ControlLogix 5580 Redundant Controller

For Use in High Availability Systems

AB QUALITY

Allen-Bradley

by **ROCKWELL AUTOMATION**

Important User Information

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

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

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

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

> **WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

> **ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

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

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

> **SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

> **BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

> **ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

The following icon may appear in the text of this document.

> Identifies information that is useful and can help to make a process easier to do or easier to understand.

Rockwell Automation recognizes that some of the terms that are currently used in our industry and in this publication are not in alignment with the movement toward inclusive language in technology. We are proactively collaborating with industry peers to find alternatives to such terms and making changes to our products and content. Please excuse the use of such terms in our content while we implement these changes.

Chapter 4

Configure the Redundancy Modules

Chapter 5

Configure the Redundant Controller

Chapter 6

Programming Best Practices

Chapter 7

Monitor and Maintain a Redundancy System

Notes:

About This Publication

This publication provides information specific to ControlLogix 5580 high availability systems:

- Installation procedures
- Configuration procedures
- Maintenance and troubleshooting methods

This publication is designed for use by anyone responsible for planning and implementing a ControlLogix® redundancy system:

- Application engineers
- Control engineers
- Instrumentation technicians

The contents of this publication are for anyone who already has an understanding of Logix 5000® control systems, programming techniques, and communication networks.

In this publication:

- RSLinx® Classic and FactoryTalk® Linx are acceptable to use as communication software, and throughout this publication are referred to as 'communication software'. For compatible communication software, see the release notes on the Product Compatibility and Download Center (PCDC).

This publication applies to these controllers:

- 1756-L81E, 1756-L81EK,1 756-L81E-NSE, 1756-L81EXT, 1756-L81EP
- 1756-L82E, 1756-L82EK, 1756-L82E-NSE, 1756-L82EXT
- 1756-L83E, 1756-L83EK, 1756-L83E-NSE, 1756-L83EXT, 1756-L83EP
- 1756-L84E, 1756-L84EK, 1756-L84E-NSE, 1756-L84EXT
- 1756-L85E, 1756-L85EK, 1756-L85E-NSE, 1756-L85EXT, 1756-L85EP

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Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This manual contains new and updated information. This list includes substantive updates only and is not intended to reflect all changes. Changes in the manual are identified by change bars.

Topic	Page
Added redundancy bundle 36.011_kit1.	140

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation. You can view or download publications at rok.auto/literature.

Resource	Description
High Availability System Reference Manual, publication HIGHAV-RM002	Provides information to help design and plan high availability systems.
ControlLogix 5580 and GuardLogix 5580 Controllers User Manual, publication 1756-UM543	Provides information on how to configure, select I/O modules, manage communication, develop applications, and troubleshoot the ControlLogix 5580 controllers.
ControlLogix 5580 Controllers Installation Instructions, publication 1756-IN043	Describes how to install ControlLogix 5580 controllers.
ControlLogix Redundancy Modules Installation Instructions, publication 1756-IN087.	Describes how to install ControlLogix redundancy modules.
1756 EtherNet/IP Communication Modules Installation Instructions, publication 1756-IN050	Describes how to install ControlLogix EtherNet/IP communication modules.
ControlLogix EtherNet/IP Network Devices User Manual, publication 1756-UM004	Describes how you can use ControlLogix® EtherNet/IP communication modules with a Logix 5000 controller and communicate with various devices on the Ethernet/IP network.
ControlLogix Power Supply Installation Instructions, publication 1756-IN619	Describes how to install standard power supplies.
ControlLogix Redundant Power Supply Installation Instructions, publication 1756-IN620	Describes how to install redundant power supplies.
ControlLogix Chassis Installation Instructions, publication 1756-IN621	Describes how to install ControlLogix chassis.
FLEXHA 5000™ I/O System User Manual, publication 5015-UM001-EN-P	Describes the FLEXHA 5000™ I/O system in a High Availability Logix 5000® control system.
1715 Redundant I/O System Specifications Technical Data, publication 1715-TD001	Contains specifications on a Redundant I/O system.
1756 ControlLogix Controllers Technical Data, publication 1756-TD001	Contains specifications on ControlLogix controllers and redundancy modules.
ControlFLASH Plus Quick Start Guide, publication CFP-QS001C-EN-E	Describes how to use the ControlFLASH Plus™ software to upgrade device firmware.
ControlLogix System Selection Guide, publication 1756-SG001	Provides information on how to select components for a ControlLogix system.
EtherNet/IP Parallel Redundancy Protocol Application Technique, publication ENET-AT006	Describes how to configure a Parallel Redundancy Protocol (PRP) network with the 1756-EN2TP EtherNet/IP™ communication module and a Stratix® 5400 or 5410 switch.
EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007	Describes how to install, configure, and maintain linear and Device Level Ring (DLR) networks that use Rockwell Automation® EtherNet/IP devices with embedded switch technology.
EtherNet/IP Socket Interface Application Technique, publication ENET-AT002	Logix 5000Describes the socket interface that you can use to program MSG instructions to communicate between a Logix 5000 controller via an EtherNet/IP module and Ethernet devices that do not support the EtherNet/IP application protocol.
EtherNet/IP Network Configuration User Manual, publication ENET-UM006	Describes how to use EtherNet/IP communication modules with your Logix 5000 controller and communicate with various devices on the Ethernet network.
Integrated Architecture and CIP Sync Configuration Application Technique, publication IA-AT003	Provides an explanation of CIP Sync™ technology and how you can synchronize clocks within the Rockwell Automation Integrated Architecture®.
Logix 5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides links to a collection of programming manuals that describe how to use procedures that are common to all Logix 5000 controllers projects.
Logix 5000 Controllers General Instructions Reference Manual, publication 1756-RM003	This manual provides details about each available instruction for a Logix-based controller.
PlantPAx Process Automation System Reference Manual, publication PROCES-UM001	Elaborates on the application rules that are required to configure a PlantPAx® system.
Redundant I/O System User Manual, publication 1715-UM001	Contains information on how to install, configure, program, operate, and troubleshoot a Redundant I/O system.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

ControlLogix 5580 High Availability Systems

The ControlLogix® 5580 high availability system uses a redundant chassis pair to maintain process operation when events occur that stop process operation on non-redundant systems, such as a fault on a controller.

The redundant chassis pair includes two synchronized ControlLogix chassis with specific, identical components in each. For example, one redundancy module and at least one EtherNet/IP™ communication module are required.

Controllers are typically used in redundancy systems, but are not required if your application only requires communication redundancy. Your application operates from a primary chassis, but can switch over to the secondary chassis and components if necessary.
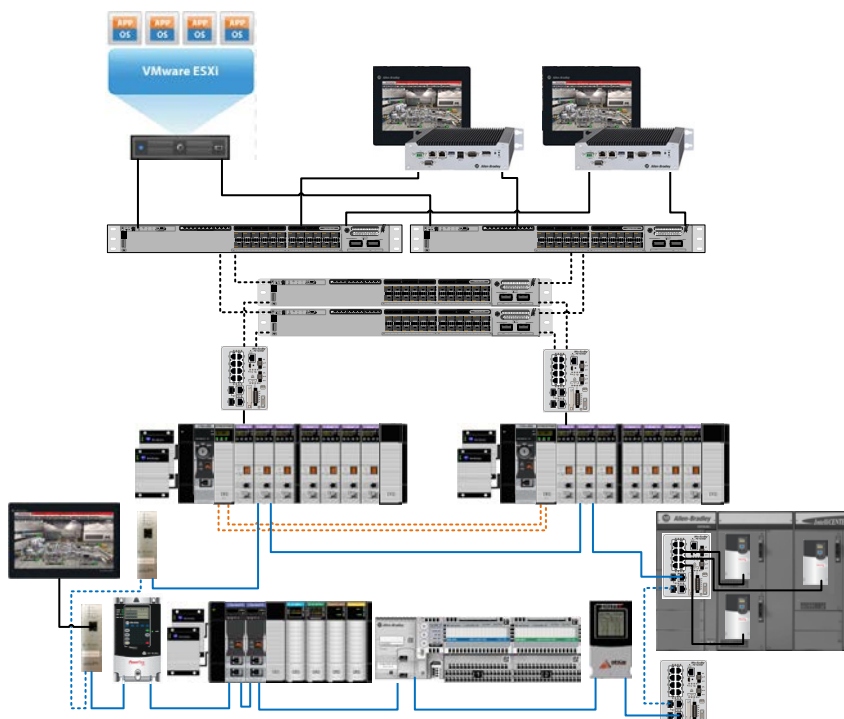
Features of the ControlLogix 5580 High Availability System

The software and hardware components that are required to configure and use a ControlLogix 5580 high availability system provide these features:

- All non-safety ControlLogix 5580 controller catalog numbers are supported.
- ControlLogix 5580 redundant controllers use the same controller firmware revision as standard controllers.
- Configure a redundant controller with a checkbox on the Controller Properties dialog box in Studio 5000 Logix Designer® application software.
- Partnered sets of 1756-RM2 modules can reach speeds as fast as 1000 Mbps.
- Redundant fiber ports for crossloading; no single point of failure of a fiber cable.
- Plug-and-play-style commissioning and configuration that does not require extensive programming.
- Support for produced unicast connections.
- EtherNet/IP network for the redundant chassis pair.
- Easy-to-use, fiber-optic communication cable that connects redundant chassis pairs.
- A redundancy system ready to command and monitor the redundant system states after basic installation, connection, and powerup.
- Switchovers occur as fast as 20 ms.
- Support for FactoryTalk® applications for Ethernet communication modules including, but not limited to:
    - FactoryTalk Alarms and Events
    - FactoryTalk Batch
    - FactoryTalk PhaseManager™
- Logix tag-based alarms considerations:
    - ControlLogix 5580 controllers support up to 7500 Logix tag-based alarms per software guidelines.
- Logix instruction-based alarms considerations:
    - ControlLogix 5580 controllers support up to 3000 Logix instruction-based alarms with 3000 burst.
- Support for CIP Sync™ technology over an EtherNet/IP network to establish time coordination across the redundant system.
- Support for CIP Security™ when you use a ControlLogix 5580 controller with firmware revision 34.011 or later and a 1756-EN4TR EtherNet/IP communication model with firmware revision 4.001 or later in the redundant chassis pair
- Access to remote I/O modules over an EtherNet/IP network.
- Access to 1715 Redundant I/O systems over an EtherNet/IP network.
- Supports FLEX 5000® I/O.
- Supports PhaseManager™.
- ControlLogix 5580 Process controllers support SequenceManager™ with firmware revision 35.011 or later.
- Supports DLR topologies with the use of an EtherNet/IP communication module. For more information about DLR, see the EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007.
- Supports Parallel Redundancy Protocol (PRP) networks with the use of an EtherNet/IP communication module. For more information about PRP, see the EtherNet/IP Parallel Redundancy Protocol Application Technique, publication ENET-AT006.
- Sockets are supported in the 1756-EN4TR, 1756-EN4TRK, and 1756-EN4TRXT modules with firmware revision 4.001 or later. For additional information, see the EtherNet/IP Socket Interface Application Technique, publication ENET-AT002.
- Sockets are supported in the 1756-EN2T, 1756-EN2TR and 1756-EN2F modules with firmware revision 5.008 or later, and 1756-EN2TP modules with firmware revision 10.002 or later. For additional information, see the EtherNet/IP Socket Interface Application Technique, publication ENET-AT002.

- For information on how to best organize a process application, see the PlantPAx® DCS Configuration and Implementation User Manual publication [PROCES-UM100](#).

Features Not Supported

- Compact 5000™ I/O
- The embedded Gigabit Ethernet port of the controller.
- DeviceNet[1], ControlNet, RIO, DH+™ networks
- Messaging to PLC-2®, PLC-3®, PLC-5®, SLC™, and other legacy controllers.
- IEC 62443-4-2 Security certification
- License-based Source and Execution Protection
- Any motion feature
- Firmware Supervisor
- Event Tasks
- Input or consumed unicast connections
- OPC UA

IMPORTANT	For Ethernet modules, signed and unsigned firmware are available. Signed modules provide the assurance that only validated firmware can be upgraded into a module.
	Signed and unsigned firmware:
	• Both signed and unsigned firmware are available. • Product is shipped with unsigned firmware. To obtain signed firmware, you must upgrade the firmware for your product. • To obtain signed and unsigned firmware, go to http://www.rockwellautomation.com/global/support/firmware/overview.page. • Once signed firmware is installed, subsequent firmware updates must be signed also. There are no functional/feature differences between signed and unsigned communication modules.

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(1)   DeviceNet modules are supported if accessed across an Ethernet bridge but may experience a bump during a ControlLogix Redundancy switchover.

Controller Keyswitch

The position of the keyswitch on the controllers in both chassis must match (both in REM or both in RUN). There should NOT be a mismatch. See Knowledgebase Technote *Processor Key Switches in ControlLogix Redundancy System*.

Primary Switch Position	Secondary Switch Position	Response on Switchover	
RUN	REM (Run)	Primary becomes secondary and synchronizes.	Secondary becomes primary with system in RUN mode.
REM (Run)	RUN	Primary becomes secondary and synchronizes.	Secondary becomes primary with system in RUN mode.
RUN	PROG	Primary becomes secondary and synchronizes.	Secondary becomes primary with system in PROGRAM mode.
REM (Run)	PROG	Primary becomes secondary and synchronizes.	Secondary becomes primary with system in PROGRAM mode.
PROG	REM (Run)	Primary becomes secondary and synchronizes.	Secondary becomes primary with system in PROGRAM mode.
REM (Program)	PROG	Primary becomes secondary and synchronizes.	Secondary becomes primary with system in PROGRAM mode.
PROG	RUN	Primary becomes secondary and **does not** synchronize.	Secondary becomes primary with **major fault** in new primary: • (Type 12) Redundancy Fault • (Code 34) Keyswitch in RUN invalid on switchover.
REM (Program)	RUN	Primary becomes secondary and **does not** synchronize.	Secondary becomes primary with **major fault** in new primary: • (Type 12) Redundancy Fault • (Code 34) Keyswitch in RUN invalid on switchover.

For more information on operation modes of the controller see *Choose the Controller Operation Mode* in the ControlLogix 5580 and GuardLogix® 5580 Controllers User Manual, publication 1756-UM543.

Redundancy System Components

Communication between a redundant chassis pair that includes matching components makes redundancy possible.

Each chassis in the redundant chassis pair contains these ControlLogix components:

- One ControlLogix power supply - Required
- One ControlLogix 1756-RM2 redundancy module - Required

    Redundancy modules link the redundant chassis pair to monitor events in each chassis and initiate system responses as required.

- At least one ControlLogix EtherNet/IP communication module - up to seven, optional (any combination)

IMPORTANT	The Series for EtherNet/IP communication modules is not required to match in a partnered set. However, the firmware levels must be the same in a partnered set. Also, if your application requires a feature specific to a module series level, you must use the same series level for each module in a partnered set.
	For example, only the 1756-EN2T/C communication module offers the double-data rate (DDR) feature. You must use 1756-EN2T/C modules or later in each chassis of the redundant chassis pair to use DDR.

- One ControlLogix 5580 controller.

    If the chassis is used as a redundant gateway, then a controller is not required.

In addition, redundant chassis are connected to other components outside the redundant chassis pair, for example, remote I/O chassis or human machine interfaces (HMIs).

For more information about components you can use in a redundancy system, see the High Availability System Reference Manual, publication HIGHAV-RM002.

Communication Modules in Redundant Chassis

Remember these points when placing EtherNet/IP communication modules in the redundant chassis pair:

- You must use enhanced communication modules in redundancy systems. Enhanced communication modules contain a '2' or '4' in their catalog number. For example, the 1756-EN**2**T or 1756-EN**4**TR modules.
- For modules compatible with your version of controller firmware, access controller release notes from the Product Compatibility and Download Center at rok.auto/pcd.

Table 1 - Components Available for Use in a Redundant Chassis Pair

Module Type	Cat. No.
Communication modules	1756-EN2F
	1756-EN2T
	1756-EN2TR
	1756-EN2TP
	1756-EN2TXT
	1756-EN4TR, 1756-EN4TRK, 1756-EN4TRXT
Controllers	1756-L81E, 1756-L81E-NSE, 1756-L81EK, 1756-L81EXT, 1756-L81EP, 1756-L82E, 1756-L82E-NSE, 1756-L82EK, 1756-L82EXT, 1756-L83E, 1756-L83E-NSE, 1756-L83EK, 1756-L83EXT, 1756-L83EP, 1756-L84E, 1756-L84E-NSE, 1756-L84EK, 1756-L84EXT, 1756-L85E, 1756-L85E-NSE, 1756-L85EK, 1756-L85EXT, 1756-L85EP
Redundancy modules	1756-RM2
	1756-RM2XT
Slot Filler Module	1756-N2

- Standard EtherNet/IP communication modules are not supported. Standard communication modules contain a 'B' in their catalog number.
  For example, the 1756-ENBT module.
- You can use any combination of up to seven enhanced communication modules in each redundant chassis.
- **Do not use the USB ports** of communication modules to access the redundant system network while the system is running, that is, online. Use of the USB ports while online can result in a loss of communication of traffic through the USB port after a switchover.

Plan for Communication Module Connections

A CIP™ connection is a point-to-point communication mechanism that is used to transfer data between a producer and a consumer. These mechanisms are examples of CIP connections:

- Logix 5000® controller message transfer to Logix 5000 controller
- I/O or produced tag
- Program upload
- RSLinx® DDE/OPC client
- PanelView™ polling of a Logix 5000 controller

ControlLogix **EtherNet/IP communication modules** that are supported in the ControlLogix redundancy chassis pair provide 259 total CIP connections. Consider these points when using CIP connections with ControlLogix EtherNet/IP communication modules:

- Three of the 259 CIP connections are reserved for redundancy.
- You can use the remaining 256 connections in any manner that your application requires, such as the examples listed previously.

I/O Modules in Redundancy Systems

A ControlLogix 5580 redundancy system supports I/O modules in a remote chassis connected via EtherNet/IP. You cannot use I/O modules in the redundant chassis pair.

You can put DeviceNet modules in a remote rack but DeviceNet devices may not be bumpless during a switchover event. For more information, see Knowledgebase Technote ControlLogix 5580 Redundancy with DeviceNet.

