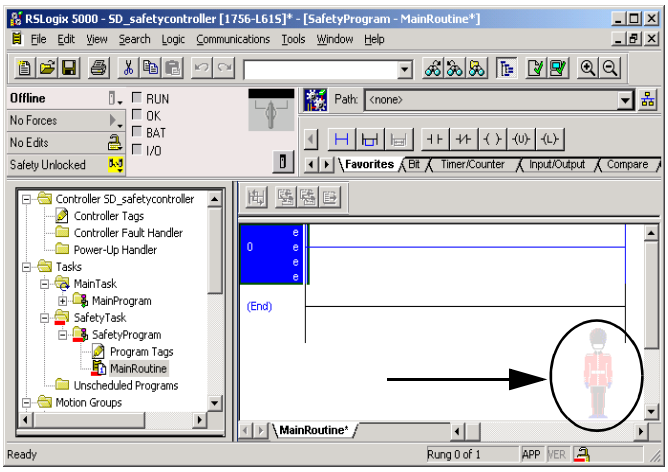
Safety programs have all the attributes of standard programs, except that they can only be scheduled in the safety task and can only contain safety components. Safety programs can only contain safety routines, one of which must be designated as the main routine, and one of which may be designated as the fault routine. Safety programs may also define program-scoped safety tags.

Safety programs cannot contain standard routines or standard tags.

Safety Routines

Safety routines have all the attributes of standard routines, except that they can exist only in a safety program. At this time, only relay ladder logic is supported for safety routines.

TIP RSLogix 5000 software uses a watermark feature to visually distinguish a safety routine from a standard routine.



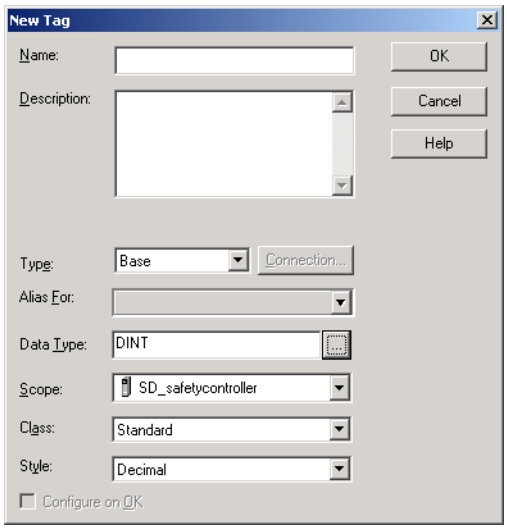
Safety Tags

A tag is a text-based name for an area of a controller's memory where data is stored. Tags are the basic mechanism for allocating memory, referencing data from logic, and monitoring data. Safety tags have all the attributes of standard tags with the addition of mechanisms certified to provide SIL 3 data integrity.

When you create a tag, you assign the following properties.

- Name
- Description (optional)
- Tag type
- Data type
- Scope
- Class
- Style

Open the New Tag dialog by right-clicking Controller Tags or Program Tags and choosing New Tag.



Tag Type

There are four types of tags: base, alias, produced, and consumed.

Tag Type	Description
Base	These tags store values for use by logic within the project.
Alias	A tag that references another tag. An alias tag can refer to another alias tag or a base tag. An alias tag can also refer to a component of another tag by referencing a member of a structure, an array element, or a bit within a tag or member. **IMPORTANT:** Aliasing between standard and safety tags is prohibited in safety applications.
Produced	A tag that a controller makes available for use by other controllers. A maximum of 15 controllers can simultaneously consume (receive) the data. A produced tag sends its data to one or more consuming tags without using logic. Produced tag data is sent at the RPI of the consuming tag.
Consumed	A tag that receives the data of a produced tag. The data type of the consumed tag must match the data type of the produced tag. The requested packet interval (RPI) of the consumed tag determines the period at which the data updates.

Data Type

The data type defines the type of data that the tag stores, such as bit, integer, floating-point value, or string.

Data types can be combined into a structure. A structure is formatted to create a unique data type that matches a specific need. Within a structure, each individual data type is called a member. Like tags, members have a name and data type. You can create your own structures, as user-defined data types.

All Logix controllers contain predefined data types for use with specific instructions. You can create safety tags of any valid data type.

Valid Data Types for Safety Tags

BOOL	FBD_CONVERT	REDUNDANT_INPUT
CAM_PROFILE	FBD_COUNTER	REDUNDANT_OUTPUT
CONNECTION_STATUS	FBD_LOGICAL	SERIAL_PORT_CONTROL
CONTROL	FBD_MASK_EQUAL	SFC_ACTION
COUNTER	FBD_MASKED_MOVE	SFC_STEP
DINT	FBD_TIMER	SFC_STOP
DIVERSE_INPUT	FIVE_POS_MODE_SELECTOR	SINT
EMERGENCY_STOP	INT	STRING
ENABLE_PENDANT	LIGHT_CURTAIN	TIMER
EXT_ROUTINE_CONTROL	MOTION_INSTRUCTION	TWO_HAND_RUN_STATION
EXT_ROUTINE_PARAMETERS	PHASE	
FBD_BIT_FIELD_DISTRIBUTE	PHASE_INSTRUCTION	

IMPORTANT This restriction includes user-defined data types that contain predefined data types.

Scope

A tag's scope determines where you can access the tag data. When you create a tag, you define it as either a controller tag (global data) or a program tag for a specific safety or standard program (local data). Safety tags can be either controller-scoped or safety-program-scoped.

Controller-scoped Tags

When tags are controller-scoped, all standard programs have access to the safety data. Tags must be controller-scoped if they are:

- used in more than one program in the project.
- used in a MSG instruction.
- used to produce or consume data.
- used to communicate with a PanelView terminal.
- used in safety tag mapping.
  See Safety Tag Mapping on page 77 for more information.

Controller-scoped safety tags can be read, but not written to, by standard routines.

IMPORTANT Controller-scoped safety tags are readable by any standard routine, but the safety tag's update rate is based on the execution of the safety task.

Tags associated with safety I/O and produced or consumed safety data must be controller-scoped safety tags. For produced/consumed safety tags, you must create a user-defined data type with the first member of the tag structure containing the status of the connection. This member is a predefined data type called CONNECTION_STATUS.

Additional Resources

Resource	Description
Safety Connections on page 100	Provides more information on the CONNECTION_STATUS member
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides instructions for creating user-defined data types

Program-scoped Tags

When tags are program-scoped, the data is isolated from the other programs. Reuse of program-scoped tag names is permitted between programs.

Safety-program-scoped safety tags can only be read by or written to via a safety routine scoped in the same safety program.

Class

Tags can be classified as either standard or safety. Tags classified as safety tags must have a valid data type and must be either controller-scoped or safety-program-scoped.

When you create program-scoped tags, the class is automatically specified, depending upon whether the tag was created in a standard or safety program.

When you create controller-scoped tags, you must manually select the tag class.

Produced/Consumed Safety Tags

To transfer safety data between GuardLogix controllers, you use produced and consumed safety tags. Produced and consumed tags require connections that must be configured.

Produced and Consumed Connections

Tag	Connection Description
Produced	A produced safety tag lets GuardLogix controllers share safety data with Safety Integrity Level (SIL) 3 integrity. The producing conroller uses two connections for each consumer: one for safety data and one for time coordination.
Consumed	GuardLogix controllers can consume safety tags from other GuardLogix controllers. Each consumed tag (or UDT) consumes two connections: one for safety data and one for time coordination.

Produced and consumed safety tags are subject to the following restrictions:

- Only controller-scoped tags can be shared.
- Produced and consumed safety tags are limited to 128 bytes.
- Produced/consumed tag pairs must be of the same user-defined data type.
- The first member of that user-defined data type must be the predefined CONNECTION_STATUS data type.
- The request packet interval (RPI) of the consumed safety tag must match the safety task period of the producing safety project.

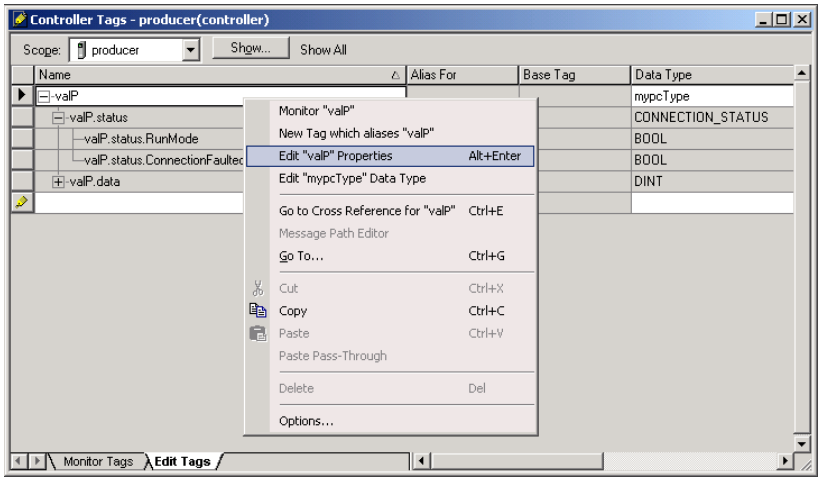
Produce a Safety Tag

Follow this procedure to produce a safety tag.