Fiber-optic Cable

If you choose to make your own fiber-optic cables, consider the following:

- Fiber-optic Communication Cable Specifications:

Attribute	1756-RM2	1756-RM2XT
Temperature, operating	0...60 °C (32...140 °F)	-25...70 °C (-13...158 °F)
Connector type	LC-PC type (fiber-optic)	
Cable type	8.5/125 micron single-mode fiber-optic cable	
Channels	1 (transmit and receive fiber)	
Length, max	10 km (10,000 m, 10936.13 yd	
Transmission	1000 Mbps	
Wavelength	1310 nm	
SFP transceiver	Transceiver Rockwell Automation PN-91972 Connector/cable: LC duplex connector, 1000BASE-LX-compliant	

- Determine Optical Power Budget

  You can determine the maximum optical-power budget in decibels (dB) for a fiber-optic link by computing the difference between the minimum transmitter-output optical power (dBm avg) and the lowest receiver sensitivity (dBm avg). As shown in Table 2 , the maximum optical power budget for the 1756-RM2 module is -9.5 - (-19) or 9.5 dB.

  The optical-power budget provides the necessary optical-signal range to establish a working fiber-optic link. You must account for the cable lengths and the corresponding link penalties. All penalties that affect the link performance must be accounted for within the link optical power budget.

Table 2 - Optical Power Budget Ranges for 1756-RM2 and 1756-RM2XT Modules

Transmitter	Min	Typical	Max	Unit
Output optical power	-9.5	—	-3	dBm
Wavelength	1270	—	1355	nm
Receiver	**Min**	**Typical**	**Max**	**Unit**
Receiver sensitivity	—	—	-19	dBm
Receiver overload	—	—	-3	dbm
Input operating wavelength	1270	—	1355	nm

Use Dual Fiber Ports with the 1756-RM2 Redundancy Module

The dual fiber ports of the 1756-RM2 module constitute a redundant pair of communication channels between the partner 1756-RM2 modules in a redundant chassis pair. One of the channels is termed as 'ACTIVE', while the other channel is termed as 'REDUNDANT'. All data communication between the partner redundancy modules is conducted exclusively over the ACTIVE channel. If or when the ACTIVE channel fails, a 'Fiber Channel Switchover' is initiated automatically and all data communication shifts to the REDUNDANT channel, which then becomes the new ACTIVE channel.

Fiber Channel Switchover

Due to the fiber channel switchover, the redundant chassis pair remains synchronized even after a failure of the ACTIVE channel. Any of the following failures of the ACTIVE channel trigger an automatic fiber channel switchover to the REDUNDANT channel, provided the REDUNDANT channel is still operating in a normal condition:

- Signal attenuation along the fiber cable path that is routed between the partner redundancy modules.
- A broken or damaged fiber cable that is routed between the partner redundancy modules.
- Improper or loosely fit cable connector.
- SFP transceiver fault.
- Removal or loose connection of the SFP transceiver.
- Data communication error (signaled by a failed CRC check).

Chassis synchronization is lost only when both of the channels have failed or are disconnected.

The fiber channel switchover can occasionally extend the completion of data communication packets between the partner redundancy modules. Therefore, the scan time of the controller can occasionally experience a delay of 10 ms or less.

Configuration

The use of dual fiber ports is entirely 'plug and play'. There is no user configuration that is needed for any of the operations of the active and redundant channels. The firmware automatically manages the selection of active and redundant channels. The dual fiber cables between the partner redundancy modules can be crossed over between CH1 and CH2 without any restriction, however, this is not recommended as it can complicate troubleshooting.

Monitoring and Repair

Synchronization is preserved if the REDUNDANT channel has failed or is being repaired. The repair of the REDUNDANT channel can be performed online while the redundant chassis pair is running synchronized. To aid online repairs, the fiber cable connections and SFP transceiver can be removed and inserted under power.

It is not mandatory to use the REDUNDANT channel that is connected between the two redundancy modules. The redundant chassis pair can be synchronized with just one of the channels connected. The REDUNDANT channel can be installed later while the chassis is running synchronized.

The status indicators on the front panel and the indicators and counters that are displayed in the Redundancy Module Configuration Tool (RMCT) provide monitoring of the channel status.

Redundancy System Operations

Once the redundancy modules in the redundant chassis pair are connected and powered, they determine which chassis is the primary chassis and which is the secondary chassis. The redundancy modules in both the primary and secondary chassis monitor events that occur in each of the redundant chassis. If certain faults occur in the primary chassis, the redundancy modules execute a **switchover** to the unfaulted, secondary chassis.

System Qualification and Synchronization

When the redundant system is first started, the redundancy modules run checks on the redundant chassis. These checks determine if the chassis contain the appropriate modules and firmware to establish a redundant system. This stage of checks is referred to as **qualification**.

After the redundancy modules complete qualification, synchronization can take place. **Synchronization** is a state in which the redundancy modules execute these tasks:

- Verify that the connection between redundancy modules is ready to facilitate a switchover.
- Verify that the redundant chassis continue to meet qualification requirements
- Verify that partner EtherNet/IP communication modules can communicate to each other over the Ethernet network.
- Synchronize the data between the redundant controllers, also called **crossloading.** This data is crossloaded:
  - Updated tag values
  - Forced values
  - Online edits
  - Other project information

Synchronization always takes place immediately following qualification. Also, depending on your system configuration, synchronization takes place at the end of each program that is run within the controller project, or at other intervals that you specify.

Some communication delays can occur during qualification. The existence and duration of these delays depend on:

- Quantity and types of tags on scan in FactoryTalk Linx software.
- Client screen and tag update rates (for example, FactoryTalk Live Data/FactoryTalk Historian).
- Number of data subscr.ibers (for example, FactoryTalk Alarms and Events, FactoryTalk Batch, and so on).
- Size of the redundant controller application.
- Network traffic.

Switchovers

During redundant system operation, if certain conditions occur on the primary chassis, primary control is switched to the secondary chassis. These conditions cause a switchover:

- Loss of power
- Major fault on the controller
- Removal or insertion of any module
- Failure of any module
- Loss of an EtherNet/IP connection - This event only causes a switchover if it results in the EtherNet/IP communication module transition to a lonely state, that is, the module does not see any devices on the network.
- A program-prompted command to switchover
- A command that is issued via the Redundancy Module Configuration Tool.

After a switchover occurs, the new primary controller continues to execute programs. For more information about how tasks execute after a switchover, see Crossloads, Synchronization, and Switchovers on page 57.

IMPORTANT	It is required that all messaging communications point to the primary controller when reading/writing to a ControlLogix Redundancy system. Do not target message instructions to modules in the secondary chassis.

Your application can require some programming considerations and potential changes to accommodate a switchover. For more information on these considerations, see Chapter 6, Programming Best Practices on page 65.

IMPORTANT	During a switchover of the fiber channels of the 1756-RM2 module, scan time encounters a delay of ~10 ms; however, the chassis always remains synched.

Data Server Communication Recovery Time Reduction During a Switchover

Brief communication interruption occurs between FactoryTalk Linx software and the redundant chassis pair when a switchover occurs. After the switchover is complete, communication resumes automatically.

These connection types can experience the communication delay when the switchover occurs:

- Data server to redundant chassis pair
- FactoryTalk® Batch server to redundant chassis pair
- FactoryTalk Alarms and Events Service to redundant chassis pair

Data server communication recovery time is the time during a switchover from primary to secondary, when tag data from the controller is unavailable for reading or writing. Data server communication recovery time applies to any software that uses tag data, such as HMI displays, data loggers, alarms systems, or historians. Data server communication recovery time reduction is important to increase the availability of the system.

When you configure the connection between a FactoryTalk Linx data server, and a redundant ControlLogix controller, you can configure redundant shortcut paths to the primary and secondary controllers. These shortcut paths help reduce data server communication recovery time that occurs during a redundancy switchover.

The following are required to take advantage of this:

- ControlLogix 5580 redundancy controllers with redundancy firmware revision 33.011 or later
- A dedicated pair of ControlLogix communication modules that do not swap IP addresses (see Do Not Use IP Address Swapping on page 30).
  - 1756-EN2TP, 1756-EN2TR, 1756-EN2T modules with firmware revision 11.002 or later, and ControlLogix 5580 redundancy controllers with redundancy firmware revision 33.011 or later.
  - 1756-EN4TR, 1756-EN4TRK, 1756-EN4TRXT modules with firmware revision 4.001 or later, and ControlLogix 5580 redundancy controllers with redundancy firmware revision 34.011 or later.
- FactoryTalk Linx 6.00 with the FactoryTalk Linx patch available from Knowledgebase Technote *Patch: FactoryTalk Linx 6.00 patch required to support ControlLogix V31.05 Redundancy*, or later versions of FactoryTalk Linx.
- Redundant ControlLogix Controller shortcut type in FactoryTalk Linx that points to the Primary and Secondary controllers through the communication modules, without swapping IP addresses. For information on shortcuts in FactoryTalk Linx, see the FactoryTalk Linx Getting Results Guide, publication LNXENT-GR001.

Restrictions

There are restrictions that you must consider when using a redundancy system. Most of these restrictions apply to all redundancy system revisions. Exceptions are noted:

IMPORTANT	Do NOT create active communications that are pointed at the secondary chassis. Anomalous behavior may result.

- See the release notes of the redundancy bundles for compatible products, versions, and revisions.
- The redundant controller program cannot contain these tasks:
  - Event tasks
  - Inhibited tasks

    For recommendations and requirements that are related to programming the redundant controller, see Programming Best Practices on page 65.
- You cannot use the Match Project to Controller feature available in Studio 5000 Logix Designer® in a redundancy system.
- You cannot use motion in a redundant controller program.
- You cannot use consumed unicast connections in a redundancy system. You can use produced unicast connections that remote consumers consume.
- Outputs controlled by IOT instructions are not guaranteed to maintain a bumpless transition during a switchover. Due to this, it is recommended to avoid using IOT instructions within a redundancy system.
- The HMIBC instruction is not supported in a redundancy system.
- You can use one controller of the same family, and seven EtherNet/IP communication modules in each chassis of a redundant chassis pair.
- Cannot use Listen Only or Input Only connections for FLEX 5000 I/O or devices that utilize Highly Integrated Hart from a redundant controller.
  - There is no ability for another controller to create listen only or dual-own these type of connections.

Configure the Redundancy System

Before You Begin

Complete these tasks before you configure the redundancy system:

IMPORTANT	For best performance, place the redundancy module in the chassis as close as possible to the controller.

- Read and understand the safety and environmental considerations explained in the installation instructions publication for each component.
- Order a 1756-RMC*x* fiber-optic communication cable if you do not have one.
- If you choose to make your own fiber-optic cable for lengths that the 1756-RMC*x* catalog numbers do not support, refer to <u>Fiber-optic Cable on page 16</u>.
- Download and install the compatible versions of the Studio 5000 Logix Designer® application, communication software, and ControlFLASH Plus™ software.

  For information on how to download and install ControlFLASH Plus software, see the ControlFLASH Plus Quick Start Guide, publication <u>CFP-QS001</u>

IMPORTANT	If communication software is already on your system, make sure to shut it down before installing/upgrading software.

- Review the release notes for the firmware bundle that you are installing. Make sure that you have compatible hardware and the correct firmware revisions.
- Determine the IP address for each of your Ethernet/IP™ communication modules. Both Ethernet/IP communication modules of the redundant chassis pair will usually have the same IP address. See <u>IP Address Swapping on page 29</u>.
- System scan time will likely be different between a synchronized and unsynchronized system. See <u>Crossloads, Synchronization, and Switchovers on page 57</u>
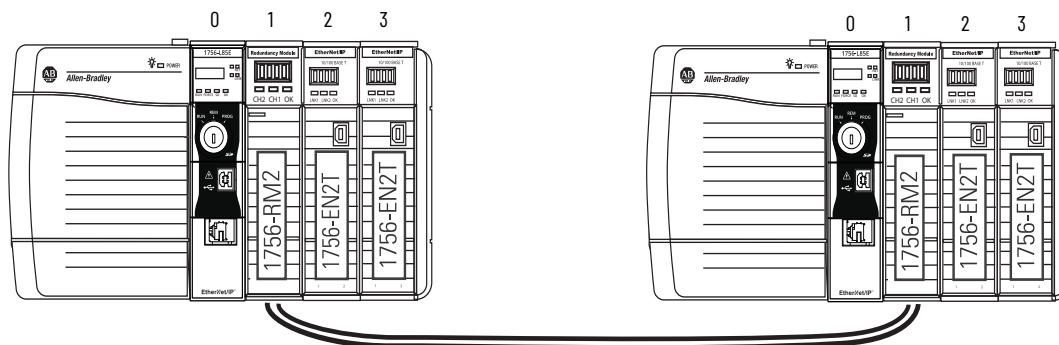
Redundant Chassis Requirements

These configuration parameters must match for the components in a redundant chassis pair during normal system operation:

- Module type
- Chassis size. All rack sizes are supported.
- Slot placement
- Firmware revision

Also see Communication Modules in Redundant Chassis on page 15.

Figure 1 - Example of Redundant Chassis Pair

Download the Redundancy Firmware Bundle

You can download the appropriate redundancy firmware bundle from the Rockwell Automation Product Compatibility and Download Center (PCDC).

1. Go to https://compatibility.rockwellautomation.com/Pages/home.aspx.
2. Search for '1756-L8x Redundancy Bundle'.
3. Select and download the appropriate bundle revision.

Install the Firmware Bundle

Follow the steps in this section.

> Create a firmware directory on your computer first, so you can unzip the files to this directory.

1. You must first shut down the communication software.
2. Browse to the location of the redundancy firmware revision bundle.
3. Unzip the redundancy firmware bundle on your computer. After you unzip, you will have these files:
   - Firmware: V*xx.0xx*_kit*x*_5580CLXRED Bundle.dmk (where *x* is the firmware revision and kit number)
   - Redundancy Module Configuration Tool
4. Unzip the Redundancy Module Configuration Tool on your computer.

Install the Redundancy Module Configuration Tool

The Redundancy Module Configuration Tool is used to configure the redundancy modules and to determine the status of the redundancy system.

- The 1756-L8x Enhanced Redundancy Bundle revision 34.011_kit1 or later does not include FactoryTalk Linx RMCT to use with FactoryTalk Linx. FactoryTalk Linx RMCT is included with Studio 5000 Logix Designer version 34.00.00 or later, or is available as a Product Add-on selection with the firmware on PCDC.

  For version 33 only, the RSLinx Redundancy Module Configuration Tool (RMCT) is included in the redundancy bundle download.

Available Downloads		✕
▲ 1756-L8x Redundancy Bundle 34.011_kit1		🛒
📄 Release Note		Downloads
Description	**Size**	**Note**
Firmware		
✔ Firmware for 1756-L8x Enhanced Redundancy Bundle v34.011_kit1	93.5 MB	
Product Add-Ons		
✔ FactoryTalk Linx RMCT v9.01.00	79.83 MB	
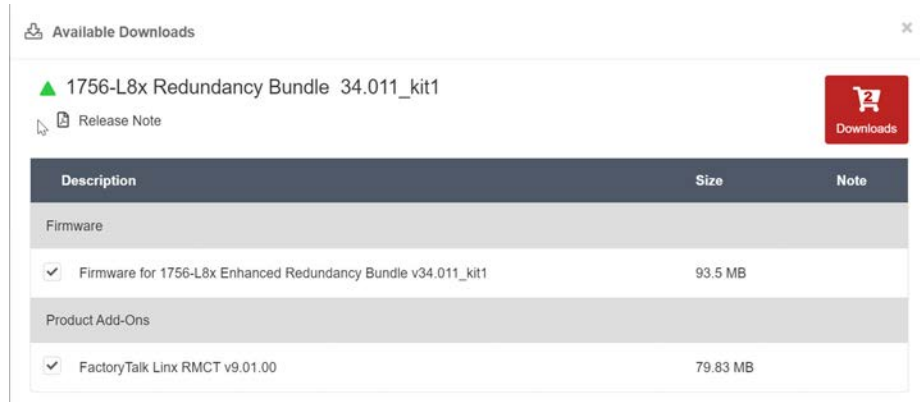
- FactoryTalk Linx RMCT is required for revision 34.011_kit1 or later.
- RSLinx RMCT does not support revision 34.011_kit1 or later.
- For compatible versions of FactoryTalk Linx RMCT and RSLinx RMCT, see the release notes for your redundancy bundle on the [Product Compatibility and Download Center (PCDC)](#).

Use the RMCT to complete these configuration-related tasks:
- Set Auto-Synchronization parameters.
- Set the time and date of redundancy modules.
- View and set module information.
- View and set Chassis ID parameters (Chassis A, Chassis B).
- Lock the redundant system for an update.
- Conduct a test switchover.

You can also use this functionality available with the RMCT to determine the status of the redundant system:
- View error diagnostics specific to redundant chassis.
- View qualification and compatibility status of partnered modules.
- Identify noncompliant modules for removal.
- View redundant system event history.

IMPORTANT	You must uninstall any existing version of the Redundancy Module Configuration Tool (RMCT) before you install the RMCT, version 8.06.03 or later. If you do not uninstall the previous version, you can have difficulty if you try to uninstall version 8.06.03 or later at another time.

To install the RMCT:

1. Browse to the RMCT directory on your computer.
2. Double-click setup.exe.
3. On the RMCT Setup dialog, click Next.
4. When the installation is complete, click Finish.

Install the Redundancy System

If you need to install the redundancy system, determine the location of your controller, Ethernet/IP communication modules, and redundancy modules in both chassis of the system, matching partners slot for slot.

IMPORTANT	Do not power on either chassis until you have installed all modules in both chassis.

1. Install the first chassis and power supply (or redundant power supplies):
   - ControlLogix® Chassis Installation Instructions, publication 1756-IN621
   - ControlLogix Power Supply Installation Instructions, publication1756-IN619
   - ControlLogix Redundant Power Supply Installation Instructions, publication 1756-IN620
2. Install and connect the 1756-RM2 redundancy modules in both chassis:
   - ControlLogix Redundancy Modules Installation Instructions, publication 1756-IN087.
3. Install the first chassis Ethernet/IP communication modules:
   - 1756 EtherNet/IP Communication Modules Installation Instructions, publication 1756-IN050
4. Install one controller in the first chassis of the redundant pair:
   - ControlLogix 5580 Controllers Installation Instructions, publication 1756-IN043
5. Install the second chassis and power supply (or redundant power supplies).
6. Install the second chassis Ethernet/IP communication modules.
7. Install one controller in the second chassis of the redundant pair.

Configure Redundant Firmware

Use ControlFLASH Plus software to upgrade the firmware of each module in each chassis. For information on how to download, install, and use ControlFLASH Plus software, see the ControlFLASH Plus Quick Start Guide, publication CFP-QS001.

IMPORTANT	• Apply power ONLY to the chassis that contains modules on which you are upgrading firmware.
	• Redundancy module firmware that is contained in the redundancy system firmware bundle is designed for use with the 1756-RM2 and 1756-RM2XT redundancy modules.
	• All modules in both chassis must use firmware as defined in the 1756-L8x Redundancy Bundle.

Upgrade the Firmware in the First Chassis

IMPORTANT	Redundancy module firmware that is contained in the redundancy system firmware bundle is designed for use with the 1756-RM2 and 1756-RM2XT redundancy modules.

Complete these steps to upgrade the firmware in the first chassis.

1. Apply power to the chassis.
2. Set the keyswitch on the controller to PROG.
3. Wait for the modules to complete their start-up scroll messages. Check Module and status indicators. During this time, the redundancy module conducts internal operations to prepare for an update.

> 💡 Create a firmware directory on your computer first, so you can unzip the files to this directory.

4. Launch ControlFLASH Plus software, and upgrade the Ethernet communication module that you going to use as the gateway to the other modules.
5. Upgrade the 1756-RM2 redundancy module.

6. Once the firmware upgrade is complete, verify that the redundancy module status displays PRIM, which indicates a successful upgrade.

7. Use ControlFLASH Plus software to upgrade the rest of the modules in the chassis.

IMPORTANT	• Verify the firmware revision of each module to make sure it matches the revision in the 1756-L8x Redundancy Bundle. • Power off the first chassis after you have verified a successful update of each module.

Upgrade the Firmware in the Second Chassis

Complete these steps to update the firmware for the modules in the second chassis.

1. Apply power to the second chassis.

2. Set the keyswitch on the controller to PROG.

3. Complete steps 3…7 in section Upgrade the Firmware in the First Chassis beginning on page 24 for the modules in the second chassis.

IMPORTANT	• verify the firmware revision of each module to make sure it matches the revision in the 1756-L8x Redundancy Bundle. • Power off the second chassis after you have verified a successful update of each module.

Set the initial Primary and Secondary Chassis

Power on the chassis you want to set as the initial primary chassis first. After you have applied power, verify all module pairs are at compatible firmware revision levels.

IMPORTANT	• Do not apply power to the chassis until you have read the instructions for designating the primary chassis. Applying power to the chassis in the correct order is crucial to designating the primary and secondary chassis. • Make sure both Ethernet/IP communication modules are set appropriately. See Data Server Communication Recovery Time Reduction During a Switchover on page 19. • It is not recommended to load an application image until the primary and secondary racks are synchronized. • Before you set the initial primary chassis and qualify the system, it is recommended to have the latest firmware installed. See Configure Redundant Firmware on page 24.

Complete these steps to designate the primary and secondary chassis of a redundant pair.

1. Verify that power is removed from both chassis.

2. Apply power to the chassis you want to designate as the primary chassis and wait for the status indicators of the module to display **PRIM**.

3. Apply power to the chassis you want to designate as the secondary chassis.

4. Verify primary and secondary chassis designations by viewing the redundancy module status displays.

   See Redundancy Module Status Indicators on page 124 for specific redundancy module display information.

IMPORTANT	If both modules have power applied to them simultaneously, the module with the lowest IP address is designated as the primary chassis and displays PRIM on the four-character display of the module. In addition, the PRI status indicator on the primary redundancy module is green. The secondary chassis displays either DISQ or SYNC, depending on the state of the secondary chassis. In addition, the PRI status light on the secondary redundancy module is not illuminated.

After Designation

When you first apply power to the primary and secondary chassis, compatibility checks are carried out between the redundant chassis. Then, because the default Auto-Synchronization parameter is set to Always, qualification begins.

While the qualification occurs, the module status display transitions from DISQ (disqualified) to QFNG (qualifying) to SYNC (synchronized). The qualification completes in 1…3 minutes and the module status display indicates the qualification status.

After you verify the system is synchronized, you can download the user application to the primary controller. It automatically crossloads to the secondary controller.

Use this table as a reference when interpreting the qualification status of the modules that are displayed on the module status display.

Module Status Display	Interpretation
QFNG	Qualification processes are in progress.
SYNC	SYNC displays after qualification processes are complete. This indicates that chassis configuration and the firmware revision levels are compatible and that the secondary chassis is ready to assume control if there is a major fault in the primary chassis.
DISQ…QFNG…DISQ	If DISQ continues to display after about 3 minutes, check the following: • Incorrect chassis configuration. That is, incompatible hardware is used. • Incompatible firmware revisions are used between the primary and secondary modules. • The partnered EtherNet/IP modules are not set to the same IP Configuration. • The Auto-Synchronization parameter within the Redundancy Module Configuration Tool is set to Never or Conditional (default setting).

Conversion from a Non-redundant to a Redundant System

To upgrade a standalone chassis to a redundant chassis pair:

1. Insert a redundancy module in a spare slot in the standalone chassis, and
2. Configure an identical chassis with compatible modules in the same slot as the standalone chassis (including the redundancy module).

A partnered chassis that is set as the secondary chassis stops functioning if it contains:

• non-redundancy-compliant modules
• modules not compatible with redundancy
• non-redundancy-compliant firmware

For more information, see .

## Qualification Status Via the RMCT

To view the details for a qualification attempt, access the Synchronization or Synchronization Status tabs of the RMCT. These tabs provide information about qualification attempts and redundant chassis compatibility.

For more information on how to use the RMCT, see Use the RMCT for Synchronization Attempts and Status on page 98.

RMCT Synchronization Status Tab
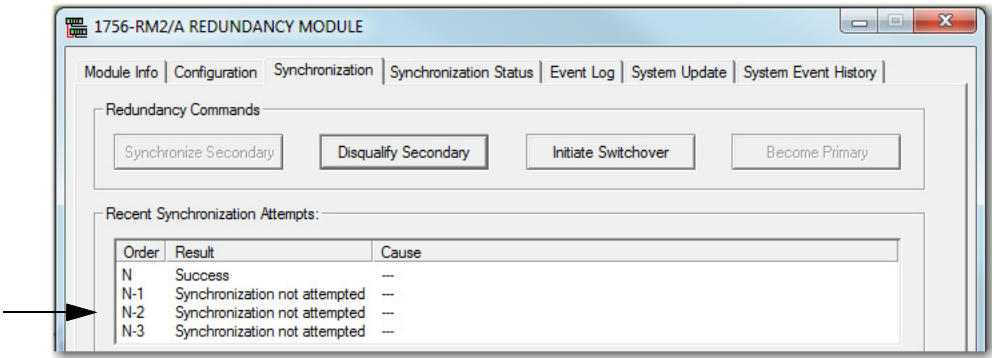
Synchronization Status Tab for Chassis Compatibility
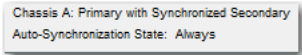
You can also view events specific to qualification in the Event Log of the RMCT.

Event Log with Qualification Events

Reset the Redundancy Module

There are two ways to reset the module.

- Cycle power to the chassis.
- Remove the module from the chassis and reinsert the module.

IMPORTANT	Do not choose to cycle power to the chassis if it causes you to lose control of your process.

Remove or Replace the Redundancy Module

IMPORTANT	If you remove the redundancy module, you will lose redundancy functionality.

To remove or replace the redundancy module, follow these steps.

1. To disengage the upper and lower module tabs, push them.
2. Slide the module out of the chassis.
3. Insert the replacement in the same slot and move the fiber cable(s) to the new module.

IMPORTANT	If you want to resume system operation with an identical module, you must install the new module in the same slot.

Configure the EtherNet/IP Network

Requested Packet Interval (RPI)

The RPI for I/O connections in a redundant-enabled controller tree are configured the same way as a with a simplex controller. Adjusting the RPI rates of I/O connections impact the loading of the associated EtherNet/IP communications modules.

The RPI for I/O connections in a redundant-enabled controller tree are configured the same way as a with a simplex controller. Adjusting the RPI rates of I/O connections impact the loading of the associated EtherNet/IP communications modules.

This table describes CPU usage for EtherNet/IP™ communication modules.

If the CPU utilization percent is	Then
0…80%	No action is required. **Important:** This range is the optimal rate.
Greater than 80%	• Take steps to reduce your CPU utilization. See the EtherNet/IP Network Configuration User Manual, publication ENET-UM001. • Adjust the requested packet interval (RPI) of your connection. • Reduce the number of devices that are connected to your module. • Add another Ethernet module to the redundant chassis pair (maximum of 7) **Important:** Your EtherNet/IP communication module can function at 100% CPU capacity, but at or near this rate, you run the risk of CPU saturation and performance degredation.

Concurrent Communication

With with firmware revision 35.011 or later, concurrent communication is a feature available to Ethernet/IP communication modules that allows two unique connections to actively communicate to an end device.

The IP address **must** be of the following format between the partner EtherNet modules: *aaa.bbb.ccc.ddd* and *aaa.bbb.ccc.(ddd+1)*.

For more information on concurrent communication, see the FLEXHA 5000™ I/O System User Manual, publication 5015-UM001-EN-P.

> **IMPORTANT**   While these connections are unicast, which will show in the software, they are supported in redundancy.

IP Address Swapping

IP address swapping is a feature available to EtherNet/IP communication modules in a redundancy system where a partnered set of EtherNet/IP communication modules swap IP addresses during a switchover.

> **IMPORTANT**   If concurrent communication is not being used, you must use IP address swapping to use remote I/O and produce/consume connections of an EtherNet/IP network.

Determine Use of IP Address Swapping

Depending on your EtherNet/IP network configuration, you can choose to use IP address swapping between your partnered EtherNet/IP communication modules in the event of a switchover.

If you want to	Then
Minimize data server communication recovery time during switchover[1]	Do not use IP address swapping
Have your partnered EtherNet/IP communication modules on different subnets	
Use Remote I/O or produce/consume	Use IP address swapping
Have your partnered EtherNet/IP communication modules on the same subnet.	
Communicate to devices that use concurrent communication.	Use concurrent communication

(1)   For more information, see <u>Data Server Communication Recovery Time Reduction During a Switchover on page 19</u>

If you are using different subnets, you are responsible for programming your system to use the address and subnet of the new primary chassis in the event of a switchover.

> **IMPORTANT**   The partner EtherNet/IP communication modules must be able to communicate to each other over the Ethernet network.

Do Not Use IP Address Swapping

If you do not use IP address swapping, assign unique values for the IP address on both EtherNet/IP communication modules in the partnered set:

> **IMPORTANT**   If concurrent communication is not being used, the IP address **cannot** be of the following format between the partner EtherNet modules: *aaa.bbb.ccc.ddd* and *aaa.bbb.ccc.(ddd+1)*.

Use IP Address Swapping

If you use IP address swapping, at minimum, the below parameters must be configured on both EtherNet/IP communication modules in the partnered set:

- IP address
- Subnet mask

<u>Figure 2</u> shows a partnered set of EtherNet/IP communication modules during initial configuration.

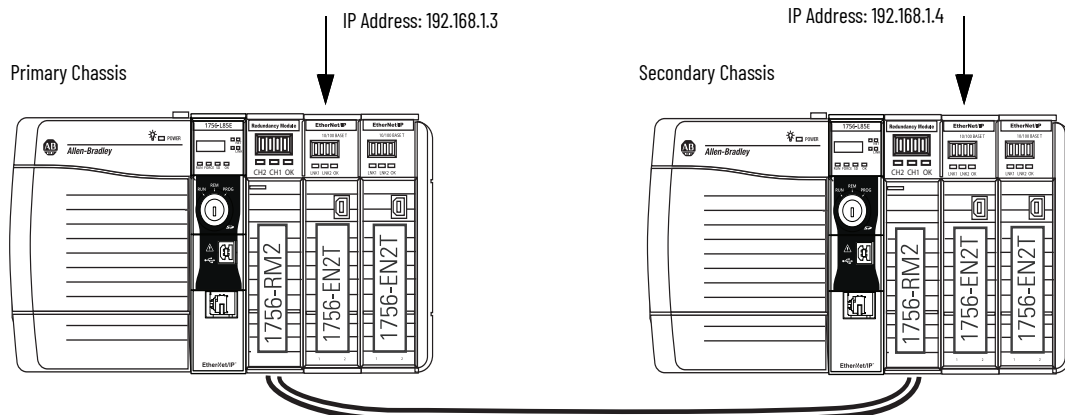**Figure 2 - IP Addresses of EtherNet/IP Communication Modules During System Configuration**
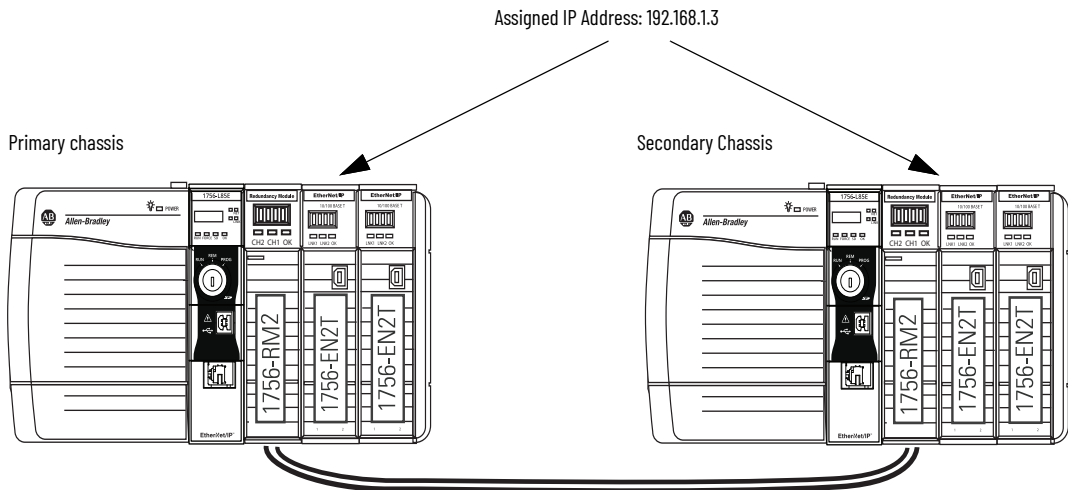
When a redundancy system begins operating, the primary EtherNet/IP communication module uses the IP address that is assigned during initial configuration. The secondary EtherNet/IP communication module automatically changes its IP address to the next highest value. When a switchover occurs, the EtherNet/IP communication modules swap IP addresses.

For example, if you assign IP address 192.168.1.3 to both EtherNet/IP communication modules in a partnered set, on initial system operation, the secondary EtherNet/IP communication module automatically changes its IP address to 192.168.1.4.

Figure 3 shows a partnered set of EtherNet/IP communication modules after system operation begins.

Figure 3 - IP Addresses of EtherNet/IP Communication Modules After System Operation Begins

> Do not assign IP addresses to EtherNet/IP communication modules outside the partnered set to values that conflict with those values that are used in the partnered set.
>
> In the previous example, the partnered set uses 192.168.1.3 and 192.168.1.4. Use 192.168.1.5 or higher for all EtherNet/IP communication modules outside the partnered set.

Figure 4 shows the partnered set of EtherNet/IP communication modules in the communication software after system operation begins.

Figure 4 - IP Addresses in Communication Software
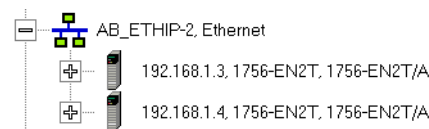
Static Versus Dynamic IP Addresses

A static IP address is manually assigned, and does not change. A dynamic IP address is automatically assigned by a Dynamic Host Configuration Protocol (DHCP) server, and can change over time.

We recommend that you use static IP addresses on EtherNet/IP communication modules in redundancy systems. You cannot use dynamic IP addresses with IP address swapping.

> ⚠️ **ATTENTION:** If you use dynamic IP addresses and a power outage, or other network failure occurs, modules that use dynamic IP addresses can be assigned new addresses when the failure is resolved. If the IP addresses change, your application could experience a loss of control or other serious complications with your system.

Reset the IP Address for an EtherNet/IP Communication Module

If necessary, you can reset the IP address of the EtherNet/IP communication module to the factory default value. To return to the factory default, set the rotary switches on the module to 888 and cycle power.

After you cycle power to the EtherNet/IP communication module, you can either set the switches on the module to the desired address, or set the switches to 999 and use one of these methods to set the IP address:

- BOOTP-DHCP server
- Communication software
- Studio 5000 Logix Designer® application

CIP Sync

CIP Sync™ provides a mechanism to synchronize clocks between controllers, I/O devices, and other automation products in your architecture with minimal user intervention.

CIP Sync uses Precision Time Protocol (PTP) to establish a Master/Slave relationship among the clocks for each CIP Sync-enabled component in the system. One master clock, which is known as the Grandmaster, sets the clock to which all other devices on the network synchronize their clocks.

IMPORTANT	Before you use this enhancement in a redundancy system, see this publication: • Deploying Scalable Time Distribution within a Converged Plantwide Ethernet Architecture Design Guide, publication ENET-TD016

- If you enable CIP Sync Time Synchronization in the controllers in a redundant chassis pair, you must also enable Time Synchronization in one of the EtherNet/IP communication modules in the redundant chassis pair so all devices have one path to the Grandmaster. To enable Time Synchronization in the EtherNet/IP communication modules, change the Time Sync Connection from None (default) to Time Sync and Motion.

  If time synchronization is enabled in any controller in the primary chassis of a disqualified redundant chassis pair, and no other device in the primary chassis has time synchronization enabled, the redundant chassis pair attempts to qualify. However, in these application conditions, the attempt to synchronize fails and the application will remain in the qualifying state for up to 10 minutes before failing qualification. If viewed in the RMCT, the system will remain at 85% complete.