1. Open the GuardLogix controller project that contains the tag you want to produce.

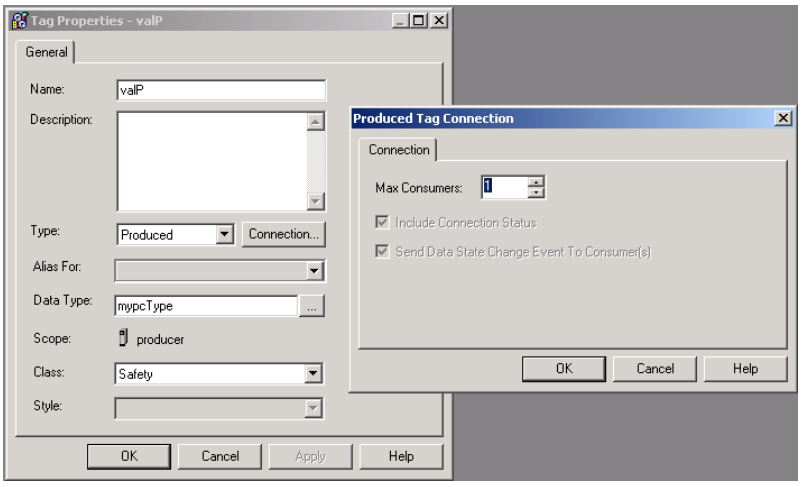
2. In the Controller Organizer, right-click the Controller Tags folder and choose Edit Tags.

3. In the Controller Tags dialog, right-click the tag you want to produce and choose Edit Tag Properties.



4. In the Tag Properties dialog, click Connection to open the Produced Tag Connection dialog.

5. Enter the number of controllers that will consume (receive) the data.



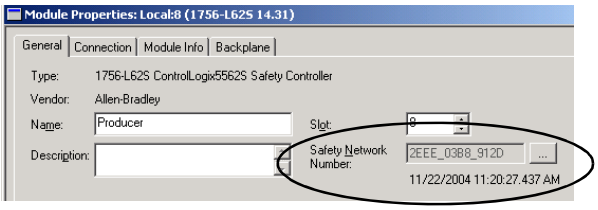
6. Click OK.

Consume Safety Tag Data

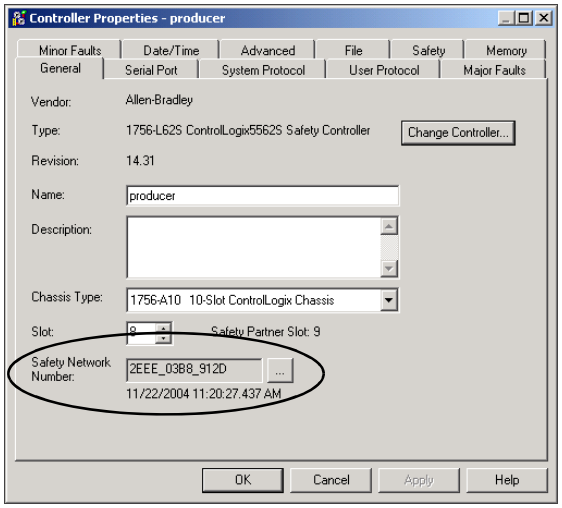
Follow these steps to consume data produced by another controller.

1. Open the GuardLogix project that will consume the data.
2. Add the controller producing the data to the I/O Configuration folder.
3. Verify that the safety network number (SNN) shown on the producer controller's Module Properties dialog in the consumer's safety project matches the SNN that is configured in the producer controller's project, as shown on the producer controller's Controller Properties dialog.

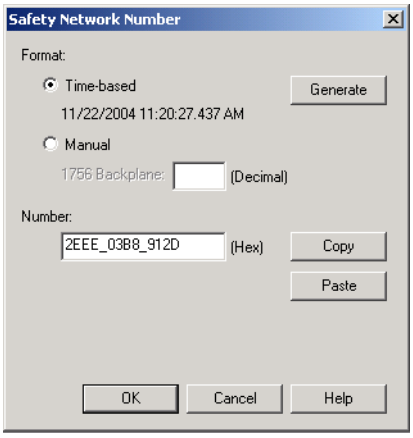
Producer Module Properties Dialog in Consumer Project



Producer Controller Properties in Producer Project



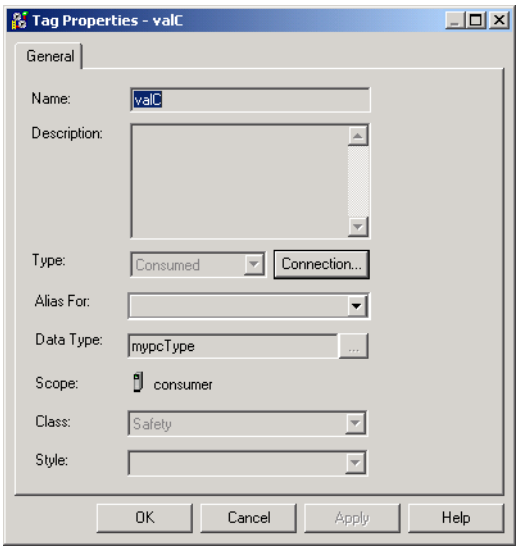
TIP An SNN can be copied and pasted using buttons on the Safety Network Number dialog.



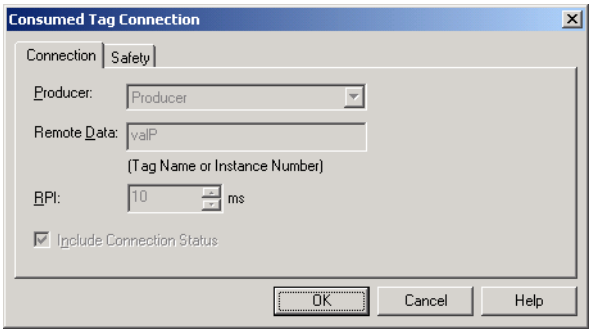
4. In the Controller Organizer, right-click the Controller Tags folder and choose Edit Tags.

5. In the Controller Tags dialog, right-click the tag that will consume the data and choose Edit Tag Properties.

6. In the Tag Properties dialog, click Connection to open the Consumed Tag Connection dialog.



7. Configure the consumed tag connection properties on the Connection tab.



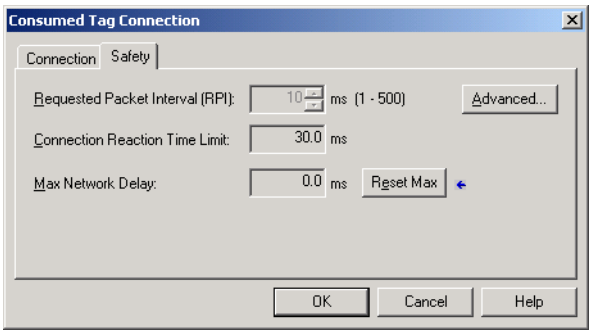
   a. Select the controller that produces the data.

   b. Enter the name of the produced tag.

   c. Enter the requested packet interval (RPI) for the connection in 1 ms increments. The default is 20 ms.

      The RPI specifies the period at which data updates over a connection. The RPI of the consumed safety tag must match the safety task period of the producing safety project.

8. Choose the Safety tab to further refine the timing parameters.



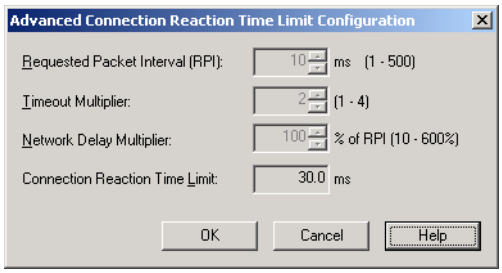
The Connection Reaction Time Limit is the maximum age of safety packets on the associated connection. For simple timing constraints, an acceptable Connection Reaction Time Limit can be achieved by adjusting the RPI.

For more complex requirements, set the Advanced Connection Reaction Time Limit parameters as described in step 9.

The Max. Network Delay is the maximum observed transport delay from the time the data was produced until the time the data was received. When online, you can reset the Max. Network Delay by clicking Reset Max.

9. If the Connection Reaction time limit is acceptable, click OK.

10. To set the Advanced Connection Reaction Time Limit parameters, click Advanced.



The Timeout Multiplier determines the number of RPIs to wait for a packet before declaring a connection timeout.

The Network Delay Multiplier defines the message transport time that is enforced by the CIP Safety protocol. The Network Delay Multiplier specifies the round-trip delay from the producer to the consumer and back to the producer. You can use the Network Delay Multiplier to increase or decrease the Connection Reaction Time Limit.

Additional Resources

Resource	Description
pages 52…55	Provides more information on setting the RPI and understanding how the Max. Network Delay, Timeout Multiplier, and Network Delay Multipliers affect the Connection Reaction Time
Chapter 7	Provides information on the CONNECTION_STATUS predefined data type
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides instructions for creating user-defined data types

Safety Tag Mapping

Controller-scoped standard tags cannot be accessed by a safety routine, because the data is not high integrity. To allow standard tag data to be used within the safety task's routines, the GuardLogix controller provides a safety tag mapping feature that allows a standard tag value to be copied into the safety task's memory at the start of the safety task's execution.

Restrictions

Safety tag mapping is subject to these restrictions.