- While CIP Sync can handle multiple paths between master and slave clocks, it resolves mastership most effectively if you configure the redundant paths so that Time Synchronization is enabled in only the minimum required number of EtherNet/IP communication modules. We recommend that PTP should have exactly one path through the system with no loops.

- If the primary controller is the Grandmaster, the redundancy system automatically manages the CIP Sync clock attributes so that the controller in the primary chassis is always set to be the Grandmaster instead of the secondary controller.

IMPORTANT	We recommend to have the Grandmaster outside the Redundant Chassis Pair if possible. If there are time sensitive devices that depend on the clock, there can be a step in the PTP time during switchover.

- When a switchover occurs, these events take place:
  - The Grandmaster status transfers from the original primary controller to the new primary controller. This transfer can take longer to complete than if Grandmaster status was transferred between devices in a non-redundant system.

**Figure 5 - Redundancy System, using CIP Sync Technology**

G = Grandmaster (time source)
M = Master
S = Slave
P1 and P2 = Priorities
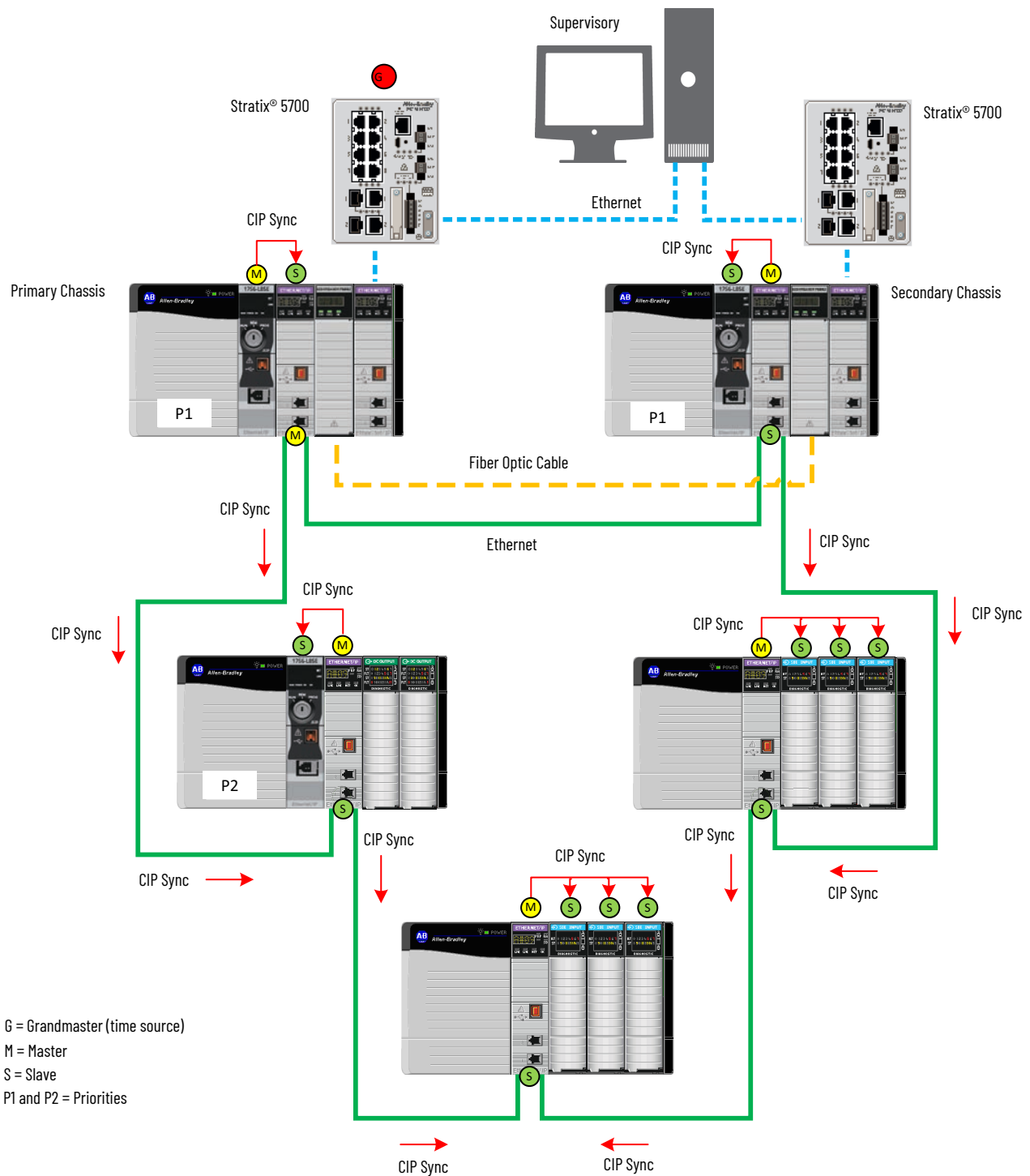
Produce/Consume Connections

Controllers let you produce (send) and consume (receive) system-shared tags over an EtherNet/IP network.

IMPORTANT	A redundant controller can produce tags to a standard controller using unicast or multicast. Redundant controllers must always consume tags using multicast.

Example System Using Produced and Consumed Tags

Primary Chassis

Secondary Chassis

Controller 1 Produced Tag

Controller 2 Consumed Tag
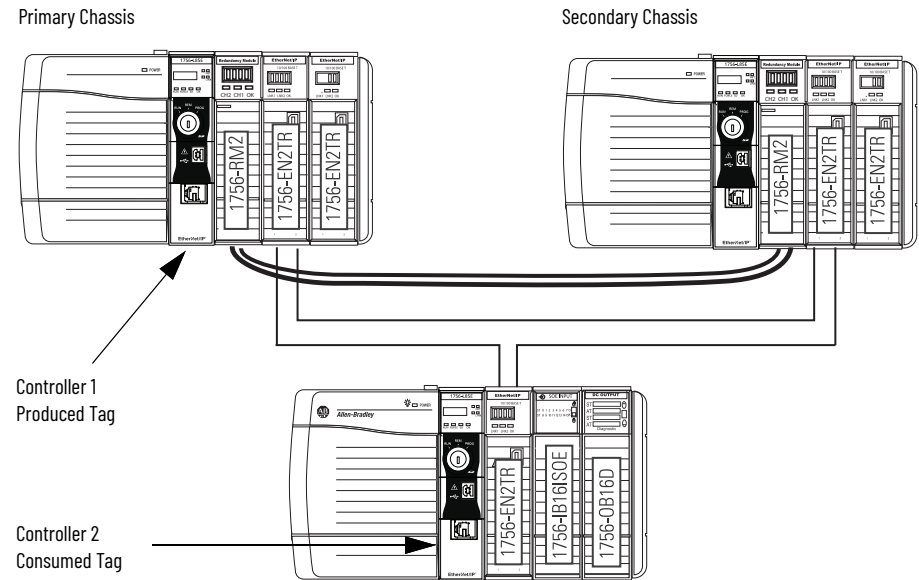
These requirements exist when you use produced and consumed connections over an EtherNet/IP network in a redundancy system:

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

- Produced and consumed tags use connections in both the controllers and the communication modules being used.

- Because the use of produced and consumed tags uses connections, the number of connections available for other tasks, such as the exchange of I/O data, is reduced.

- The number of connections available in a system depends on controller type and network communication modules used. Closely track the number of produced and consumed connections to leave as many as necessary for other system tasks.

- When configuring a tag that will be consumed by a redundant controller pair, the tag configuration in both the remote controller (the producer) and the consumer controller (the redundant ControlLogix® pair) must be configured to be multicast.

  When configuring a tag that will be produced by a redundant controller pair, the tag can be configured as multicast if there will be multiple consumers or unicast if there is only a single consumer.

IMPORTANT	When you add an Ethernet module for the redundancy chassis to the I/O tree of a remote consuming controller, change the Connection setting from Rack Optimized to None. If this setting is not changed the configured connection can briefly drop during a switchover.	
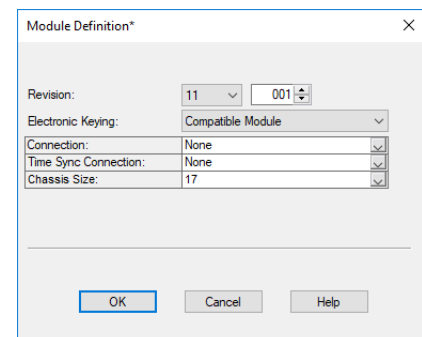
Produced/Consumed Tags between Primary Controllers and Non-redundant Controllers

The connection from the remote controller to the redundant controller can briefly drop during a switchover. This condition can occur if the EtherNet/IP communication modules of the remote chassis do not use specific firmware revisions. The controllers in the redundant chassis pair must also produce tags over the EtherNet/IP network that the controllers in the remote chassis consume.

Configure EtherNet/IP Communication Modules in a Redundant System

Use these procedures to configure EtherNet/IP communication modules that are used in redundant chassis.

Before You Begin

Before you begin configuring the EtherNet/IP communication modules in the redundant chassis, verify that these tasks have been completed:
- The redundancy modules are installed and connected in the redundant chassis.
- A plan for IP address use has been executed:
  - If you are using IP address swapping, plan for the use of two consecutive IP addresses in the partnered set.
  - If you are not using IP address swapping, plan for the use of two IP addresses.
- Know the subnet mask and gateway address for the Ethernet network the redundant modules are to operate on.
- The partner EtherNet/IP communication modules must be able to communicate to each other over the Ethernet network.

Options for Setting the IP Addresses of EtherNet/IP Communication Modules

By default, ControlLogix EtherNet/IP communication modules ship with the rotary switches set to 999 and with Bootstrap Protocol (BOOTP)/Dynamic Host Configuration Protocol (DHCP) enabled.

Use one of these tools to set the IP addresses for your EtherNet/IP communication modules:
- Rotary switches on the module
- Communication software
- Programming software
- BOOTP/DHCP utility

Half/Full Duplex Settings

The redundancy system uses the duplex settings of the EtherNet/IP communication module that is the primary. After a switchover, the duplex settings of the new primary EtherNet/IP communication module are used. By default, the duplex setting is set to automatic. We recommend that you use this setting whenever possible.

To avoid communication errors, configure both the primary and secondary EtherNet/IP communication modules with the same duplex settings. If you use different duplex settings on partnered EtherNet/IP communication modules, then communication errors can occur after a switchover.

Use a Redundancy System with Device Level Ring

Device Level Ring (DLR) is an EtherNet/IP protocol defined by ODVA, Inc. DLR provides a means for detecting, managing, and recovering from single faults in a ring-based network.

A DLR network includes the following types of ring nodes.

Node	Description
Ring supervisor	A ring supervisor provides these functions: • Manages traffic on the DLR network • Collects diagnostic information for the network A DLR network requires at least one node to be configured as ring supervisor. **IMPORTANT:** By default, the supervisor function is disabled on supervisor-capable devices, so they are ready to participate on a linear or star network or as a ring node on a DLR network. In a DLR network, you must configure at least one of the supervisor-capable devices as the ring supervisor before physically connecting the ring. If you do not, the DLR network will not work. **IMPORTANT:** We recommend to assign at least one supervisor outside of the redundant chassis pair to prevent losing supervision of the DLR during switchover. For more information on DLR operation see the EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007.
Ring participants	Ring participants provide these functions: • Process data that is transmitted over the network. • Pass on the data to the next node on the network. • Report fault locations to the active ring supervisor. When a fault occurs on the DLR network, ring participants reconfigure themselves and relearn the network topology.
Redundant gateways (optional)	Redundant gateways provide redundant paths from a DLR network to the outside network.

Depending on their firmware capabilities, both devices and switches can operate as supervisors or ring nodes on a DLR network. Only switches can operate as redundant gateways.

For more information about DLR, see the EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007.

Use a Redundancy System with Parallel Redundancy Protocol

Parallel Redundancy Protocol (PRP) is defined in international standard IEC 62439-3 and provides high-availability in Ethernet networks. PRP technology creates seamless redundancy by sending duplicate frames to two independent network infrastructures, which are known as LAN A and LAN B.

A PRP network includes the following components.

Component	Description
LAN A and LAN B	Redundant, active Ethernet networks that operate in parallel.
Double attached node (DAN)	An end device with PRP technology that connects to both LAN A and LAN B.
Single attached node (SAN)	An end device without PRP technology that connects to either LAN A or LAN B. A SAN does not have PRP redundancy.
Redundancy box (RedBox)	A switch with PRP technology that connects devices without PRP technology to both LAN A and LAN B.
Virtual double attached node (VDAN)	An end device without PRP technology that connects to both LAN A and LAN B through a RedBox. A VDAN has PRP redundancy and appears to other nodes in the network as a DAN.
Infrastructure switch	A switch that connects to either LAN A or LAN B and is not configured as a RedBox.

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

Configure the Redundancy Modules

The Redundancy Module Configuration Tool (RMCT) is used to configure the redundancy modules and to determine the status of the redundancy system.

Use the RMCT to complete these configuration-related tasks:
- Set Auto-Synchronization parameters.
- Set the time and date of redundancy modules.
- View and set module information.
- View and set Chassis ID parameters (Chassis A, Chassis B).
- Lock the redundant system for an update.
- Conduct a test switchover.

You can also use this functionality available with the RMCT to determine the status of the redundant system:
- View error diagnostics specific to redundant chassis.
- View qualification and compatibility status of partnered modules.
- Identify noncompliant modules for removal.
- View redundant system event history.

Determine If Further Configuration Is Required

The default configuration of the redundancy modules lets you synchronize your redundant chassis without additional configuration if you are using a basic redundant chassis pair.

However, some applications and uses of the redundancy system can require additional configuration. For example, you must use the RMCT for additional configuration if you must complete any of these tasks:
- Set the redundancy modules to another time or date (recommended).
- Program your controller to control the redundant system.
- Change the redundancy synchronization options of the redundant system.
- Change the synchronization states of your redundant chassis.
- Conduct a test switchover.
- Complete a firmware update of a module in the redundant chassis while the system is online.

If you must complete any of these tasks, see the sections that follow.

Configure the Redundancy Module

To access and begin using the RMCT, launch the communication software and browse to your redundancy module. Right-click the redundancy module and choose the configuration option: Module Configuration (RSLinx® RMCT) or Device Configuration (FactoryTalk® Linx RMCT).

RSLinx RMCT	FactoryTalk Linx RMCT
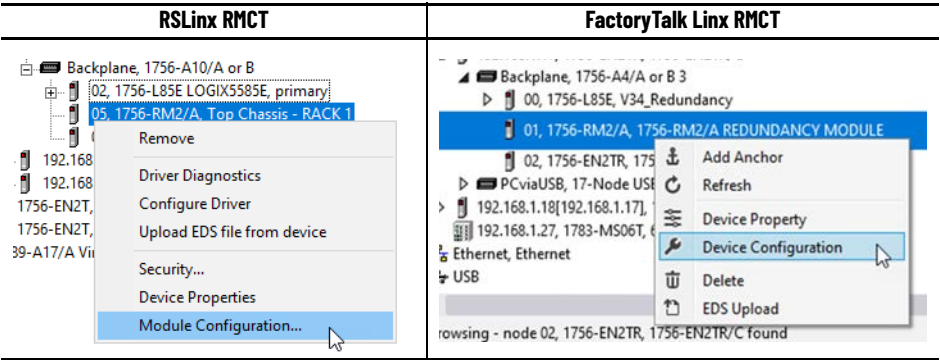
If you cannot see the Configuration option in the list, then a compatible version of the RMCT is not installed.

When you access the RMCT, the dialog box always indicates the status of the redundancy chassis in the bottom-left corner.
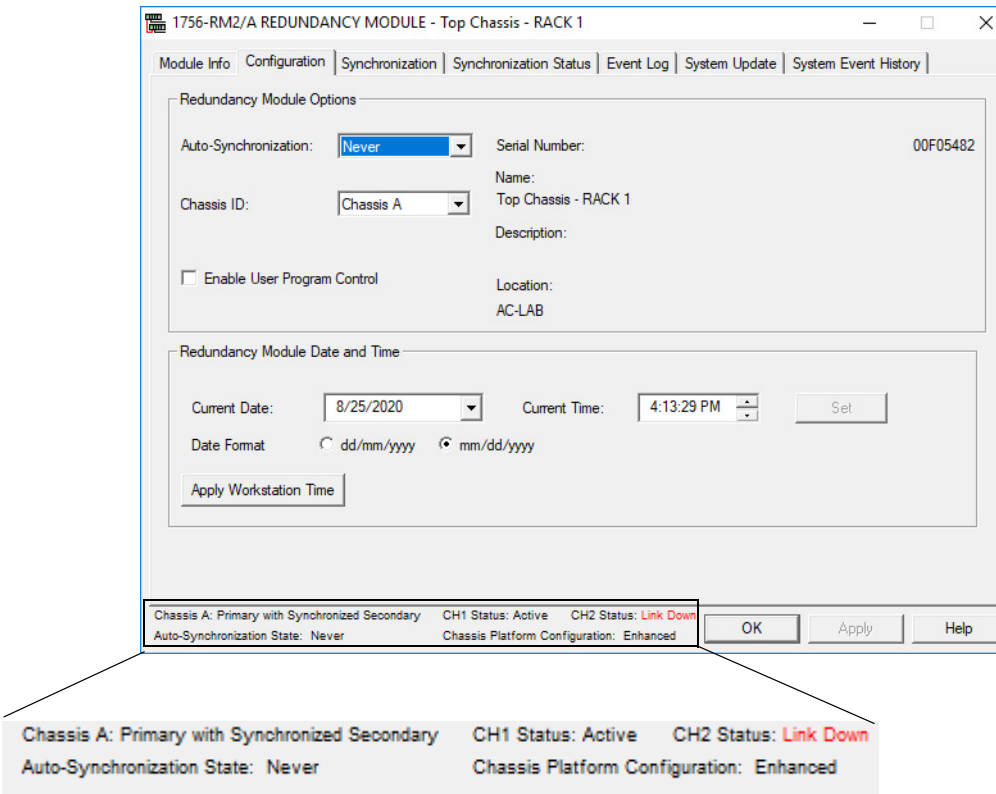
Identify the RMCT Version

You must use a version of the RMCT that is compatible with your redundancy module firmware.