- The safety tag and standard tag pair must be controller-scoped.
- The data types of the safety and standard tag pair must match.
- Alias tags are not allowed.
- Mapping must take place at the whole tag level. For example, myTimer.pre is not allowed if myTimer is a TIMER tag.
- One safety tag may be mapped to one standard tag.
- Tag mapping cannot be modified when:
  - the project is safety-locked.
  - a safety signature exists.
  - the keyswitch is in RUN position.
  - a nonrecoverable safety fault exists.
  - an invalid partnership exists between the primary controller and safety partner.

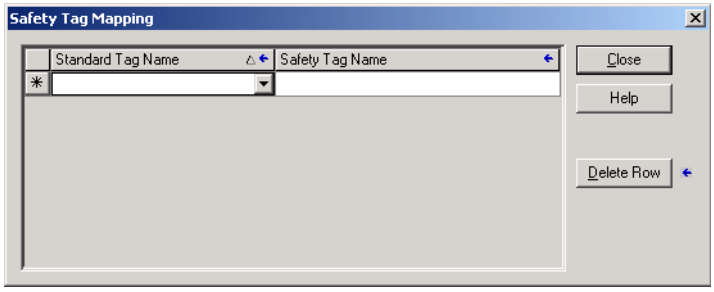
ATTENTION

When using standard data in a safety routine, you are responsible for providing a reliable means of ensuring that the data is used in an appropriate manner. Using standard data in a safety tag does not make it safety data. You must not directly control a safety output with standard tag data.

Refer to the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093 for more information.

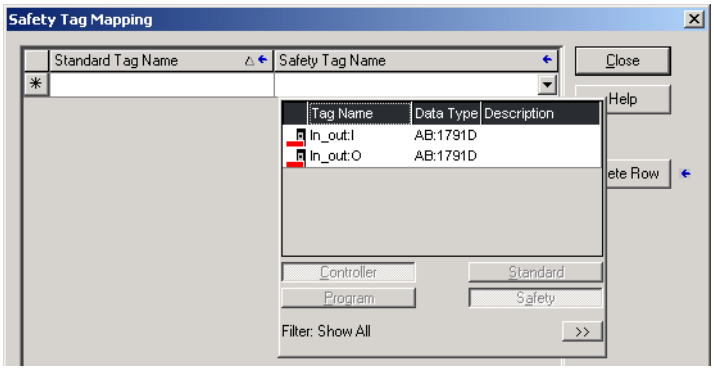
Create Tag Mapping Pairs

1. Choose Map Safety Tags from the Logic menu to open the Safety Tag Mapping dialog.



2. Add an existing tag to either the Standard Tag Name or Safety Tag Name column by:
   - typing the tag name into the cell.
   - selecting a tag from the pull-down list.

   Clicking the pull-down arrow to display a filtered tag browser dialog. If you are in the Standard Tag Name column, the browser shows only controller-scoped standard tags. If you are in the Safety Tag Name column, the browser shows controller-scoped safety tags.



3. Add a new tag to either the Standard Tag Name or Safety Tag Name column by:
   - right-clicking in the empty cell and selecting New Tag
   - typing the tag name into the cell.

4. Right-click in the cell and choose New tagname, where tagname is the text you entered in the cell.

Monitor Tag Mapping Status

The left-most column of the Safety Tag Mapping dialog indicates the status of the mapped pair.

Tag Mapping Status Icons

Cell Contents	Description
Empty	Tag mapping is valid
	When offline, the X icon indicates that tag mapping is invalid. You can move to another row or close the Safety Tag Mapping dialog.(1) When online, an invalid tag map results in an error message explaining why the mapping is invalid. You cannot move to a different row or close the Safety Tag Mapping dialog if a tag mapping error exists.
	Indicates the row that currently has the focus
	Represents the Create New Mapped Tag row
	Represents a pending edit

(1) Tag mapping is also checked during project verification. Invalid tag mapping results in a project verification error.

For more information, see the tag mapping restrictions on page 77.

Safety Application Protection

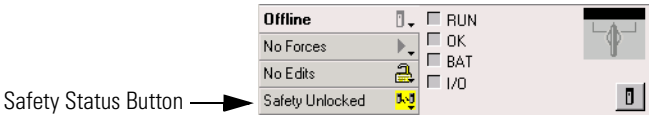
Safety-lock the Controller

The GuardLogix controller system can be Safety-locked to protect safety-related control components from modification. The Safety-lock feature applies only to safety components, such as the safety task, safety programs, safety routines, safety tags, Safety I/O, or safety signature.

The following actions are not permitted in the safety portion of the application when the controller is safety-locked:

- Online/offline programming or editing
- Forcing safety I/O
- Changing the inhibit state of safety I/O or producer controllers
- Data manipulation (except by safety routine logic)
- Generating or deleting the safety signature

TIP The text of the online bar's safety status button indicates the safety-lock status.



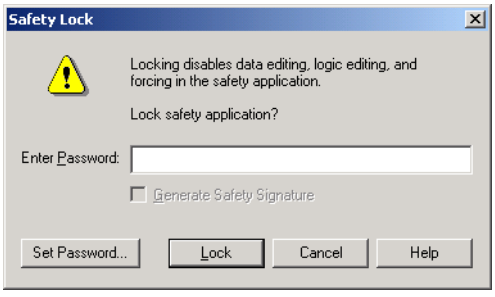
The application tray also displays the following icons to indicate the safety controller's safety-lock status.

- = controller safety-locked
- = controller safety-unlocked

You can safety-lock the controller project regardless of whether you are online or offline and regardless of whether you have the original source of the program. However, no safety forces or pending online safety edits may be present.

Safety-locked or -unlocked status cannot be changed when the keyswitch is in the RUN position.

You can Safety-lock and -unlock the controller from the Safety tab of the Controller Properties dialog or by choosing Safety > Safety Lock/Unlock from the Tools > Safety menu.



If you set a password for the safety-Lock feature, you must type it in the Enter Password field. Otherwise, click Lock.

You can also set or change the password from the Safety Lock dialog. See page 26.

In addition to the safety-lock feature described in this section, the standard RSLogix Security measures are also applicable to GuardLogix controller applications.

Refer to the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001, for information on RSLogix 5000 Security features.

Generate a Safety Signature

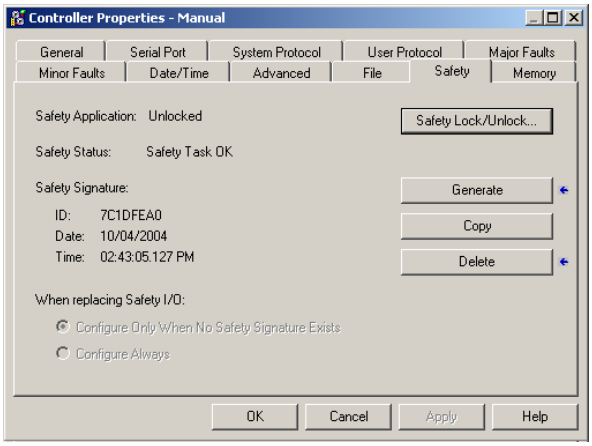
Before verification testing, you must generate the safety signature. You can generate the safety signature only when the GuardLogix controller is online, in Program mode, safety-unlocked, and has no safety forces, pending online safety edits, or safety faults. The safety status must equal Safety Task OK.

TIP You can view the safety status via the safety status button on the online bar (see page 99) or on the Safety tab of the Controller Properties dialog, as shown on page 81.

When a safety signature exists, the following actions are not permitted in the safety portion of the application.

- Online/offline programming or editing
- Forcing Safety I/O
- Changing the inhibit state of safety I/O or producer controllers
- Data manipulation (except by safety routine logic)

You can generate the safety signature from the Safety tab of the Controller Properties dialog by clicking Generate. You can also choose Safety > Generate Signature from the Tools menu.



If a previous signature exists, you will be prompted to overwrite it.

Copy the Safety Signature

You can use the Copy button to create a record of the safety signature for use in safety project documentation, comparison, and validation. When you click Copy, the ID, Date, and Time components are copied to the Windows clipboard.

Delete the Safety Signature

You can use the Delete button to delete the safety signature only when the controller is Safety-unlocked. The safety signature cannot be deleted when the controller is in Run mode with the keyswitch in RUN.

ATTENTION

If you delete the safety signature, you must retest and revalidate your system to meet SIL 3.

Refer to the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093, for more information on SIL 3 requirements.

Software Restrictions

Restrictions limiting the availability of some menu items and features (that is, cut, paste, delete, search and replace) are imposed by the programming software to protect safety components from being modified whenever:

- the controller is safety-locked.
- a safety signature exists.
- safety faults are present.
- safety status is:
  - partner missing.
  - partner unavailable.
  - hardware incompatible.
  - firmware incompatible.

If any of those conditions apply, you may not:

- create new safety objects, including safety programs, safety routines, safety tags, and safety I/O modules.
- modify existing safety objects, including safety programs, safety routines, safety tags, and safety I/O modules.

IMPORTANT The scan times of the safety task and any safety programs can be reset when online.

- edit safety routines.
- modify safety tag values using the tag monitor.
- apply forces to safety tags.
- create new safety tag mappings.
- modify or delete existing tag mappings.
- modify or delete user-defined data types that are utilized by safety tags.
- modify the controller name, description, chassis type, slot, and safety network number.
- modify or delete the safety signature, when safety-locked.

Go Online with the Controller

Introduction

Connect the Controller to the Network

If you have not already done so, connect the controller to the network.

Network Connections

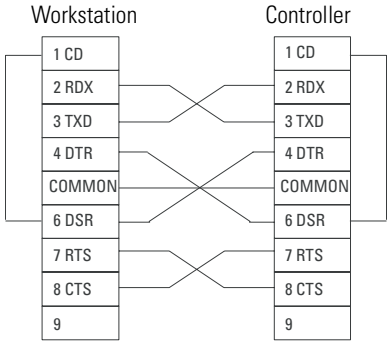
For This Network	Connect the Controller via a
Serial	1756-CP3 or 1747-CP3 cable
EtherNet/IP	1756-ENBT module in an open slot in the same chassis as the controller
DeviceNet	1756-DNB module in an open slot in the same chassis as the controller
ControlNet	1756-CN2 module in an open slot in the same chassis as the controller to bridge to safety I/O 1756-CNB module in an open slot in the same chassis as the controller to bridge to standard I/O

Connect the Controller via a Serial Network

The 1756-CP3 cable attaches the serial port of the workstation directly to the controller.

TIP If you make your own cable:

- limit the length to 15.2 m (50 ft).
- wire the connectors as shown below.
- attach the shield to both connectors.



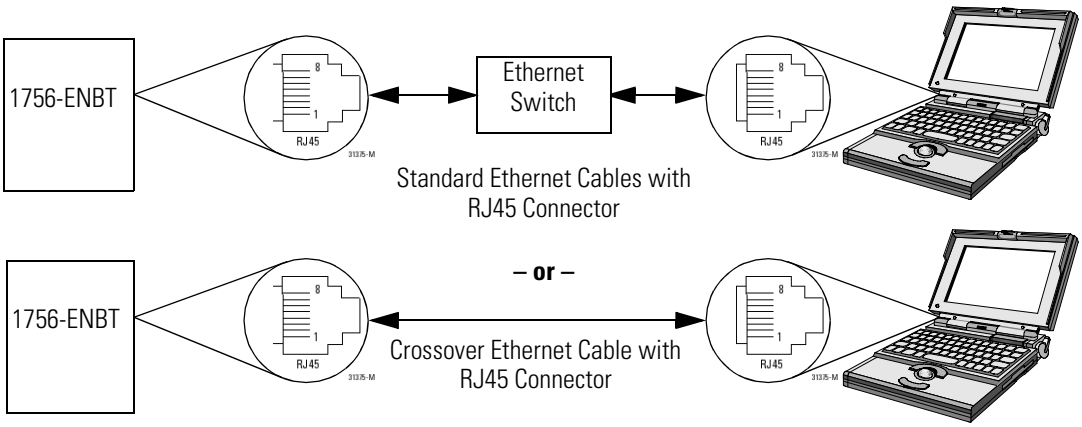
You can also use a 1747-CP3 cable from the SLC product family, but once the cable is connected, you cannot close the controller door.

Connect Your EtherNet/IP Device and Computer

WARNING

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

Connect your EtherNet/IP device and computer using Ethernet cable.



Connect Your DeviceNet Scanner or ControlNet Communication Module and Your Computer

To access either the DeviceNet network or the ControlNet network, you can:

- connect directly to the network.
- connect to a serial or EtherNet/IP network and browse (bridge) to the desired network. This requires no additional programming.

Configure the Network Driver

RSLinx software handles communication between GuardLogix controllers and RSLogix 5000 software. To communicate with the controller, configure RSLinx software for the required communication network.

Network Drivers

For This Network	Configure This Driver
Serial	RS-232 DF1devices
EtherNet/IP	EtherNet/IP driver or Ethernet devices
DeviceNet	DeviceNet drivers
ControlNet	ControlNet drivers

Configure a Serial Communications Driver

1. Start RSLinx software.
2. From the Communications menu, choose Configure Drivers.
3. From the Available Driver Types list, select the driver.
4. Click Add New.
5. Click OK to accept the default name for the driver.
6. From the Comm Port pull-down list, select the serial port (on the workstation) to which the cable is connected.
7. From the Device pull-down menu, choose Logix5550 Serial Port.
8. Click Auto-Configure.

9. Does the dialog display the following message?

   Auto Configuration Successful!

If	Then
Yes	Click OK.
No	Go to Step 6 and verify that you selected the correct comm port.

10. Click Close.

Configure an EtherNet/IP, DeviceNet, or ControlNet Driver

For information on configuring an EtherNet/IP or DeviceNet driver, refer to the appropriate publication.

- EtherNet/IP Modules in Logix5000 Control Systems, publication ENET-UM001
- DeviceNet Modules in Logix5000 Control Systems, publication DNET-UM004
- The ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001

Understand the Factors that Affect Going Online

RSLogix 5000 software determines whether you can go online with a target controller based on whether the offline project is new or whether changes have occurred in the offline project. If the project is new, you must first download the project to the controller. If changes have occurred to the existing project, you will be prompted to upload or download. If no changes have occurred, you can go online to monitor the execution of the project.

A number of factors affect these processes, including Project to Controller Match feature, the safety status between the primary controller and safety partner, the existence of a safety signature, and the safety-lock/-unlock status of the project and the controller.

Project to Controller Matching

The Project to Controller Match feature affects the download, upload, and go online processes of all projects, both standard and safety.

If the Project to Controller Match feature is enabled in the offline project, RSLogix 5000 software compares the serial number of the controller in the offline project to that of the connected controller. If they do not match, you must either cancel the download/upload, connect to the correct controller, or confirm that you are connected to the correct controller, which will update the serial number in the project to match the target controller.

Firmware Revision Matching

Firmware revision matching affects the download process. If the revision of the controller does not match the revision of the project, you are prompted to update the firmware of the controller. RSLogix 5000 software lets you update the firmware as part of the download sequence.

IMPORTANT To update the firmware of the controller, first install a firmware upgrade kit. An upgrade kit ships on a supplemental CD along with RSLogix 5000 software.

TIP Firmware upgrades can also be performed via the Tools > ControlFlash menu in RSLogix 5000 software.

Safety Partner Status/Faults

Upload of program logic and going online is allowed regardless of safety status. Safety status affects the download process only.

You can view the safety status via the Safety tab on the Controller Properties dialog.

Safety Status

Safety Status/Fault Condition	Action Required
Safety partner is missing or unavailable.	Install a compatible safety partner.
Safety partner hardware is incompatible with primary controller.	Install a compatible safety partner.
Safety partner firmware is incompatible with the primary controller.	Update the safety partner with the correct firmware revision. The safety partner's firmware revision must be an exact match to the primary controller's.
Safety status OK.	None. The software proceeds to check for the existence of a safety signature in the offline project. See Safety Signature and Safety-locked/-unlocked Status below.
Safety task inoperable.	

Safety Signature and Safety-locked/-unlocked Status

On Upload

If the controller contains a safety signature, it is uploaded with the project. The safety-lock status of the uploaded project is set to that of the online project. For example, if the online project was safety-unlocked, it remains safety-unlocked following the upload, even if the offline project was locked prior to the upload.

Following an upload, the safety signature also matches the status of the uploaded project. If a safety signature existed in the offline project, but there is no safety signature in the controller, the offline safety signature is deleted during the upload.

On Download

For safety projects, the existence of a safety signature in the controller, as well as the controller's safety-lock status, determines whether or not a download can proceed. Following a successful download, the controller's safety-lock status is set to the original value of the offline project.

The combination of safety signature status and controller safety-locked status affects the GuardLogix controller's download functionality.

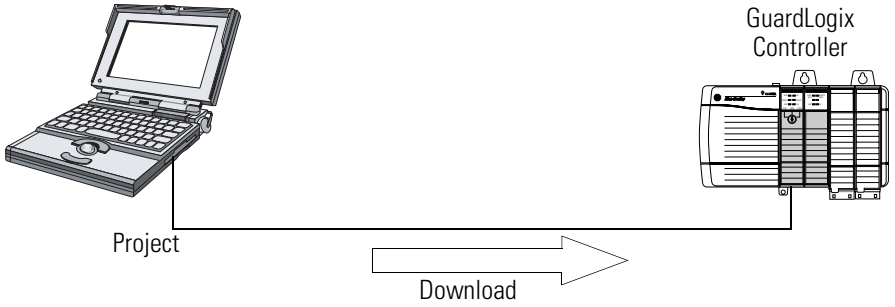
The Effect of Safety-lock and Safety Signature on Download Operation

Safety-lock Status	Safety Signature Status	Download Functionality
Controller safety-unlocked	Safety signature in the offline project matches the safety signature in the controller.	The standard application is downloaded and the safety application is reinitialized via the safety signature. Safety tags are reinitialized to the values they had when the safety signature was created. The safety task is not downloaded.
	Safety signatures do not match.	If the controller had a safety signature, it is automatically deleted. The entire project is downloaded. If the offline project has a safety signature but the controller does not, the entire project is downloaded to the controller.
	Safety signature status is irrelevant.	Firmware in the controller is different than in the offline project. Either: • RSLogix 5000 software prompts you to flash the controller so that it matches the offline project. Once the update is completed, the entire project is downloaded. or • Upgrade the project to the controller version. **IMPORTANT:** This causes the safety signature to be deleted, and the system will require revalidation.
Controller safety-locked	Safety signature in the offline project matches the safety signature in the controller.	If the offline project is safety-locked, the standard application is downloaded and the safety task is reinitialized. If the offline project is not safety-locked, the download is blocked and you must first unlock the controller to allow the download to proceed.
	Safety signatures do not match or either the controller or the offline project does not have a safety signature.	You must first safety-unlock the controller to allow the download to proceed. Refer to the Controller safety-unlocked portion of this table for download functionality.