The redundancy module firmware reports back to the Redundancy Module Configuration Tool (RMCT) as to which version of the RMCT is compatible. If there is an incompatibility, the RMCT shows only the Module Info tab and indicates the version that the firmware is compatible with.

For more information on the RMCT compatibility, see Knowledgebase Technote *Redundancy Module Configuration Tool (RMCT)*.

Complete these steps to check or verify the version of the Redundancy Module Configuration Tool (RMCT) that you have installed.

> The RMCT launches at the version that is compatible with the ControlLogix® 5580 redundancy module firmware that is installed.
>
> If you have not updated your ControlLogix 5580 redundancy module firmware after upgrading your RMCT version, the RMCT version that is indicated can differ from the version you updated to. You can also check the RMCT version that you have installed by using Add or Remove Programs in the Control Panel.

1. Launch the communication software.
2. Click the RSWho icon.

3. Right-click your redundancy module and choose the Configuration option.

RSLinx RMCT	FactoryTalk Linx RMCT
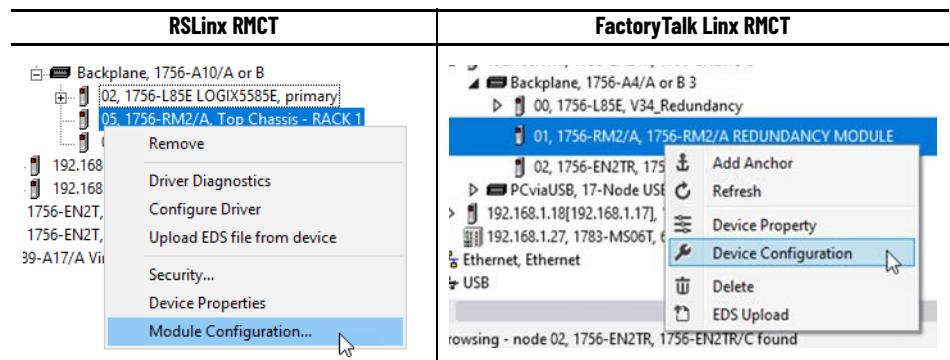
The Module Configuration dialog box opens.

> If device configuration is grayed out, make sure Enable Device Configuration is checked for the instance of the FactoryTalk Linx software. For more information, see Knowledgebase Technote *RMCT support with FactoryTalk Linx*.
>
> If you cannot see the Configuration option in the list, then the compatible version of the RMCT is not installed.

4. Right-click the title bar and choose About.
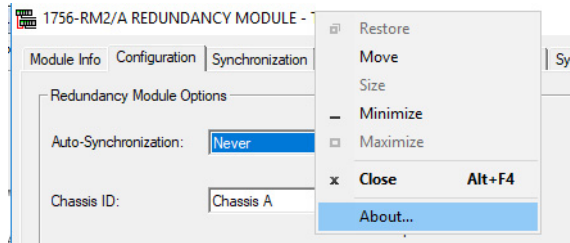
The About dialog box opens and indicates the RMCT version.
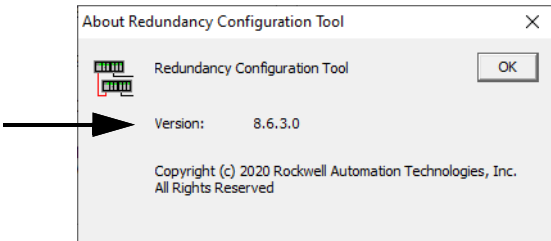
This should show the version you need based on your bundle or higher. The RMCT always shows the latest version installed, and later versions are backwards compatible with earlier versions.

Module Info Tab

The Module Info tab of the RMCT provides a general overview of the identification and status information of the redundancy module. This status information is updated approximately once every two seconds.
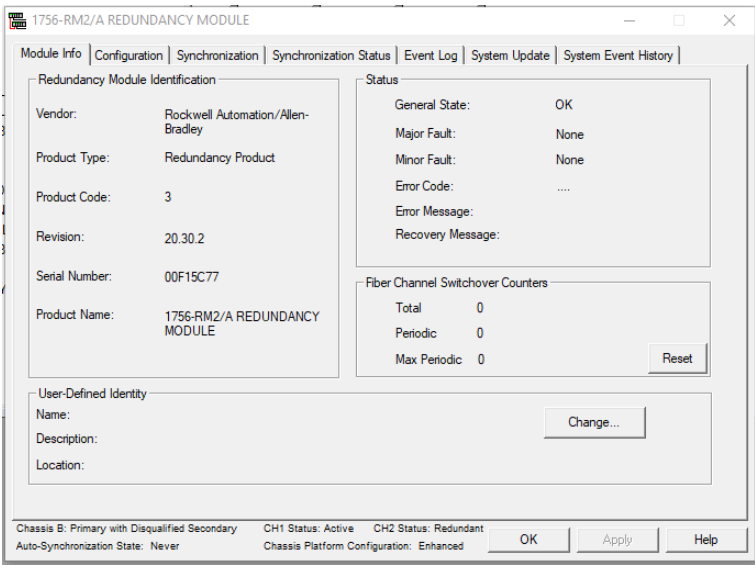
These parameters are indicated in the Module Info tab.

Module Info Tab - Parameters Indicated

Parameter	Description
Vendor	Name of the vendor of the redundancy module.
Product Type	General product type of the redundancy module.
Product Code	CIP™ product code for the redundancy module.
Revision	Major and minor revision information for the redundancy module.
Redundancy Module Serial Number	Serial number of the redundancy module.
Product Name	Predefined catalog name of the redundancy module.
General Status	General state of the redundancy module. Possible values include Startup, Load, Fault, and OK.
Major Fault	The major fault status of a redundancy module. When a major fault is detected, the system does not provide redundancy support.
Minor Fault	The minor fault status of a redundancy module. When a minor fault is detected, the system continues to provide redundancy support.
Error Code	Error code that is related to the fault if one exists.
Error Message	Text-based message that describes the error if a fault exists.
Recovery Message	Text-based message that indicates the recovery from a fault.
Total	Indicates the number of channel switchovers that have occurred from CH1 to CH2 and vice versa on the module since its last powerup. It is reset to 0 automatically by firmware on a power cycle.
Periodic	Indicates the number of switchovers that have occurred between CH1 and CH2 over the last 10-second interval. The counter is constantly updated to reflect the value that is recorded at every 10-second interval. The counter is automatically reset to 0 on a power cycle.
Max Periodic Switchovers	The maximum number that is recorded in the Periodic counter. The time of the update is recorded every time that the counter is updated. The counter is automatically reset to 0 on a power cycle and can also be reset by clicking the Reset button.[1]
CH1 Status	Fiber Channel 1 status. The status shows the operating condition of the respective fiber channels in terms of one of the following values: • Unknown - Operating state is not yet determined • Active - Channel is operating normally as the ACTIVE channel • Redundant - Channel is operating normally as the REDUNDANT channel • Link Down - Channel is disconnected. Causes can be: the cable is disconnected/broken/damaged; signal is attenuated, connector is loose, the partner 1756-RM2 module is power down or in a major fault state • No SFP - No transceiver was detected, it has failed, it is loosely connected, it is not installed • SFP !Cpt - Transceiver is not a Rockwell Automation supported unit • SFP Fail - Transceiver is in a failed state
CH2 Status	Fiber Channel 2 status. See CH1 Status on page 41.
Chassis Platform Configuration	Indicates configuration.

(1) The Periodic counters can be used to identify a burst of switchovers that can take place due to intermittent channel failures within a few seconds. The recorded time can be helpful to correlate the switchover occurrences with any external failures that have occurred on the fiber cables.

In addition, you can click Change to edit the User-defined Identity parameters to meet your application needs.

Configuration Tab

Use the Configuration tab to set redundancy options and the internal clock of the redundancy module. After you modify a parameter, the Apply Workstation Time button becomes active.
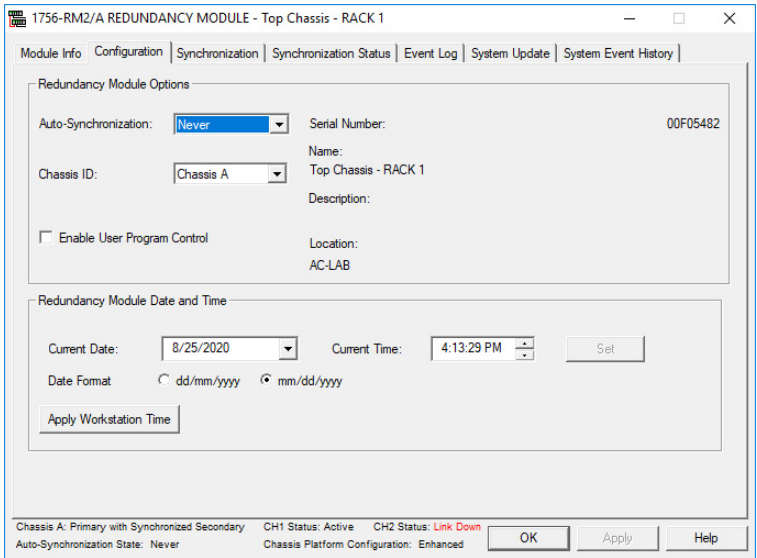
Auto-synchronization

The first parameter in the Configuration tab is the Auto-Synchronization parameter. The value that you chose for this parameter determines a significant part of your redundant system behavior.

Rockwell Automation suggests setting Auto-Synchronization to Always.

Verify that your Auto-Synchronization parameter is at the proper value **before** you modify your redundant system. This verification helps prevent system errors.

For example, if you are upgrading your redundant system firmware, verify that this parameter is set to Never or Conditional before disqualifying your secondary chassis. If this parameter is Always, you cannot properly disqualify your chassis and conduct the update.

Use the following table to determine the Auto-Synchronization setting that best suits your application.

If you use this parameter	This synchronization behavior results
Never	The system remains in the same state, that is, either synchronized or disqualified, until one of these events takes place: • A command is issued from the RMCT to either synchronize or disqualify. • The controller commands synchronization or disqualification by using a MSG instruction. For this action to occur, Enable User Program Control must be checked. • A fault on the primary causes a switchover.
Always	The system automatically synchronizes regularly. If you attempt to disqualify the system by using the Disqualify Secondary command in the RMCT, the resulting disqualification is temporary as the system automatically qualifies and synchronizes again. If the controller program disqualifies the system, the resulting disqualification is also temporary.
Conditional	The system behavior with this setting is dependent on the Auto-Synchronization state of your system, found in the lower left portion of the RMCT window after setting the Auto-Synchronization parameter to Conditional: • If your Auto-Synchronization parameter is set to Conditional and your Auto-Synchronization state is 'Conditional, Enabled', then the system continually attempts to synchronize. • If your Auto-Synchronization parameter is set to Conditional and your Auto-Synchronization state is 'Conditional, Disabled', then the system does not automatically attempt to synchronize. To change from 'Conditional, Enabled' to 'Conditional, Disabled', click Disqualify Secondary on the Synchronization tab. To change from 'Conditional, Disabled' to 'Conditional, Enabled', click Synchronize Secondary on the Synchronization tab.

Chassis ID

The chassis ID parameter is used to assign a generic label to the chassis that house the redundancy modules. The available chassis labels are Chassis A and Chassis B.

If you change the chassis label in the RMCT of the primary redundancy module, the secondary module and chassis are automatically assigned the other chassis label.

The chassis label that is assigned to the module remains associated with the same physical chassis, regardless of its primary or secondary control designation.

Enable User Program Control

Check Enable User Program Control in the Configuration tab if you plan to use MSG instructions in your controller program to initiate a switchover, change the redundancy module time, or synchronize.

If you leave Enable User Program Control unchecked, the redundancy modules do not accept any commands from the controller.

Redundancy Module Date and Time

The Redundancy Module Date and Time parameters can be applied separate from the Redundancy Module Options parameters. The time that is specified with these parameters is the time that the event logs reference when a redundant system event occurs.

To change the redundancy module time settings, use the pull-down menu or type your changes and then click Set to implement time changes. Or, to set the time of the redundancy module to match that of the workstation, click Apply Workstation Time.

IMPORTANT	We recommend that you set the redundancy module date and time when you commission a system. We also recommend that you periodically check the date and time settings to make sure that they match the settings of the controller.
	If a power failure occurs on the redundant chassis, you must reset the date and time information of the redundancy modules. The modules do not retain those parameters when power is lost.

Synchronization Tab

The Synchronization Tab has commands for these options:

- Change the synchronization state of the system (synchronize or disqualify)
- Initiate a switchover
- Force the disqualified secondary to become the primary
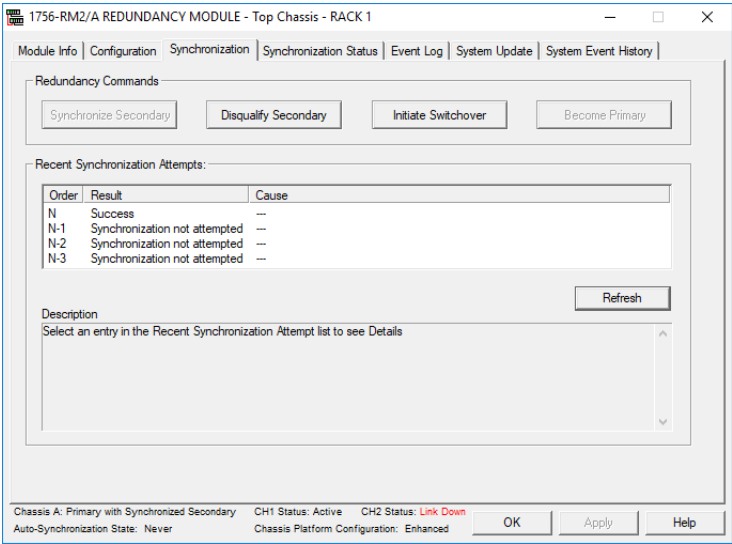
The commands are described in Commands in the Synchronization Tab on page 45.

This tab also has information about the last four synchronization attempts in the Recent Synchronization Attempts log. N or N-*X* identify synchronization attempts in the log. If the redundant chassis fail to synchronize, a cause is identified in the Recent Synchronization Attempts log.

The causes and their interpretations are described in the Recent Synchronization Attempts Log section on page 45.

Commands in the Synchronization Tab

These sections explain each redundancy command and the system conditions that are required for the command to be available.

Command	Description
Synchronize Secondary	This command forces the primary redundancy module to attempt synchronization with its partner. This command is available in specific conditions: • Available only when the chassis redundancy state is as follows: • Primary with Disqualified Secondary • Disqualified Secondary • Unavailable (dimmed) in all other chassis states Synchronization is asynchronous with the execution of this command. Successful execution of this command begins with synchronization, which can take several minutes. Monitor the chassis status that is displayed at the bottom of the RMCT to determine when synchronization has completed.
Disqualify Secondary	This command forces the primary redundancy module to disqualify its partner. **ATTENTION:** • Disqualifying the secondary chassis makes it unable to assume control functions, that is, redundancy is lost. • If you disqualify the secondary and a major fault occurs on the remaining primary, a switchover does not occur. This command is available in specific conditions: • Available only when the chassis redundancy state is as follows: • Primary with Synchronized Secondary • Synchronized Secondary • Unavailable (dimmed) in all other chassis states If you use the Disqualify Secondary command when the Auto-Synchronization parameter is set to Always, a synchronization attempt occurs immediately after the secondary chassis becomes disqualified. To keep the secondary disqualified after issuing a Disqualify Secondary command, set the Auto-Synchronization parameter to Conditional or Never before disqualifying the secondary.
Initiate Switchover	This command forces the system to initiate an immediate switchover from the primary chassis to the secondary chassis. This command can be used when you upgrade redundancy system firmware or when you complete maintenance on one chassis of the redundant pair. This command can also be used to perform a realistic test of your redundant system behavior by simulating a failure that is detected in the primary control chassis. This command is available in specific conditions: • Available only when the chassis redundancy state is as follows: • Primary with Synchronized Secondary • Synchronized Secondary • Unavailable (dimmed) in all other chassis states
Become Primary	This command forces a disqualified secondary system to become a primary system and is available in specific conditions: • Available only when the chassis redundancy state is Secondary with No Primary. • Unavailable (dimmed) in all other chassis states

Recent Synchronization Attempts Log

This table describes the possible result and causes of synchronization states.

Recent Synchronization Attempts Log - Result Interpretations

Result	Result Interpretation
Undefined	The result of the synchronization is unknown.
No attempt since last powerup	Synchronization has not been attempted since power was applied to the module.
Success	Full synchronization was successfully completed.
Abort	The synchronization attempt failed. See Table 3 for further information.

If the Synchronization Attempts log indicates that the Synchronization attempt was aborted, use Table 3 to diagnose the cause.