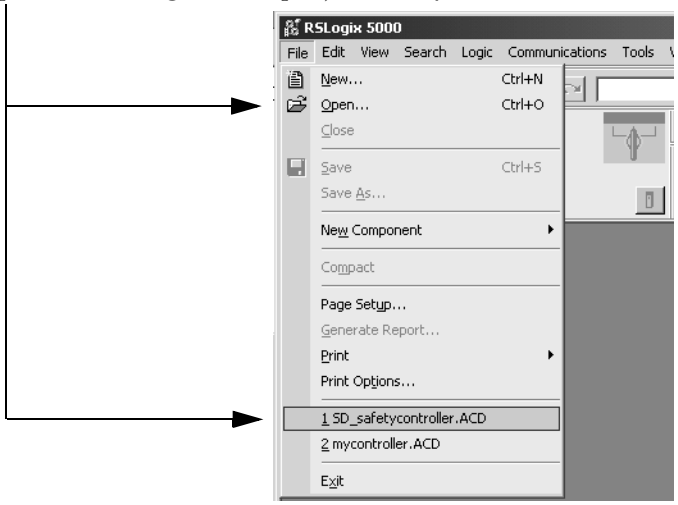
IMPORTANT During a download to a controller that is safety-unlocked, the controller's status will be set to the safety-locked or -unlocked value of the offline project.

Download

Download – transfer a project from your computer to your controller so you can execute its logic.



1. Turn the keyswitch of the controller to REM.
2. Open the RSLogix 5000 project that you want to download.



3. Define the path to the controller:
   a. Click Who Active  .
   b. Select the controller.
      To open a level, click the + sign. If a controller is already selected, make sure that it is the correct controller.
4. Click Download.

   The software compares the following information in the offline project and the controller.

   - Controller serial number (if project to controller match is selected)
   - Firmware major and minor revisions
   - Safety status between the primary controller and safety partner
   - Safety signature (if one exists)
   - Safety-lock status

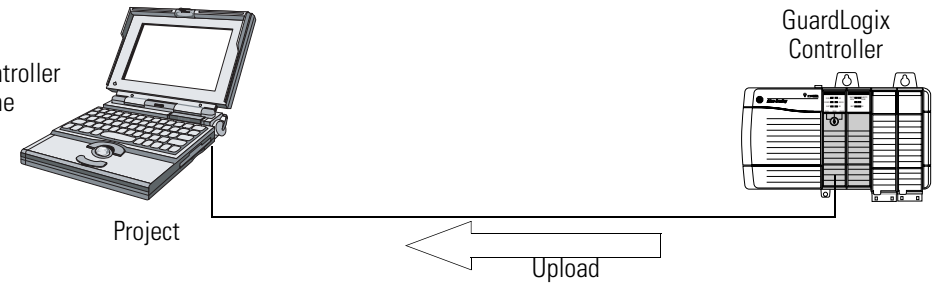
5. Follow the directions in this table to complete the download based on the software's response.

If the software indicates	Then
Download to the controller.	Choose Download. The project downloads to the controller and RSLogix 5000 software goes online.
Unable to download to the controller. Mismatch between the offline project and the controller serial number. Selected controller may be the wrong controller.	Connect to the correct controller or verify that this is the correct controller. If it is the correct controller, select the Update project serial number checkbox to allow the download to proceed. The project serial number will be modified to match the controller serial number.
Unable to download to the controller. The major revision of the offline project and the controller's firmware are not compatible.	Choose Update Firmware. Choose the required revision and click Update. Confirm your selection by clicking Yes.
Unable to download to controller. The safety partner is missing or unavailable.	Cancel the download process. Install a compatible safety partner before attempting to download.
Unable to download to controller. The firmware revision of the safety partner is not compatible with the primary controller.	Update the firmware revision of the safety partner. Choose Update Firmware. Choose the required revision and click Update. Confirm your selection by clicking Yes.
Unable to download to controller. Incompatible safety signature cannot be deleted while the project is safety-locked.	Cancel the download. To download the project, you must: • safety-unlock the offline project, delete the safety signature, and then download the project. **IMPORTANT:** The safety system will require revalidation.
Cannot download in a manner that preserves safety signature. Controller's firmware minor revision is not compatible with safety signature in offline project.	• If the firmware minor revision is incompatible, to preserve the safety signature, update the firmware revision in the controller to exactly match the offline project. Then download the offline project. • To proceed with the download despite the safety signature incompatibility, click Download. The safety signature will be deleted. **IMPORTANT:** The safety system will require revalidation.
Unable to download to controller. Controller is locked. Controller and offline project safety signatures do not match.	Choose Unlock. The Safety Unlock for Download dialog appears. If the Delete Signature checkbox is selected and you choose Unlock, you must confirm the deletion by selecting Yes.

Following a successful download, the safety-locked status and safety signature of the controller match the project that was downloaded. Safety data is initialized to the values that existed when the safety signature was created.

Upload

Upload – transfer a project from a controller to your computer so you can monitor the project.



1. Define the path to the controller:

   a. Click Who Active  .

   b. Select the controller.
   To expand a level, click the + sign. If a controller is already selected, make sure that it is the correct controller.

2. Click Upload.

3. If the project file does not already exist, create the project file on your computer by choosing Select File, then Select and Yes. If the project file exists, select it.

   If the project to controller match is enabled, RSLogix 5000 software checks whether the serial number of the open project and the serial number of the controller match.

   If the controller serial numbers do not match, you can:

   - Cancel the upload and connect to a matching controller. Then, start the upload procedure again.
   - Select a new project to upload into or select a different project by choosing Select File.
   - Update the project serial number to match the controller by checking the Update Project Serial Number checkbox and choosing Upload.

4. The software checks whether the open project matches the controller project.

   a. If the projects do not match, you must select a matching file or cancel the upload process.

   b. If the projects match, the software checks for changes in the offline (open) project.

5. The software checks for changes in the offline project.

   a. If there are no changes in the offline project, you can go online without uploading. Click Go Online.

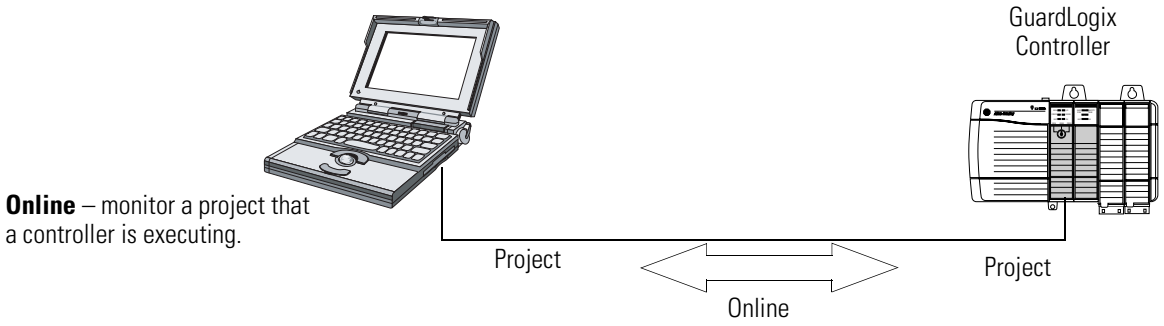
   b. If there are changes in the open project that are not present in the controller, you can choose to upload the project, cancel the upload, or select a different file.

   If you choose Upload, the standard and safety applications are uploaded. If a safety signature exists, it is also uploaded. The

safety-lock status of the project reflects the original status of the online (controller) project.

TIP Prior to the upload, if an offline safety signature exists, or the offline project is safety-locked but the controller is safety-unlocked or has no safety signature, the offline safety signature and safety-locked state will be replaced by the online values (safety-unlocked with no safety signature). If you do not want to make these changes permanent, do not save the offline project following the upload.

Go Online



1. Define the path to the controller:

   a. Click Who Active  .

   b. Select the controller.
   To expand a level, click the + sign. If a controller is already selected, make sure that it is the correct controller.

2. Click Go Online.

   The software checks:

   - whether the offline project and controller serial numbers match (if Project to Controller Match is selected).
   - whether the offline project contains changes that are not in the controller project.
   - whether the revisions of the offline project and controller firmware match.
   - whether the offline project or the controller are safety-locked.
   - whether the offline project or the controller have compatible safety signatures.

3. Follow the directions in the table below to connect to the controller based on the software's response.

Connect to the Controller

If the software indicates	Then
Unable to connect to controller. Mismatch between the offline project and the controller serial number. Selected controller may be the wrong controller.	Connect to the correct controller, select a different project file, or choose the Update project serial number checkbox and choose Go Online… to connect to the controller and update the offline project serial number to match the controller.
Unable to connect to controller. The revision of the offline project and the controller's firmware are not compatible.	Choose one of the following options: • Choose Update Firmware. Choose the required revision and click Update. Confirm your selection by clicking Yes. **IMPORTANT:** The online project will be deleted. • To preserve the online project, cancel the online process and install a version of RSLogix 5000 software that is compatible with the firmware revision of your controller.
You need to upload or download in order to go online using the open project.	Choose one of the following options: • Upload to update the offline project, • Download to update the controller project, or • Select File to choose a different offline project.
Unable to connect in a manner that preserves safety signature. Controller's firmware minor revision is not compatible with safety signature in offline project.	• To preserve the safety signature when the firmware minor revision is incompatible, update the firmware revision in the controller to exactly match the offline project. Then go online to the controller. • To proceed with the download despite the safety signature incompatibility, click Download. The safety signature will be deleted. **IMPORTANT:** The safety system will require revalidation.
Unable to connect to controller. Incompatible safety signature cannot be deleted while project is safety-locked.	Cancel the online process. You must safety-unlock the offline project before attempting to go online.

When the controller and RSLogix 5000 software are online, the safety-locked status and safety signature of the controller match the controller's project. The safety-lock status and safety signature of the offline project are overwritten by the controller. If you do not want the changes to the offline project to be permanent, do not save the project file following the go online process.

Monitor Status and Handle Faults

Introduction

Monitor Controller Status

You can monitor status using the controller LED indicators and fault codes.

Controller LED Indicators

Primary controller and safety partner status is displayed by LED indicators.

View LED Indicators

LED	Color/Status	Primary Controller Description	Safety Partner Description
RUN	Off	No user tasks running. Controller is in PROGram mode.	Not applicable.
	Green	Controller is in RUN mode.	Not applicable.
SAFE RUN	Off	Not applicable.	The user safety task or safety outputs are disabled. The controller is in the PROGram mode, test mode, or the safety task is faulted.
	Green	Not applicable.	The user safety task and safety outputs are enabled. The safety application is executing at its periodic rate.
FORCE	Off	No forces, standard or safety, are enabled on the controller.	Not applicable.
	Amber	Standard and/or safety forces have been enabled.	Not applicable.
	Amber, Flashing	One or more I/O addresses, standard and/or safety, have been forced to an on or off state, but forces are not enabled.	Not applicable.

View LED Indicators

LED	Color/Status	Primary Controller Description	Safety Partner Description
BAT	Off	The battery is able to support memory.	The battery is able to support memory.
	Red	The battery is not able to support memory.	The battery is not able to support memory.
OK	Off	No power is applied.	No power is applied.
	Green	The controller is operating with no faults.	The safety partner is operating with no faults.
	Red, Flashing	Nonrecoverable fault or recoverable fault not handled in the fault handler. All user tasks, both standard and safety, are stopped.	Not applicable.
	Red	Powering up or nonrecoverable controller fault.	Powering up or nonrecoverable controller fault.
I/O(1)	Off	No activity. No I/O is configured.	Not applicable.
	Green	The controller is communicating to all configured I/O devices, both standard and safety.	Not applicable.
	Green, Flashing	One or more I/O devices is not responding.	Not applicable.
	Red, Flashing	Controller is not communicating to any configured I/O.	Not applicable.
RS232	Off	There is no activity.	Not applicable.
	Green	Data is being received or transmitted.	Not applicable.
SAFETY TASK	Off	Not applicable.	No partnership established. Primary controller is missing, is not functioning properly, or its firmware revision is incompatible with that of the safety partner.
	Green	Not applicable.	Safety controller status is OK. The coordinated system time (CST) is synchronized and I/O connections are established.
	Green, Flashing	Not applicable.	Safety controller status is OK. The coordinated system time (CST) is not synchronized on either the primary controller or the safety partner.
	Red	Not applicable.	Partnership was lost and a new partnership has not been established. primary controller is missing, is not functioning properly, or its firmware revision is incompatible with that of the safety partner.
	Red, Flashing	Not applicable.	Safety controller status is Inoperable.

(1) I/O includes produced/consumed tags from other controllers.

Online Bar

The online bar displays project and controller information, including the controller's status, force status, online edit status, and safety status, as shown below.

When the Controller Status button is selected as shown above, the online bar shows the controller's mode (RUN) and status (OK). The BAT LED indicator combines the status of both the primary controller and the safety partner. If either or both have a battery fault, the LED indicator illuminates. The I/O LED indicator combines the status of both standard and safety I/O and behaves just like the LED indicator on the controller. The I/O with the most significant error status is displayed next to the LED indicator.

When the Safety Status button is selected as shown below, the online bar displays the safety signature.

The Safety Status button itself indicates whether the controller is safety-locked or -unlocked, or faulted. It also displays an icon that shows the safety status.

Safety Status Icon

If the safety status is	This icon is displayed
Safety Task OK	
Safety Task Inoperable	
Partner Missing Partner Unavailable Hardware Incompatible Firmware Incompatible	
Offline	

Icons are green when the controller is safety-locked, yellow when the controller is safety-unlocked, and red when the controller has a Safety fault. When a safety signature exists, the icon includes a small check mark.

Monitor Connections

All Connections

If communication with a device in the I/O configuration of the controller does not occur for 100 ms, the communication times out and the controller produces the following warnings.

- The I/O LED indicator on the front of the controller flashes green.
- An alert symbol ⚠ shows over the I/O configuration folder and over the device that has timed out.
- A module fault is produced, which you can access through:
  - the Connections tab of the Module Properties dialog for the module.
  - the GSV instruction.

ATTENTION

Safety I/O and produce/consume connections cannot be configured to automatically fault the controller when a connection is lost. Therefore, you need to monitor for connection faults to be sure that the safety system maintains SIL 3 integrity.

See Safety Connections on page 100.

Safety Connections

For tags associated with produced or consumed safety data, you can monitor the status of safety connections using the CONNECTION_STATUS member. For monitoring input and output connections, Safety I/O tags have a connection status member called SafetyStatus. Both data types contain two bits: RunMode and ConnectionFaulted.

The RunMode value indicates if consumed data is actively being updated by a device that is in the Run Mode (1) or Idle State (0). Idle state is indicated if the connection is closed, the safety task is faulted, or the remote controller or device is in Program mode or Test mode.

The ConnectionFaulted value indicates whether the safety connection between the safety producer and the safety consumer is Valid (0) or Faulted (1). If ConnectionFaulted is set to Faulted (1) as a result of a loss of the physical connection, the safety data is reset to zero.

The following table describes the combinations of the RunMode and ConnectionFaulted states.

Safety Connection Status

RunMode Status	ConnectionFaulted Status	Safety Connection Operation
1 = Run	0 = Valid	Data is actively being controlled by the producing device. The producing device is in Run mode.
0 = Idle	0 = Valid	The connection is active and the producing device is in the Idle state. The safety data is reset to zero.
0 = Idle	1 = Faulted	The safety connection is faulted. The state of the producing device is unknown. The safety data is reset to zero.
1 = Run	1 = Faulted	Invalid state.

If a module is inhibited, the ConnectionFaulted bit is set to Faulted (1) and the RunMode bit is set to Idle (0) for each connection associated with the module. As a result, safety consumed data is reset to zero.

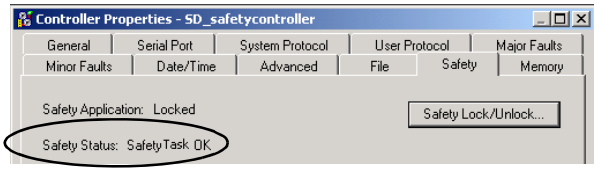
Monitor Status Flags

All Logix controllers, including GuardLogix controllers, support status keywords that you can use in your logic to monitor specific events.

For more information on how to use these keywords, refer to the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

Monitor Safety Status

In addition to viewing controller safety status information on the safety status button on the online bar, you can also find controller safety status information on the Safety tab of the Controller Properties dialog.



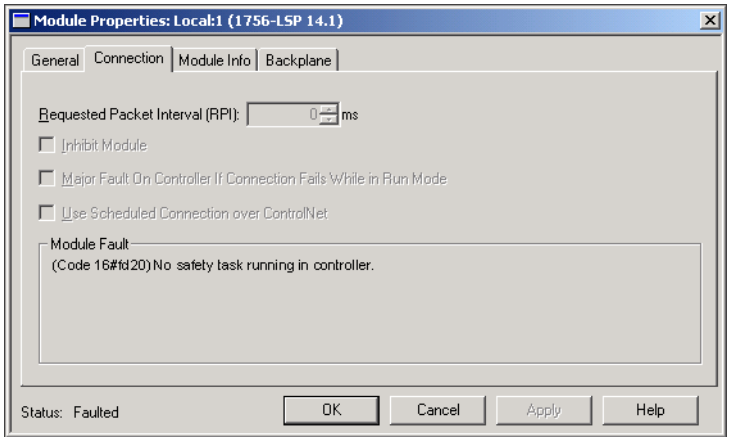
The possible values for safety status are:

- safety partner is missing or unavailable.
- safety partner hardware is incompatible with primary controller.
- safety partner firmware is incompatible with the primary controller.
- safety task inoperable.
- safety task OK.

With the exception of safety task OK, the descriptions indicate that nonrecoverable safety faults exist.

See Safety Faults on page 104 for fault codes and corrective actions.

The status of the safety partner can be viewed on the Connections tab of its Module Properties dialog.