Table 3 - Synchronization Interpretation

Cause	Cause Interpretation
Undefined	The cause of synchronization failure is unknown.
Module Pair Incompatible	Synchronization was aborted because one or more module pairs are incompatible.
Module Configuration Error	Synchronization was aborted because one of the modules is improperly configured.
Edit Session In Progress	Synchronization was aborted because an edit or session is in progress.
Crossloading Failure	An undetermined failure occurred during synchronization between redundancy modules.
Comm Disconnected	The cable between the redundancy modules was disconnected.
Module Insertion	Synchronization was aborted because a module was inserted into a chassis.
Module Removal	Synchronization was aborted because a module was removed from a chassis.
Secondary Module Failed	Synchronization was aborted because of a failure in the secondary module.
Incorrect Chassis State	Synchronization was aborted due to an incorrect chassis state.
Comm Does Not Exist	Synchronization could not be performed because the communication link between redundancy modules does not exist.
Non-redundant Compliant Module Exists	Synchronization could not be performed because one or more non-redundancy modules are present in one of the chassis.
Sec Failed Module Exists	A module in the secondary chassis has asserted the SYS_FAIL line, which indicates that it has faulted or failed.
Local Major Unrecoverable Fault	Synchronization was aborted because of a local major unrecoverable fault.
Partner Has Major Fault	Synchronization was aborted because the partner module has a major fault.
Sec SYS_FAIL_L Subsystem Failed	The test of the SYS_FAIL line in the secondary chassis failed.
Sec RM Device Status = Comm Error	Synchronization was aborted because the status of the secondary redundancy module indicates a communication error.
Sec RM Device Status = Major Recoverable Fault	Synchronization was aborted because the status of the secondary redundancy module indicates a major recoverable fault.
Sec RM Device Status = Major Unrecoverable Fault	Synchronization was aborted because the status of the secondary redundancy module indicates a major unrecoverable fault.
Incorrect Device State	Synchronization was aborted because the device is in the wrong state.
Primary Module Failed	Synchronization was aborted because of a failure in the primary module.
Primary Failed Module Exists	A module in the primary chassis has asserted the SYS_FAIL line, which indicates that it has faulted or failed.
Auto-Sync Option	Synchronization was aborted because the Auto-Synchronization parameter of one of the redundancy modules was changed during synchronization.
Module Qual Request	Synchronization was aborted because another synchronization request was received. The current synchronization has stopped so that the new synchronization request can be serviced.
SYS_FAIL_L Deasserted	Synchronization was aborted because one of the modules came out of a faulted or failed state.
Disqualify Command	Synchronization was aborted because the redundancy module received a disqualify command from another device. The originating device sends this command when it can no longer perform in the qualified state.
Disqualify Request	Synchronization was aborted because the redundancy module received a disqualify command from another device. The originating device sends this command when it can no longer perform in the qualified state.
Platform Configuration Identity Mismatch Detected	There are modules in the primary or secondary chassis that do not belong to the platform.
Application Requires Enhanced Platform	A redundant controller is running an application that contains a feature that is qualified to run only on an enhanced redundant platform, for example, Alarms.
ICPT Asserted	A test line on the backplane is asserted.
Unicast Not Supported	A unicast connection is configured in the redundant controller, and redundancy systems do not support Unicast.
PTP Configuration Error	The PTP clock of a redundant controller is not synchronized or the partner controller pair is synchronized to another Grandmaster.
Secured Module Mismatch	A mismatch was detected between a primary and secondary secured module.

Contact Rockwell Automation technical support for help with troubleshooting the cause listed in the table above.

Synchronization Status Tab

The Synchronization Status tab provides a module-level view of these items:

- Synchronization state (for example, Synchronized or Disqualified)
- Chassis designation (Primary or Secondary)
- Module compatibility with its partner (for example, Full or Undefined)

Each module that is installed in the chassis is identified and information regarding its partner and compatibility are provided.

Synchronization State　　　　Chassis Designation　　　　Module-partner Compatibility

1756-RM2/A REDUNDANCY MODULE - Top Chassis - RACK 1　　　—　　☐　　✕

Module Info | Configuration | Synchronization | **Synchronization Status** | Event Log | System Update | System Event History

Slot	% Complete	Module Name	Module Revision	Secondary Readiness	State	Compatibility
0	---	\<empty\>	---	---	---	---
1	---	\<empty\>	---	---	---	---
2	100	1756-L85E/B_561...	33.11	Synchronized	Primary	Full
3	---	\<empty\>	---	---	---	---
4	---	\<empty\>	---	---	---	---
5	100	1756-RM2/A RED...	20.30	Synchronized	Primary	Full
6	---	\<empty\>	---	---	---	---
7	---	\<empty\>	---	---	---	---
8	---	\<empty\>	---	---	---	---
9	100	1756-EN2T/B	5.28	Synchronized	Primary	Full

Chassis A: Primary with Synchronized Secondary　　CH1 Status: Active　　CH2 Status: Link Down

Auto-Synchronization State: Never　　Chassis Platform Configuration: Enhanced

OK　　Apply　　Help

System Update Tab

Use of the commands in the System Update tab lets you perform firmware updates in the secondary chassis while the primary chassis remains in control. Reference the lock and switchover logs in this tab for update information when completing a firmware update.

> ⚠️ **ATTENTION:** When performing firmware updates by using commands in the System Update tab, redundancy is lost. In the event of a fault on the operating primary chassis, the system cannot switch control to the secondary chassis.

1756-RM2/A REDUNDANCY MODULE - Top Chassis - RACK 1   — ☐ ✕

Module Info | Configuration | Synchronization | Synchronization Status | Event Log | System Update | System Event History

System Update Commands

| Lock For Update | Abort System Lock | Initiate Locked Switchover |

System Update Lock Attempts

System Lock History	Initiation Time	Status	Result
N	---	Not attempted	---
N-1	---	Not attempted	---
N-2	---	Not attempted	---
N-3	---	Not attempted	---

Locked Switchover Attempts

Locked Switchover History	Initiation Time	Status	Result
N	---	Not attempted	---
N-1	---	Not attempted	---
N-2	---	Not attempted	---
N-3	---	Not attempted	---

Refresh

Chassis A: Primary with Synchronized Secondary   CH1 Status: Active   CH2 Status: Link Down   OK   Apply   Help
Auto-Synchronization State: Never   Chassis Platform Configuration: Enhanced

---

System Update Commands

The three system update commands are available only when accessing a primary redundancy module. These commands are not available when accessing the secondary redundancy module.

> 💡 While you are completing tasks to update the system by using the system update commands, you cannot access these tabs in the RMCT:
> - Configuration
> - Synchronization
> - Synchronization Status
>
> If you attempt to access any of these tabs while the system is locked or is completing a locked switchover, it results in an error dialog box.

Lock For Update

The Lock for Update command lets you synchronize a redundant chassis pair under these conditions:

- The secondary redundancy module uses updated firmware and an updated programming software application program version.

- The running primary redundancy module uses a previous firmware revision and previous programming software application program version.

The Lock for Update command is available only when all modules in the primary chassis have no compatibility discrepancies. Before issuing the lock command, complete these tasks:

- Set the Auto-Synchronization option in the Configuration tab to Never.
- Disqualify the secondary chassis by using the Disqualify Secondary command in the Synchronization tab of the RMCT of the secondary redundancy module.
- Update the primary and secondary redundancy modules to compatible firmware revisions.
- Update all other modules in the secondary chassis to their intended firmware revisions.
- Configure the controller project as required to accommodate the update and replacement of modules if needed.

For details about how to complete those tasks, see <u>Configure Redundant Firmware on page 24</u>.

Click the Lock for Update command to initiate the locking process. The lock can take several minutes to finish. Monitor the System Update Lock Attempts log to determine when the lock is complete. In addition, the chassis status that is shown at the bottom-left of the dialog box changes from Primary with Disqualified Secondary to Primary Locked for Update.

Lock for Update Status Updates

Lock initiated.

System Update Lock Attempts			
System Lock History	Initiation Time	Status	Result
N	12/16/2019 16:16:16:848	In Progress	Lock for update initiated at :12/16/2019 16:16:16:8

Lock complete.

System Update Lock Attempts			
System Lock History	Initiation Time	Status	Result
N	12/16/2019 16:16:16:848	Locked	System locked at :12/16/2019 16:16:49:498

Lock complete.

Chassis A: Primary Locked For Update

Abort System Lock

The Abort System Lock command can be used to stop the system lock. It is available as soon as a lock for update is initiated.

Click Abort System Lock to return the redundant chassis status to Primary with Disqualified Secondary. This action also causes the system update to stop and the program in the secondary controller to clear. If you click Abort System Lock, you must download the program to the secondary controller before reattempting a Lock for Update.

Initiate Locked Switchover

The Initiate Locked Switchover command is available only when the chassis redundancy state is Primary with Locked Secondary. That is, the Initiate Locked Switchover is available only after the lock for update is complete.

If you click Initiate Locked Switchover, your secondary chassis assumes control and becomes the new primary. The old primary is now the new secondary chassis and you can update the firmware of the modules in the new secondary chassis.

Illustration of Switchover
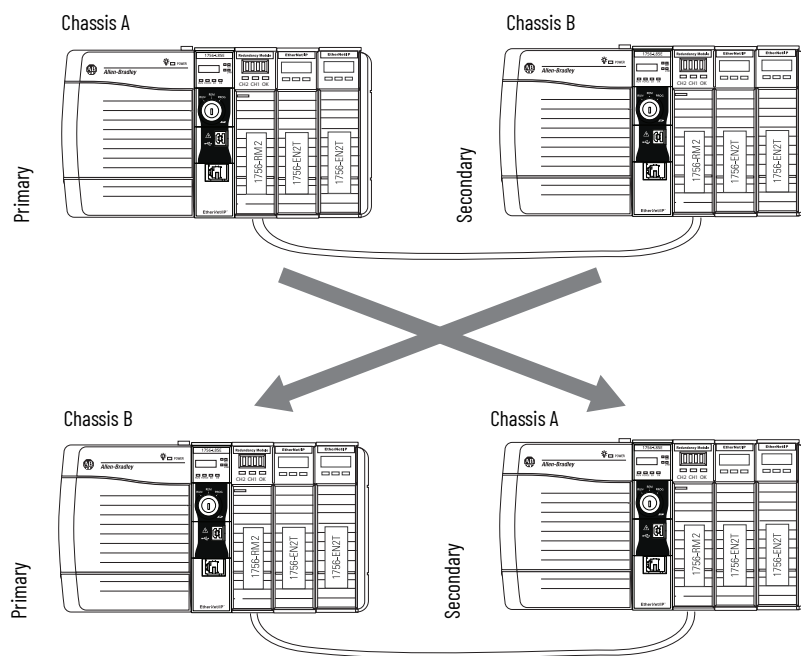
The difference between a locked switchover and a normal switchover is that you initiate the locked switchover. You or a fault in the primary chassis initiate a normal switchover.

System Update Lock Attempts

The System Update Lock Attempts log is where attempts to lock the system are logged. This log displays the last four lock attempts and provides this information specific to each attempt:

- Time and date
- Status (for example, Locked or Abort)
- Result (for example, System Locked or Invalid Response Received)

The status indicated in the System Update Lock Attempts log can be any one of the states that are listed in Table 4.

Table 4 – System Update Lock Attempts Log Statuses

Status	Interpretation
Not Attempted	A system lock has not been attempted since the last powerup.
In Progress	A lock is in progress.
Locked	The lock was successfully completed.
Abort	The lock attempt failed. The reason for the failure is indicated in a Result field.

If your status is indicated as Abort, one of these conditions can exist:

- An error occurred while communicating with the partner redundancy module.
- A module in the secondary chassis does not have a partner in the primary chassis.
- A module pair is incompatible.
- The SysFail test was unsuccessful in the primary redundancy module.
- A Major Recoverable Fault occurred in primary redundancy module.
- A Major NonRecoverable Fault occurred in primary redundancy module.
- A module was inserted into the chassis.
- A module was removed from the chassis.
- A failed module exists in the secondary chassis.
- A failed module exists in the primary chassis.
- An Abort System Update command was received.
- Invalid response was received from a module.
- A module rejected the state change.
- A platform mismatch was detected.

For more information on Lock for Update Failures, see Knowledgebase Technote *Lock for Update Fails.*

Locked Switchover Attempts

The Locked Switchover Attempts log provides information about the status of the last four locked switchover attempts. This log includes this information about each attempt:

- Time and date
- Status
- Result

The status indicated in the Locked Switchover Attempts log can be any one of the states that are listed in Table 5.

Table 5 - Locked Switchover Event Log Statuses

Status	Description
Not Attempted	A locked switchover has not been attempted since the last powerup.
In Progress	A locked switchover is in progress.
Success	A locked switchover was successfully completed.
Abort	The locked switchover attempt failed. The cause of the failure is indicated in a Result field.

If a locked switchover is aborted, it can be because of the following:

- A module declined a locked switchover readiness request.
- An invalid response was received from the locked switchover readiness request.
- After an initiate switchover prompt, a module rejected the command.
- After an initiate switchover prompt, a module replied with an invalid response.

Configure the Redundant Controller

Configure the Redundant Controller

Both controllers in the ControlLogix® redundancy system operate by using the same program. You do not need to create a project for each controller in the redundant system.

IMPORTANT	When programming your redundancy system, you should only interface with the controller in the primary rack unless a specific workflow dictates that the controller in the secondary rack should be the target of modification

To configure your controllers to operate in a redundant system, complete these steps.

1. Open or create a project for your redundant controller.
2. Access the Controller Properties dialog box for the controller.
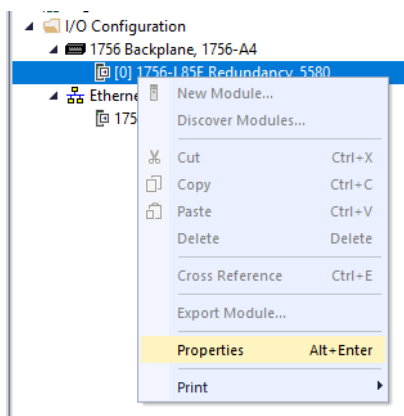
3. Click the Redundancy tab, and check the Redundancy Enabled checkbox.
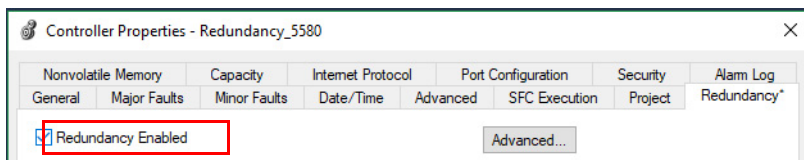
4. If you are going to complete edits to your redundant controller while online, see for information about the parameters available in the Advanced settings.

5. Click the Advanced tab, and verify that Match Project to Controller is unchecked.

IMPORTANT	Do not use Match Project to Controller property with redundant controllers.
	If you use the Match Project to Controller property available in the Advanced tab of the Controller Properties dialog box, you cannot go online with, download to, or upload from the new primary controller after a switchover. This is because the serial number of the new primary controller is not the same as the serial number of the old primary controller and the project cannot be matched to the newly switched to controller.

Verify that this option is not checked.
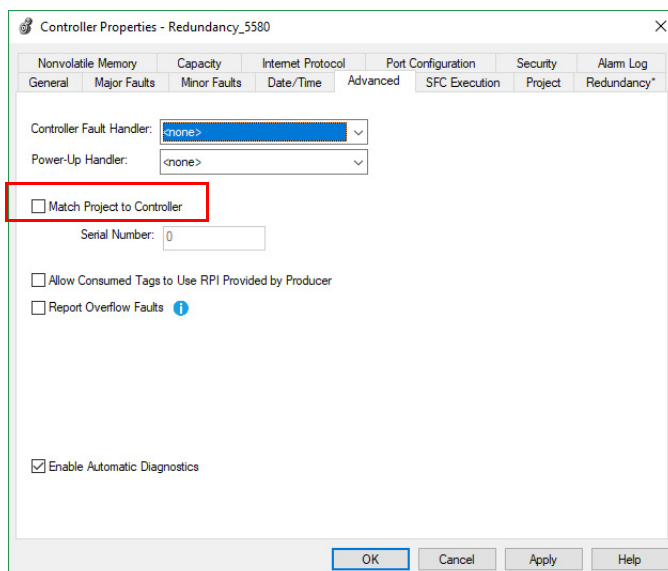
6. Click Apply.

7. On the Logix Designer popup, click Yes.
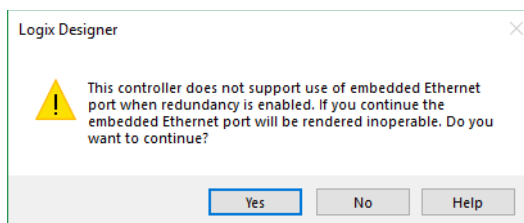
The Logix Designer application removes the front Ethernet port from the I/O configuration.
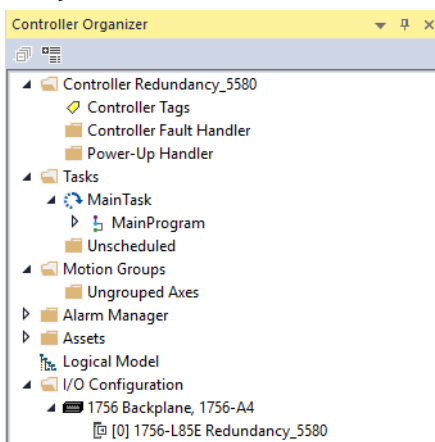
8. On the Controller Properties dialog box, Click OK. You have completed the minimum configuration that is required for your redundant controllers.

Enable Time Synchronization

Time synchronization is not required for redundancy to function.

> **IMPORTANT**   Do not use CIP Sync Time Synchronization if it is not required, as it can increase crossload time and use up a significant amount of processing power in the 1756-RM2 module. You should only use CIP Sync Time Synchronization if required by an application element, such as Logix tag-based alarms, or Sequence of Event (SOE) module(s) being used in a remote rack.

If your application requires Time synchronization, then follow these steps.

1. At the Date/Time tab in Controller Properties, make sure that Enable Time Synchronization is checked.

2. Click Apply.
3. Click OK.
4. Click Yes, on the Logix Designer popup.
5. Access the Module Properties dialog box for the Ethernet module.