GuardLogix Controller Faults

Faults in the GuardLogix system can be nonrecoverable controller faults, nonrecoverable safety faults in the safety application, or recoverable safety faults in the safety application.

Nonrecoverable Controller Faults

These occur when the controller's internal diagnostics fail. When a nonrecoverable controller fault occurs, safety task execution stops and CIP Safety I/O on DeviceNet networks is placed in the safe state. Recovery requires that you download of the application program again.

Nonrecoverable Safety Faults in the Safety Application

When a nonrecoverable safety fault occurs in the safety application, both safety logic and the safety protocol are terminated. Safety task watchdog and control partnership faults fall into this category.

If the safety task encounters a nonrecoverable safety fault that is cleared programmatically in the Controller Fault Handler, the standard application continues to execute.

ATTENTION

Overriding the safety fault does not clear it! If you override the safety fault, it is your responsibility to prove that doing so maintains safe operation.

You must provide proof to your certifying agency that allowing a portion of the system to continue to operate maintains safe operation.

If a safety signature exists, you only need to clear the fault to enable the safety task to run. If no safety signature exists, the safety task cannot run again until the entire application is downloaded again.

Recoverable Faults in the Safety Application

When a recoverable fault occurs in the safety application, the system may or may not halt the execution of the safety task, depending upon whether or not the fault is handled by the Program Fault Handler in the safety application.

If a recoverable fault is cleared programmatically, the safety task is allowed to continue without interruption.

If a recoverable fault in the safety application is not cleared programmatically, a Type 14, Code 2 recoverable safety fault occurs. The safety program execution is stopped, and safety protocol connections are closed and reopened to reinitialize them. Safety outputs are placed in the safe state and the producer of safety-consumed tags commands the consumers to place them in a safe state, as well.

Recoverable faults let you to edit the standard and safety application as required to correct the cause of the fault. However, if a safety signature exists or the controller is safety-locked, you must first unlock the controller and delete the safety signature before you can edit the safety application.

View Faults

The Recent Faults dialog on the Major Faults tab of the Controller Properties dialog contains two sub-tabs, one for standard faults and one for safety faults.

Fault Codes

The Safety Faults table shows the major and minor fault codes specific to GuardLogix controllers. The type and code correspond to the type and code displayed on the Major Faults tab (or Minor Faults tab) of the Controller Properties dialog and in the PROGRAM object, MAJORFAULTRECORD (or MINORFAULTRECORD) attribute.

Safety Faults

Type	Code	Cause	Status	Corrective Action
Major (14)	01	Task watchdog expired. User task has not completed in a specified period of time. A program error caused an infinite loop, the program is too complex to execute as quickly as specified, a higher priority task is keeping this task from finishing, or the safety partner has been removed.	Nonrecoverable	Clear the fault. If a safety signature exists, safety memory is re-initialized via the safety signature and the safety task will begin executing. If a safety signature does not exist, you must download the program again to allow the safety task to run. Reinsert the safety partner, if it was removed.
	02	An error exists in a routine of the safety task.	Recoverable	Correct the error in the user-program logic.
	03	Safety partner is missing.	Nonrecoverable	Install a compatible safety partner.
	04	Safety partner is unavailable.	Nonrecoverable	Install a compatible safety partner.
	05	Safety partner hardware is incompatible.	Nonrecoverable	Replace the existing safety partner with a compatible safety partner.
	06	Safety partner firmware is incompatible.	Nonrecoverable	Update the safety partner so that the firmware major and minor revision matches the primary controller.
	07	Safety task is inoperable.	Nonrecoverable	Clear the fault. If a safety signature exists, safety memory is re-initialized via the safety signature and the safety task will begin executing. If a safety signature does not exist, you must download the program again to allow the safety task to run.
	08	Coordinated system time (CST) not found.	Nonrecoverable	Clear the fault. Configure a device to be the CST master.
	09	Safety partner nonrecoverable controller fault.	Nonrecoverable	Clear the fault and download the program. If the problem persists, replace the safety partner.
Minor (10)	11	The Safety partner's battery is missing or requires replacement.	Recoverable	Install or replace the battery on the safety partner.

See Appendix B for information on replacing the battery.

The Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001, contains descriptions of the fault codes common to all Logix controllers.

Develop a Fault Routine

If a fault condition occurs that is severe enough for the controller to shut down, the controller generates a major fault and stops the execution of logic, that is, turning all outputs to their user-configured states.

Depending on your application, you may not want all safety faults to shut down your entire system. In those situations, you can use a fault routine to clear a specific fault and let the standard control portion of your system continue to operate or configure some outputs to remain ON.

ATTENTION

You must provide proof to your certifying agency that allowing a portion of the system to continue to operate maintains safe operation.

The controller supports two levels for handling major faults.

- Program Fault Routine
- Controller Fault Handler

Both routines can use the GSV and SSV instructions as described on page 106.

Program Fault Routine

Each program can have its own fault routine. The controller executes the program's fault routine when an instruction fault occurs. If the program's fault routine does not clear the fault, or if a program fault routine does not exist, the controller proceeds to execute the controller fault handler, if one exists.

Controller Fault Handler

The controller fault handler is an optional component that executes when the program fault routine could not clear the fault or does not exist.

You can create only one program for the controller fault handler. After you create that program, you must configure a routine as the main routine.

The Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001, provides details on creating and testing a fault routine.

Use GSV/SSV Instructions

Logix controllers store system data in objects rather than in status files. You can use the Get System Value (GSV) and Set System Value (SSV) instructions to get and set controller data.

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

When you enter a GSV or SSV instruction, the programming software displays the valid object classes, object names, and attribute names for each instruction.

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

For the safety task, the GSV and SSV instructions are more restricted. Note that SSV instructions in both safety and standard tasks cannot set bit 0 (major fault on error) in the the mode attribute of a safety I/O module.

For safety objects, the GSV/SSV Accessibility table on page 107 shows which attributes you can get values for using the GSV instruction, and which attributes you are allowed to set using the SSV instruction, in both the Safety and standard tasks.

ATTENTION

Use the GSV/SSV instructions carefully. Making changes to objects can cause unexpected controller operation or injury to personnel.

GSV/SSV Accessibility

Safety Object	Attribute Name	Attribute Description	Accessible from the Safety Task		Accessible from Standard Tasks	
			GSV	SSV	GSV(1)	SSV
Safety Task	Instance	Provides instance number of this task object. Valid values are 0…31.	✓		✓	
	MaximumInterval	The max time interval between successive executions of this task.			✓	✓
	MaximumScanTime	Max recorded execution time (ms) for this task.			✓	✓
	MinimumInterval	The min time interval between successive executions of this task.			✓	✓
	Priority	Relative priority of this task as compared to other tasks. Valid values are 0…15.	✓		✓	
	Rate	Period for the task (in ms), or timeout value for the task (in ms).	✓		✓	
	Watchdog	Time limit (in ms) for execution of all programs associated with this task.	✓		✓	
Safety Program	Instance	Provides the instance number of the program object.	✓		✓	
	MajorFaultRecord	Records major faults for this program.	✓	✓	✓	
	MaximumScanTime	Max recorded execution time (ms) for this program.			✓	✓
Safety Routine	Instance	Provides the instance number for this routine object. Valid values are 0…65,535.	✓			
Safety Controller	SafetyLocked	Indicates whether the controller is safety-locked or -unlocked.			✓	
	SafetyStatus	Specifies the safety status as: • Safety task OK • Safety task inoperable • Partner missing • Partner unavailable • Hardware incompatible • Firmware incompatible			✓	
	SafetySignatureExists	Indicates whether the safety signature is present.	✓		✓	
	SafetyTaskFaultRecord	Records safety task faults.			✓	

(1) From the standard task, GSV accessibility of safety object attributes is the same as for standard object attributes.

Controller Specifications

Introduction

This appendix contains specification information for GuardLogix controllers.

Certifications

When marked, the components have the following certifications. For UL, CE, and C-Tick, see the Product Certification link at http://ab.com/certification/safety for Declarations of Conformity, Certificates, and other certification details.

Certification	Description
UL	UL Listed Industrial Control Equipment
CSA	CSA Certified Process Control Equipment
CSA	CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
TÜV	Functional Safety: SIL 1 to 3, according to IEC 61508; Category 1 to 4, according to EN954-1.

The following products are certified for UL NRGF:

Catalog Number	Description
1756-L61S	Primary controller with 2 MB memory
1756-L62S	Primary controller with 4 MB memory
1756-LSP	Safety partner

For the current list of GuardLogix series and operating system revisions certified for UL NRGF, see http://ab.com/certification/safety.

General Specifications

Catalog Number	1756-L61S	1756-L62S	1756-LSP
Memory - Standard Task	2 MB	4 MB	N/A
Memory - Safety Task	1 MB	1 MB	1 MB
Backplane Current at 5V dc	1.20 A	1.20 A	1.20 A
Backplane Current at 24V dc	14 mA	14 mA	14 mA
Power Dissipation	3.5 W	3.5 W	3.5 W
Thermal Dissipation	11.9 BTU/hr	11.9 BTU/hr	11.9 BTU/hr
Weight	0.32 kg (11.3 oz)	0.32 kg (11.3 oz)	0.32 kg (11.3 oz)

Safety Specifications

Functional Verification Test Interval	Probability of Failure on Demand (PFD)	Probability of Failure per Hour (PFH)	Safe Failure Fraction (SFF)
15 years	8.5E-06	1.9E-10	99.1%
10 years	5.5E-06	1.9E-10	

Environmental Specifications

Description	Value
Operating Temperature	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): • 0…60 °C (32…140 °F)
Storage Temperature	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): • -40…85 °C (-40…185 °F)
Relative Humidity	IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat): 5…95% noncondensing
Vibration	IEC60068-2-6 (Test Fc, Operating): 2 g @ 10…500 Hz
Operating Shock	IEC60068-2-27 (Test Ea, Unpackaged Shock): 30 g
Nonoperating Shock	IEC60068-2-27 (Test Ea, Unpackaged Shock): 50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity	IEC 61000-4-2: • 6 kV contact discharges • 8 kV air discharges
Radiated RF Immunity	IEC 61000-4-3: • AM - 10V/m @ 80…1000 MHz @ 1 kHz • AM - 10V/m @ 1…2 GHz @ 1 kHz • PM - 10V/m @ 900 MHz @ 200 Hz
EFT/B Immunity	IEC 61000-4-4: • ±4 kV @ 2.5 kHz on power ports • ±4 kV @ 2.5 kHz on communications ports
Surge Transient Immunity	IEC 61000-4-5: ±2 kV line-earth (CM) on shielded ports
Conducted RF Immunity	IEC 61000-4-6: 10V @ 150 kHz …80 MHz @ 1 kHz
Enclosure Type Rating	None (open-style)
Isolation Voltage	30V Tested to withstand 500V for 60 s
Programming Cable	1756-CP3 or 1747-CP3 serial cable category 3(1)
Replacement Battery	1756-BA2 (0.50 g lithium)

(1) See Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environment and Enclosure Information

ATTENTION

Environment and Enclosure

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

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

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional installation requirements pertaining to this equipment.

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations.

Products marked CL I, DIV 2, GP A, B, C, D are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest T number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.

WARNING

EXPLOSION HAZARD

- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Substitution of components may impair suitability for Class I, Division 2.
- If this product contains batteries, they must be changed only in an area known to be nonhazardous.

Maintain the Battery

Introduction

This chapter provides information on the 1756-BA2 battery.

Estimate Battery Life

Battery life is dependent upon chassis temperature, project size, and how often you cycle power to the controller. Battery life is not dependent upon whether or not the controller has power.

Before BAT LED Indicator Turns On

Use the Battery LED Indicator Worst Case Time table to estimate the worst case time before the BAT LED indicator turns red.

Battery LED Indicator Worst Case Time

Max Temperature 1 in. Below Chassis	Power Cycles per Day	Project Size		
		1 MB	2 MB	4 MB
0…40 °C (32…104 °F)	3	3 years	3 years	26 months
	2 or fewer	3 years	3 years	3 years
41…45 °C (105…113 °F)	3	2 years	2 years	2 years
	2 or fewer	2 years	2 years	2 years
46…50 °C (114…122 °F)	3 or fewer	16 months	16 months	16 months
51…55 °C (123…131 °F)	3 or fewer	11 months	11 months	11 months
56…60 °C (132…140 °F)	3 or fewer	8 months	8 months	8 months

EXAMPLE Under the following conditions, the battery will last at least 2 years before the BAT LED indicator turns red.

- Max temperature 1 in. below the chassis is 45 °C (113 °F).
- Power is cycled 3 times per day.
- The controller contains a 2 MB project.

After BAT LED Indicator Turns On

IMPORTANT If the BAT LED indicator turns on when you apply power to the controller, the battery life may be less than the Battery LED Indicator Worst Case Time table indicates.

Some of the battery life may have been used up while the controller was off and unable to turn on the BAT LED indicator.

Expect a minimum of 4 weeks of battery life after the BAT LED indicator turns on.

When to Replace the Battery

When the battery is about 95% discharged, the controller provides the following warnings.

- The BAT LED indicator on the front of the controller turns on (solid red).
- A minor fault occurs (type 10, code 10 for the controller).

ATTENTION

To prevent possible battery leakage, even if the BAT LED indicator is off, replace the battery according to the following schedule.

Battery Replacement Schedule

If the temperature 2.54 cm (1 in.) below the chassis is	Replace the battery every
0…35 °C (32…95 °F)	No required replacement
36…40 °C (96…104 °F)	3 years
41…45 °C (105…113 °F)	2 years
46…50 °C (114…122 °F)	16 months
51…55 °C (123…131 °F)	11 months
56…60 °C (132…140 °F)	8 months

IMPORTANT Because the GuardLogix controller is a 1oo2 controller (two processors), we strongly recommend that both controller batteries be replaced at the same time.

Replace the Battery

Because the controller uses a lithium battery, you must follow specific precautions when handling or disposing of a battery.

WARNING

The controller uses a lithium battery, which contains potentially dangerous chemicals.

Before handling or disposing of a battery, review Guidelines for Handling Lithium Batteries, publication AG-5.4.

WARNING

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

IMPORTANT

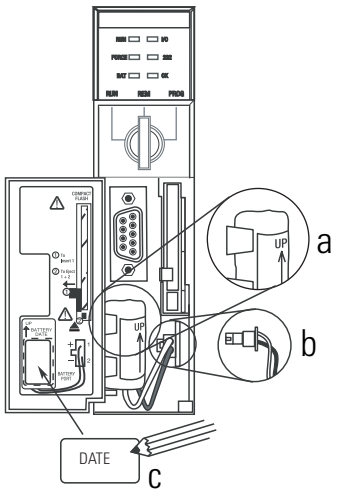
If you remove the battery and then lose power, the project in the controller will be lost.

Follow this procedure to replace the battery.

1. Turn on the chassis power.
2. Does the existing battery show signs of leakage or damage?

If	Then
Yes	Before handling the battery, review Guidelines for Handling Lithium Batteries, publication AG-5.4.
No	Go to the next step.

3. Remove the old battery.
4. Install a new 1756-BA2 battery.
   a. Insert the battery as shown.
   b. Connect the battery:
      + Red
      - Black
   c. Write the date you installed the battery on the battery label and attach the label to the inside of the controller door.



ATTENTION

Install only a 1756-BA2 battery. If you install a different battery, you may damage the controller.

5. Is the BAT LED indicator on the front of the controller off?

If	Then
Yes	Go to the next step.
No	1. Check that the battery is correctly connected to the controller. 2. If the BAT LED indicator remains on, install another 1756-BA2 battery. 3. If the BAT LED indicator remains on after installing the alternate battery in Step 2, contact your Rockwell Automation representative or local distributor.

4. Dispose of the old battery in accordance with all local regulations.

ATTENTION

Do not incinerate or dispose of lithium batteries in general trash collection. They may explode or rupture violently. Follow all local regulations for disposal of these materials. You are legally responsible for hazards created during disposal of your battery.

Store Replacement Batteries

ATTENTION

A battery may leak potentially dangerous chemicals if stored improperly. Store batteries in a cool, dry environment. We recommend 25 °C (77 °F) with 40…60% relative humidity. You may store batteries for up to 30 days at temperatures between -45…85 °C (-49…185°F), such as during transportation. To avoid possible leakage, do not store batteries above 60 °C (140 °F) for more than 30 days.

Additional Resources

Resource	Description
Guidelines for Handling Lithium Batteries, publication AG-5.4	Provides more information on handling, storing, and disposing of lithium batteries

Change Controllers

Introduction

Because safety controllers have special requirements and do not support certain standard features, you must understand the behavior of the system when changing controllers from standard to safety or safety to standard. Changing controller type affects:

- supported features.
- physical configuration of the project, that is the safety partner and safety I/O.
- controller properties.
- project components such as tasks, programs, routines, and tags.

From Standard to Safety

In order to successfully change from a standard controller to a safety controller, the chassis slot immediately to the right of the safety primary controller must be available for the safety partner.

Upon confirmation of a change from a standard controller to a safety controller, safety components are created to meet the minimum requirements for a safety controller.

- The safety task is created only if the maximum number of downloadable tasks has not been reached. The safety task is initialized with its default values.
- Safety components are created (that is safety task, safety program and so forth).
- A time-based safety network number (SNN) is generated for the local chassis.
- Any standard controller features, such as redundancy, which are not supported by the safety controller are removed from the Controller Properties dialog.

From Safety to Standard

Upon confirmation of a change from a safety controller to a standard controller, some components are changed and others are deleted, as described below.

- The safety partner, 1756-LSP, is deleted from the I/O chassis.
- Safety I/O modules and their tags are deleted.
- The safety task, programs, and routines are changed to a standard task, programs, and routines.
- All safety tags, except safety consume tags, are changed to standard tags. Safety consume tags are deleted.
- Safety tag mappings are deleted.
- The safety network number (SNN) is deleted.
- Safety-lock and -unlock passwords are deleted.
- If the standard controller supports features that were not available to the safety controller, such as nonvolatile storage, those new features will be visible in the Controller Properties dialog.

TIP Peer safety controllers are not deleted, even if they have no connections remaining.

As a result of the above changes to the system, safety-specific instructions or safety I/O tags will not verify. Instructions may still reference modules that have been deleted. In addition, consumed tags are deleted when the producing module is deleted.

Numerics

A

B

C

R

S

T

U

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.

United States	1.440.646.3223 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.

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