6. At the General tab of the Module Properties dialog box of the Ethernet module, click Change.

> **IMPORTANT**   At least one Ethernet module requires this configuration if time synchronization is enabled on the controller. For more information, see the Knowledgebase Technote Troubleshooting ControlLogix Redundancy Systems.
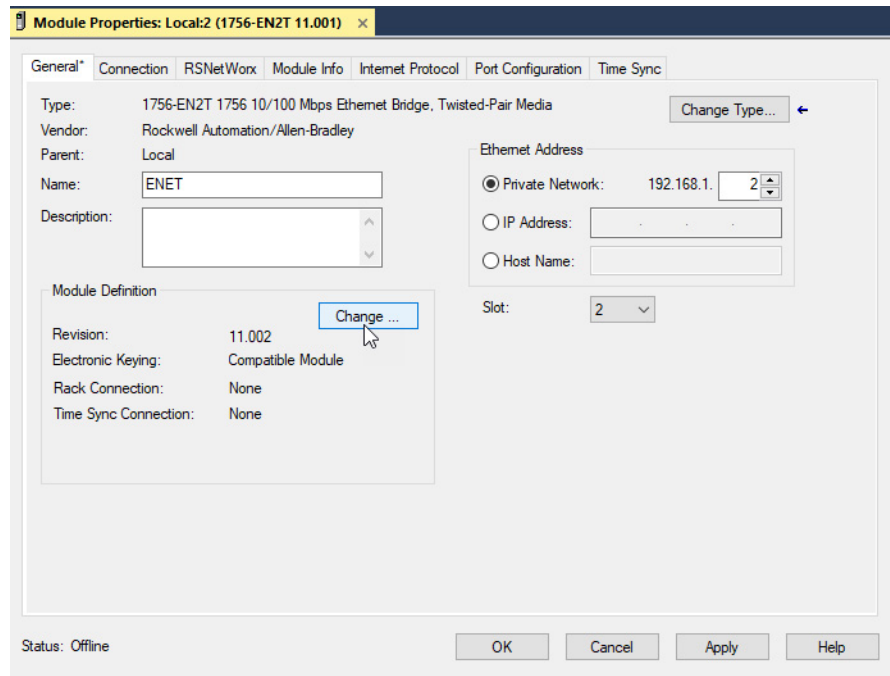
7. From the Time Sync connection pull-down menu, select Time Sync and Motion.
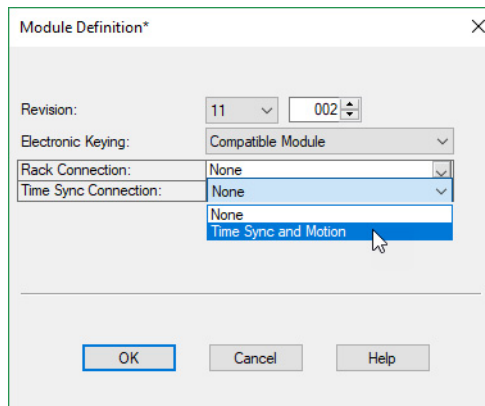
8. Click OK to close the dialog box.
9. At the warning dialog box, click Yes.
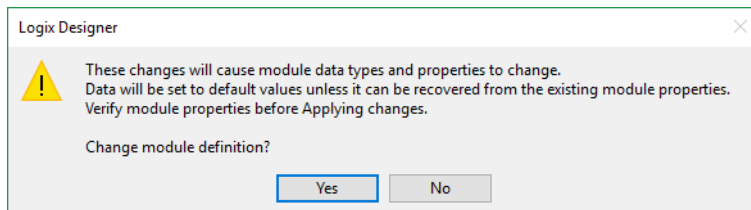
10. Click Apply.
11. Click OK to close the Module Properties dialog box.

Crossloads, Synchronization, and Switchovers

Crossloading or synchronization points are points where the primary controller transfers data to the secondary controller. Crossload and synchronization points keep the secondary controller ready to assume control in the event of a fault on the primary.

Before you begin programming your redundant controller, be aware of the impact of crossloads and synchronization on the execution of a program after a switchover. If you understand these concepts, it helps you to create programming that best meets the needs for your redundant application.

Continue reading the sections that follow for explanations of crossloads and synchronization and their relationship to switchovers and program execution.

Changing Crossload and Synchronization Settings

In the redundancy system, crossload and synchronization points for programs within the Studio 5000 Logix Designer® project are configurable. You can limit which programs data crossloading and synchronization follow. In many applications, changes to this setting can reduce the overall impact to the task scan time by reducing the number of times data is crossloaded.

If you reduce the number of crossload and synchronization points, the switchover time becomes longer. This increase in switchover time is because more programs need to be rescanned after the switchover.

Synchronization is performed at the end of the last program in the program list of the task, regardless of the Synchronize Data after Execution setting for the program.

To change the synchronization setting of a program, open the Program Properties dialog box of the program and check or uncheck Synchronize redundancy data after execution.

Use this setting to change crossload and synchronization points.
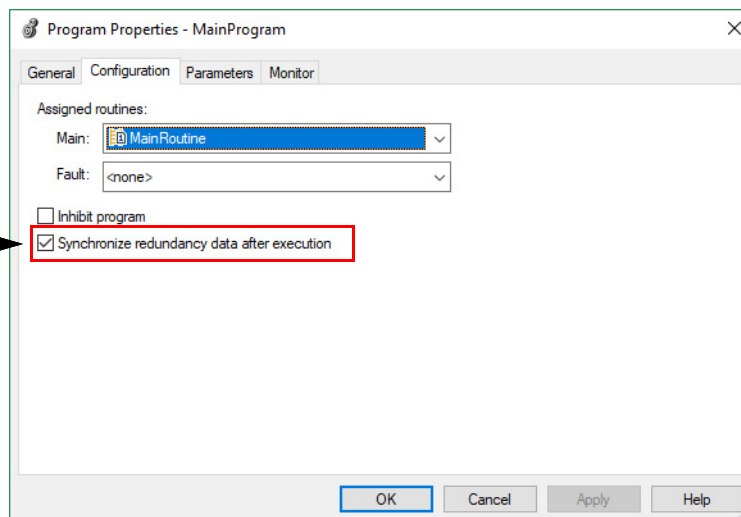
Default Crossload and Synchronization Settings

The default setting for a **program** in a redundant project is for a crossload to occur at the end of each program execution. However, for an **equipment phase**, the default is that the crossload does not execute at the end of the phase.

Before you change the default crossload and synchronization settings, read the sections that follow so you have a complete understanding of the implications. For information about how to change the point in a task where a crossload occurs, see .

Recommended Task Types

To make synchronization, crossloads, and HMI updates as fast as possible, avoid using a continuous task. Instead, the best practice is to use periodic tasks. The fewer the number of periodic tasks used, the better the performance.

IMPORTANT	We suggest avoiding a continuous task for applications that are larger and/or have heavy communication, For more information see Programming Best Practices on page 65.

Only the single highest-priority periodic task can ensure bumpless output switching on switchover. The sections that follow explain the impact of crossloads and synchronization after a switchover based on the task structure you use.

Continuous Task After Switchover

After a switchover occurs within a controller project that contains only a continuous task, the new primary begins executing at the last crossload and synchronization point. Depending on your crossload and synchronization setting, the program that the new primary controller begins with can be the following:

- The program that the switchover interrupted
- The program that immediately follows the last crossload and synchronization point

Continuous Task with Crossloads at Each Program End

This diagram demonstrates how programs set to crossload and synchronize at each program-end are executed after a switchover. As is shown, the new primary controller begins executing at the beginning of the program that the switchover interrupted. This process is the switchover execution that occurs if you use the default crossload and synchronization setting for a program.

Figure 6 - Program Execution After a Switchover (Crossload After each Program)
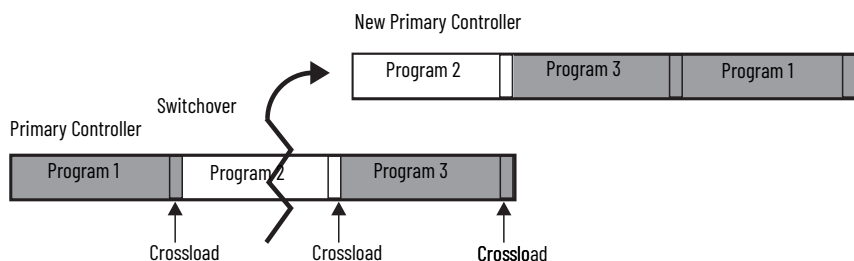
Continuous Task with Varying Crossloads at Program End

This diagram demonstrates how programs set to crossload and synchronize at various intervals are executed after a switchover. As is shown, the new primary controller begins executing the program that follows the last crossload and synchronization point.

Figure 7 - Program Execution After a Switchover (no Crossload After each Program)
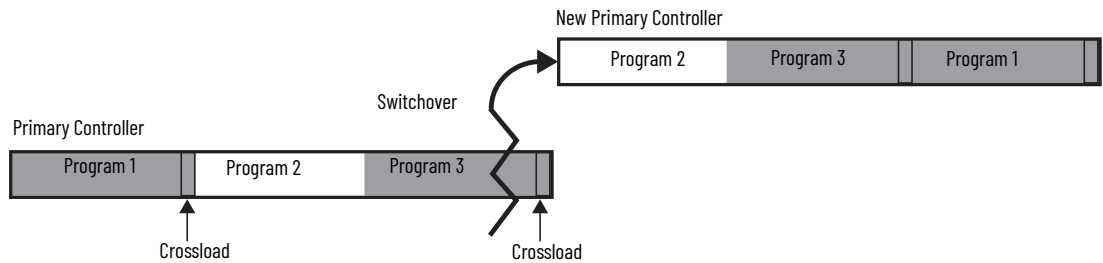
For information about how to change the point in a task where a crossload occurs, see Changing Crossload and Synchronization Settings on page 57.

Multiple Periodic Tasks

> ⚠️ **ATTENTION:** If you use multiple periodic tasks, program all crucial outputs within the highest-priority task. Failure to program outputs in the highest-priority task can result in outputs changing state if a switchover occurs.

In a project where multiple periodic tasks are used, the point where program execution begins after a switchover depends on the following:

- Crossload and synchronization settings
- Task priority settings

As with the continuous task, the controller begins executing at the program that follows the last crossload and synchronization point.

In addition, a higher priority task can interrupt a lower priority task. If a switchover occurs during or just after the higher priority task executes and the lower priority task has not been completed, then the lower priority task and programs are executed from the point at which the last crossload occurred.

This diagram demonstrates how tasks at different priorities execute if a switchover occurs while a lower priority task is executing. The crossload and synchronization points in this example are set to occur only at the end of the last program within the tasks. The points are not set to occur at the end of each program.

Figure 8 - Normal Periodic Task Execution (no switchover)
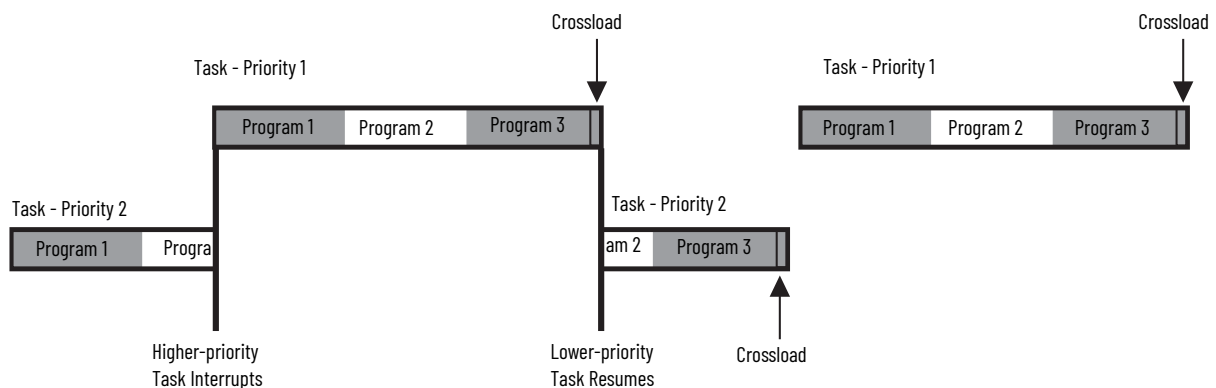
The following diagram shows a lower priority task that has not been completed and a switchover occurs. The lower priority task and programs are executed from the beginning of the program where the switchover occurred. This result is because the program uses the default configuration and crossloads and synchronization points occur at the end of each program.

Figure 9 – Periodic Task Execution After Switchover When Configured to Crossload After Programs
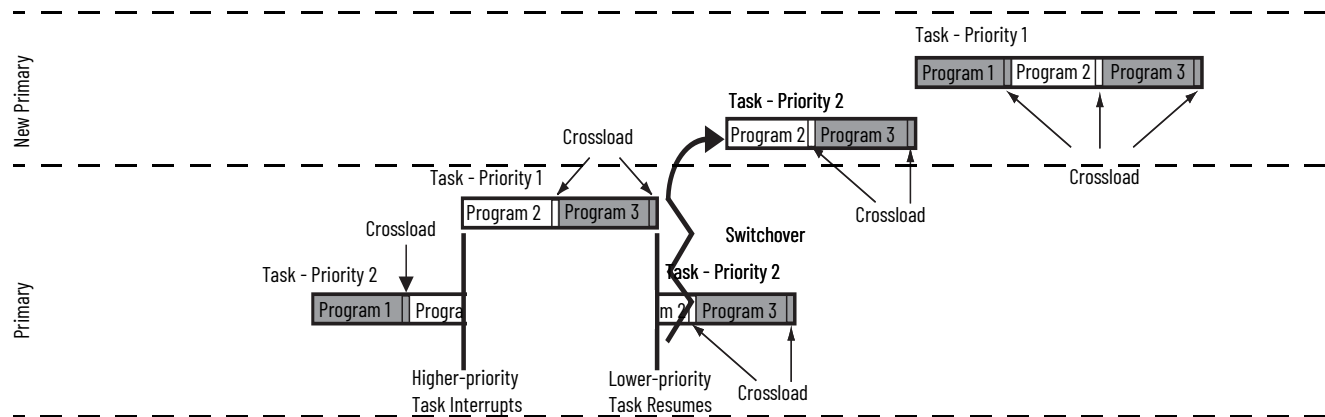
The following diagram shows a lower priority task that has not been completed and a switchover occurs. The lower priority task and programs are executed from the beginning and not at the program where the switchover occurred. This result is because the crossloads and synchronization points were not configured to occur at the end of each program.

Figure 10 – Periodic Task Execution After Switchover When Configured Not to Crossload After Programs
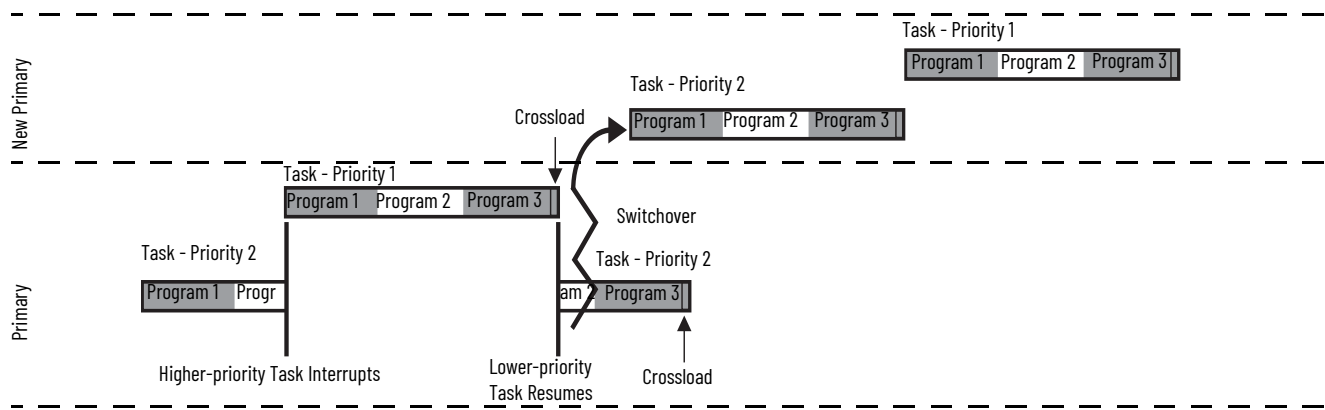
For more information about programs and tasks with controllers, see the Logix 5000® Controllers Tasks, Programs, and Routines Programming Manual, publication 1756-PM005.

Crossloads and Scan Time

It is important to plan for controller crossloads because the length of the crossloads affects the scan time of your program. A crossload is a transfer of data from the primary controller to the secondary controller. The crossload can occur at the end of each program or at the end of the last program in a task.

The scan time of your program or phase is a total of the program execution time and the crossload time. The following diagram demonstrates this concept.

Figure 11 - Crossload and Scan Time
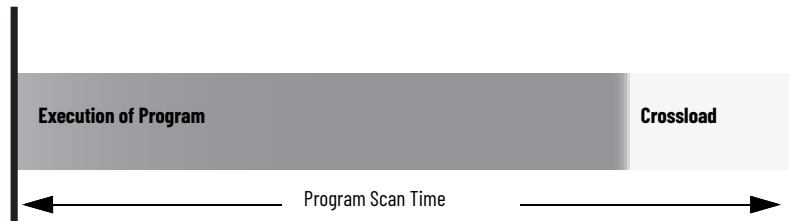
Estimate the Crossload Time

The amount of time that is required for a crossload is primarily dependent upon the amount of data being crossloaded. During a crossload, any tag that has been written to during the program execution is crossloaded, even if the tag value has not changed.

The crossload requires time to transfer tag value changes. The crossload also requires a small amount of overhead time to communicate information about the program being executed.

Redundancy Object Attributes for Crossload Times

Before you complete calculations to estimate the crossload time, you must use a Get System Value (GSV) instruction to read certain attributes of the redundancy object. These attributes are data transfer sizes that are measured in DINTs (4-byte words) and are used to calculate the estimated crossload time.

> To get these attributes, you do not need to have the secondary chassis installed or operating. If you do not have the secondary chassis operating, the attribute values read indicate what data sizes would be transferred if the secondary chassis was in use.

This table indicates the two attributes that you can choose to get specific to the crossload data transfer size. Get the attribute value that meets your application requirements.

If you need the	Then get this attribute value
Data size of the last data that is transferred during the last crossload	LastDataTransferSize
Data size of the largest crossload of data	MaxDataTransferSize

The LastDataTransferSize attribute refers to the transfer size of the **previous** crossload and synchronization point, which occurred before the program that contains the GSV instruction.

If you must measure the crossloaded data from the last program in the program list of the task, add an additional program at the end of the task that acquires the LastDataTransferSize value from the program that was formerly at the end of the task.

> **IMPORTANT** MaxDataTransferSize obtains maximum data transferred from only the task the GSV executes within. This includes program-scoped data in addition to controller-scoped data that was changed after the previous sync point.

Equation for Estimating Crossload Times

Use this equation to estimate the crossload time of your controllers for each program after you have either of the following:

- The size of the last data transfer
- The maximum size of data that is transferred

The following equations apply when a ControlLogix 5580 controller is paired with a redundancy module in both chassis in a redundancy system.

Crossload Times for ControlLogix 5580 Controllers

Controller Firmware Revision	Crossload Time
33.0xx	Crossload time per sync point (ms) = (DINTs * 0.000360) + 0.44 ms
34.0xx	Crossload time per sync point (ms) = (DINTs * 0.000338) + 0.51 ms
35.0xx	Crossload time per sync point (ms) = (DINTs * 0.000339) + 0.52 ms

> A sync point is a mechanism that the primary controller uses to keep the secondary controller in sync. By default, at the end of each program scan, the primary controller sends the secondary controller the sync point and the secondary controller responds by moving its execution pointer to match the primary controller.
>
> The default for phases is not to send a sync point.

Set the Task Watchdog

Watchdog times set for tasks in redundancy applications must be larger than watchdog times set for tasks in non-redundancy applications because more time is required to conduct crossloads and synchronization.

> **IMPORTANT**   A continuous task should not have a watchdog time longer than 10 seconds in order to prevent issues with online edits or RSU Locked Switchovers.

An increase in the required watchdog time is also a result of the way programs are executed in the event of a switchover. A program or programs can be executed a second time after switchover. This action depends on when in the task or program the switchover occurs and where in the task crossload and synchronization occurs.

If a program is executed a second time, the length of time that is required for the program scan is increased. However, the watchdog timer is not reset and continues to countdown from the beginning of the task that the old primary controller started. Therefore, the watchdog timer must be configured to account for the potential of additional program scans.

Figure 12 - Watchdog Configured for Redundancy Switchover
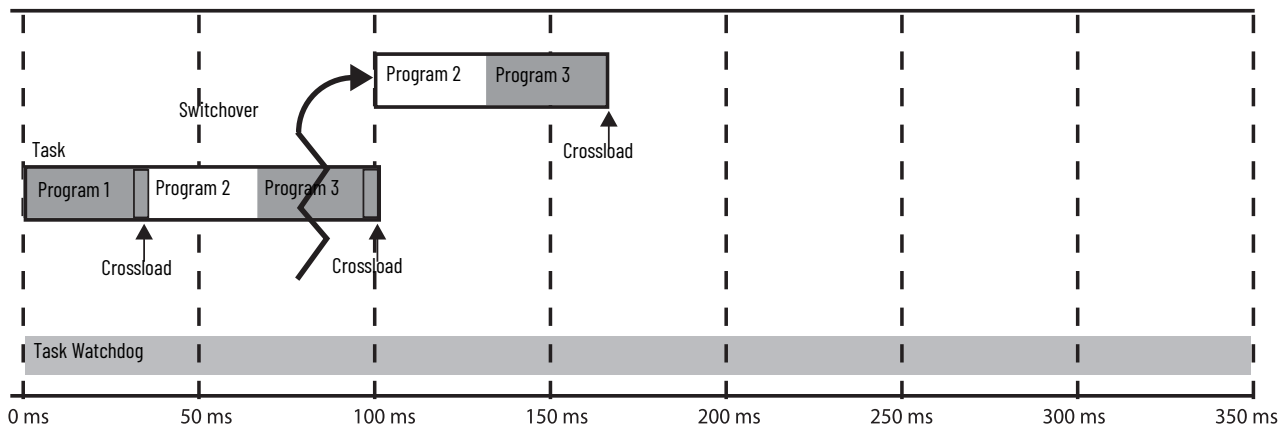
In the event of a watchdog timeout, a major fault (type 6, code 1) results. If this fault occurs after a switchover, the control system fails-to-safe or to the configured hold state.

Figure 13 - Watchdog Not Configured for Redundancy Switchover
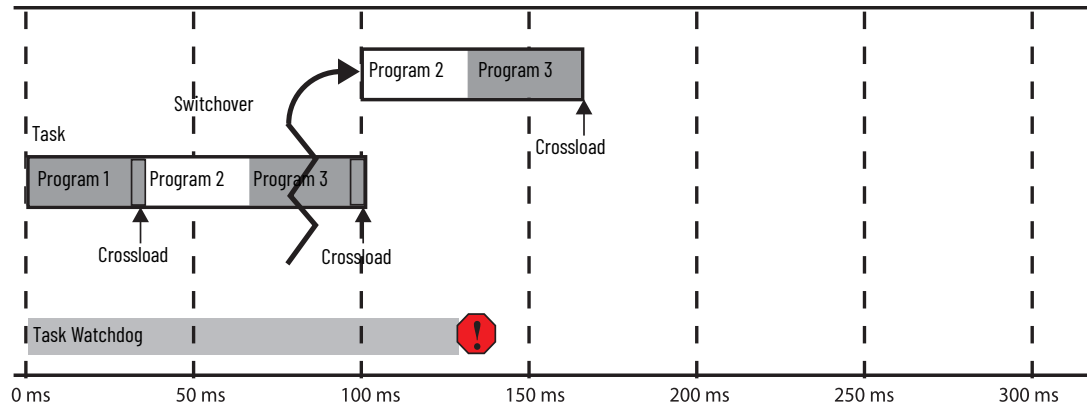
Minimum Value for the Watchdog Time

To set Watchdog time for your ControlLogix 5580 controller, use this table to determine which equation to use to calculate the time for each task.

If	Then use this equation
Using Ethernet I/O ms	$(2 * maximum\_scan\_time) + 100$

The *maximum_scan_time* is the maximum scan time for the entire task when the secondary controller is synchronized.

To set the initial task tuning of the ControlLogix 5580 controller, follow these steps.

IMPORTANT   This process works only when there is no Continuous task that is configured in the Logix application.

---

1. Monitor the Max Scan Time for each task while the redundant chassis pair is synchronized.
2. Set the Watchdog times for each task to three times the Max Scan Time.
3. To configure each Task Period, use the L_CPU Add-on-Instruction.[a]

   a. Adjust the Task periods of each so that the maximum scan time is less than 80% of the task period rate.

   b. Adjust the Task periods so that the Logix CPU % utilization is never above 80%.

   c. While performing these tests, the HMI and any other external systems must be connected to the Logix controller and actively executing communications.

IMPORTANT   Verify that there are no task overlaps.

(a) See the Knowledgebase Technote *L_CPU AOI Download*

Notes:

Programming Best Practices

Program to Minimize Scan Times

There are several aspects of your program that must be as efficient as possible to facilitate the fastest possible switchover because total program scan time impacts system switchover time. The sections that follow describe methods to make your program more efficient to minimize your program scan time.

These methods make your program more efficient and minimize program scan times:

- Minimize the Number of Programs
- Manage Tags for Efficient Crossloads
- Use Concise Programming

Minimize the Number of Programs

When programming a redundant controller, use the fewest programs possible. Use of the fewest programs possible is especially important if you plan to crossload data and synchronize the controllers after the execution of each program.

If you must crossload data at the end of each program, follow these programming best practices to minimize the crossload impact on the program scan time:

- Use only one or a few programs.
- Divide each program into the number of routines that is appropriate for your application. A routine does not cause a crossload or increase the scan time.
- Use the main routine of each program to call the other routines of the program.
- If you want to use multiple tasks for different scan periods, use only one program in each task.

Use of Multiple Routines (preferred)

- ⊿ ◁ Tasks
  - ⊿ ◎ MainTask (100 ms)
    - ⊿ ᖯ MainProgram
      - ◊ Parameters and Local Tags
      - ▤ MainRoutine
      - ▤ Routine_1
      - ▤ Routine_2
      - ▤ Routine_3
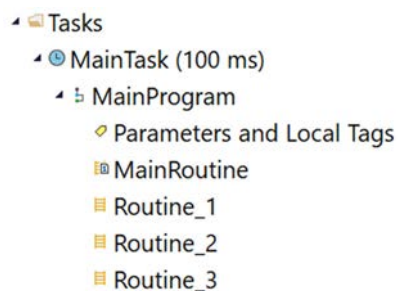
Use of Multiple Programs (not preferred)

- ⊿ ◁ Tasks
  - ⊿ ◎ MainTask (100 ms)
    - ⊿ ᖯ MainProgram
      - ◊ Parameters and Local Tags
      - ▤ MainRoutine
    - ▷ ᖯ Program_1
    - ▷ ᖯ Program_2
    - ▷ ᖯ Program_3
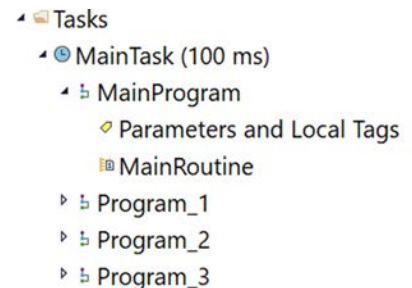
Manage Tags for Efficient Crossloads

Manage your data tags as the following sections recommend to program for more efficient crossloads of data and reduce the amount of time that is required for a crossload to execute.

Delete Unused Tags

If you delete unused tags, it reduces the size of the tag database. A smaller database takes less time to crossload.

Use Arrays and User-defined Data Types

If you use arrays and user-defined data types, the tags use smaller 4-byte (32-bit) words for all data in the type or array. If you create an individual tag, the controller reserves 4 bytes (32 bits) of memory even if the tag uses only 1 bit.

Arrays and user-defined data types help conserve the most memory with BOOL tags. However, we also recommend that you use them for your SINT, INT, DINT, REAL, COUNTER, and TIMER tags.

Figure 14 - Example Savings with the Use of an Array
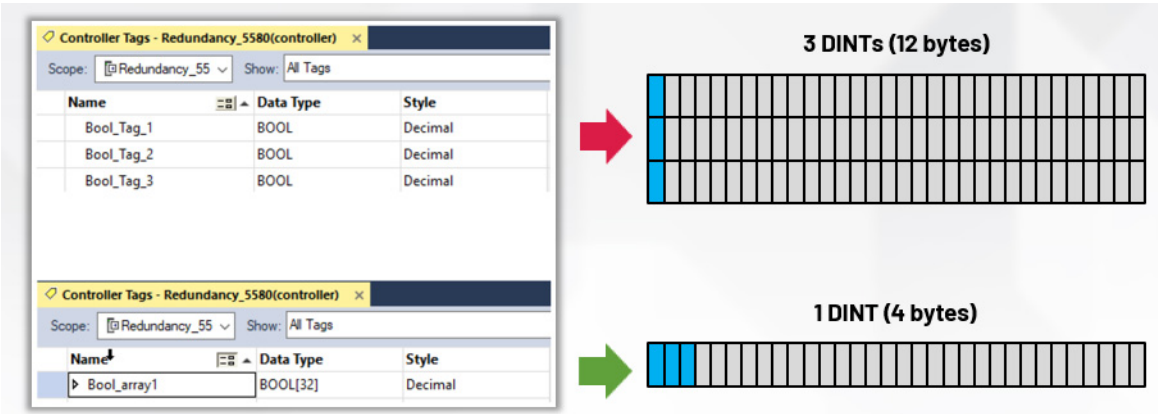
If you have already created individual tags and programming that uses those tags, consider changing the individual tags to alias tags that reference the elements in an array.

If you choose this method, your programming can still reference the individual tag names, but the crossload transfers the base array.

For more information about how to work with arrays, user-defined data types, and alias tags, see the Logix 5000® Controllers I/O and Tag Data Programming Manual, publication 1756-PM004.

Group Data Types Together in User-defined Data Types

When you create a user-defined data type for use in your redundancy program, group like data types together. Grouping like data types compresses the data size and helps reduce the amount of data that is transferred during a crossload. Group data into types that equal 32 bits as much as possible (for example, 32 BOOLs equals 32 bits).

Figure 15 - Example of Bytes Saved by Grouping Like Data
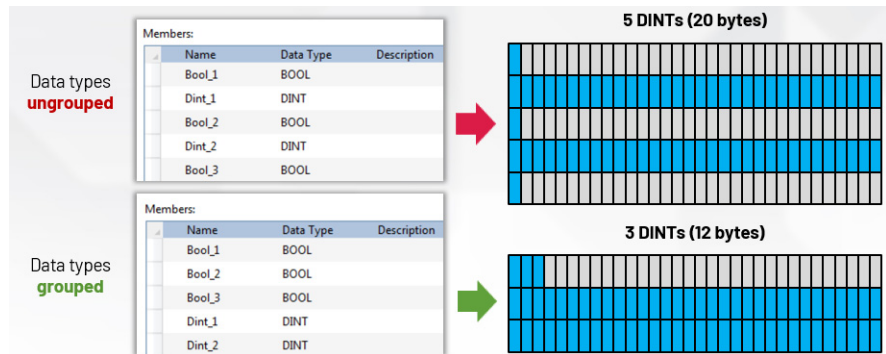
Group Data into Arrays of User-defined Data Types by Frequency of Update

To update the secondary controller, the primary controller divides its memory into pages of 4096 bytes. When an instruction writes a value to a tag, the 4096 byte memory page that the tag is located in will get flagged for crossloading. During the next crossload event, all of the used data table memory of each flagged memory page will be crossloaded.. For example, if your logic writes only 1 BOOL value to a block and all the data on that page is used, the controller crossloads the entire page (4096 bytes).

To minimize crossload time, group your data by how frequently it is written to. Even if the data value doesn't change, if the tag is actively written to (by a MOV, OTE, data table write, etc.), it counts as a data change.

For example, if your application uses DINTs that you use only as constants to initialize your logic, BOOLs that you update every scan, and REALs that you update every second, you can create a separate user-defined data type for each type of tag that is used at different points in the application. Using separate user-defined data types for each group, rather than grouping all tags together in one user-defined data type, helps to minimize the amount of data that is transferred during the crossload.

Tags Grouped into User-defined Data Types by Frequency of Use

Tags in One User-defined Data Type

Use Concise Programming

Use these recommendations to create concise programming. Using concise programming makes your program execute faster and reduces your program scan time.

Execute an Instruction Only when Needed

We recommend that you execute instructions only when needed because each time an instruction writes a value to a tag, even if the value is not changing, the used memory of that page (up to 4096 bytes) that contains that tag is flagged for crossloading.

Because many instructions write tag values whenever executed, strategic and economical use of instructions is needed. Strategic programming techniques include the following:

- Use preconditions to limit the execution of instructions.
- Combine preconditions when possible.
- Divide programming into subroutines that are called only when required.
- Run noncritical code every 2 or 3 scans instead of during every scan.

For example, precondition an ADD instruction to run only when the controller gets new data. As a result, the Dest_Tag is crossloaded only when the ADD instruction produces a new value.

Figure 16 - Precondition Used with ADD Instruction
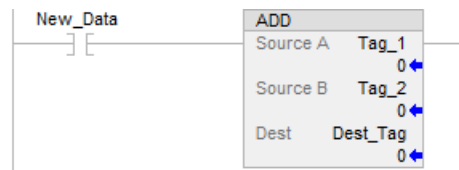
In combination with using preconditions, try to group instructions together that use the same precondition. In this example, the four preconditions that are used in the two branches can be combined to precede the two branches. Doing so reduces the number of precondition instructions from four to two.

Figure 17 - Efficient Precondition Use
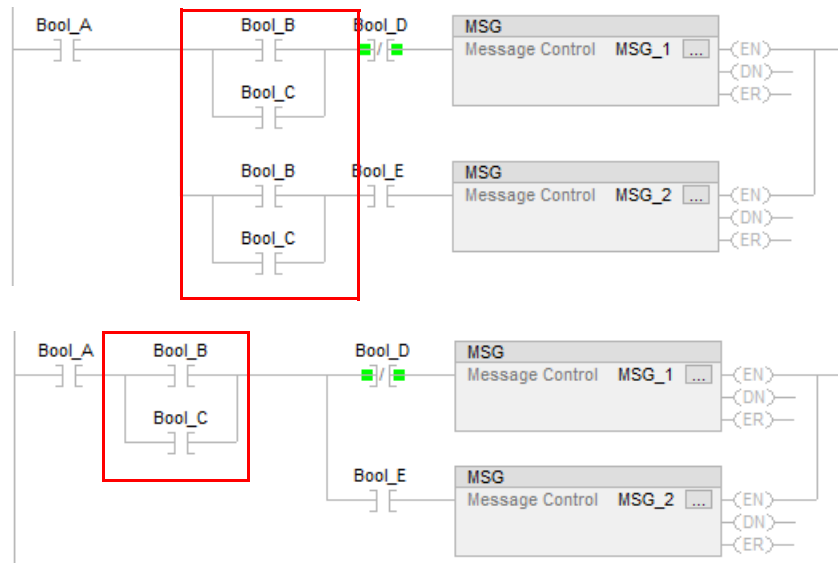
Program to Maintain Data Integrity

When programming your redundant controllers, there are some instructions and techniques that can cause data loss or corruption when used. These instructions and techniques include the following:

- Timer Instructions
- Array (File)/Shift Instructions
- Scan-dependent Logic

Timer Instructions

Timer-based instructions (e.g. TON, TOF, RTO) will continue to time after a switchover using the same timebase as before the switchover.

Array (File)/Shift Instructions

This section only applies when the instructions are modifying controller-scoped data. When there are interruptions to Array (File)/Shift instructions by a task with the same or higher priority and then a switchover event occurs, it could result in an incomplete data shift and corrupted data.

These Array (File)/Shift instructions can result in corrupt data in the event of a switchover:

- Bit Shift Left (BSL)
- Bit Shift Right (BSR)
- FIFO Unload (FFU)
- File Arithmetic and Logic (FAL)
- File Bit Comparison (FBC)
- Diagnostic Detect (DDT)
- File Sort (SRT)

If Array (File)/Shift Instructions are used, these system behaviors can result:

- If a higher priority task interrupts one of the Array (File)/Shift instructions, the partially shifted array values are crossloaded to the secondary controller.
- If a switchover occurs before the instruction completes its execution, data remains only partially shifted.
- After a switchover, the secondary controller starts executing at the beginning of the program. When it reaches the partially executed instruction, it shifts the data again.

Buffering Critical Data

If you cannot place Array (File)/Shift instructions that modify controller-scoped data in the highest-priority task, consider using a buffer with Copy File (COP) and Synchronous Copy File (CPS) instructions to maintain the integrity of the array of data.

The programming example that is shown here shows the use of a COP instruction to move data into a buffer array. The BSL instruction uses the data in that buffer array. The CPS instruction updates the array tag and maintains data integrity because a higher priority task cannot interrupt it. If a switchover occurs, the source data (that is, the array tag) remains unaffected.

Figure 18 - Using a Buffer to Maintain Data During Shift
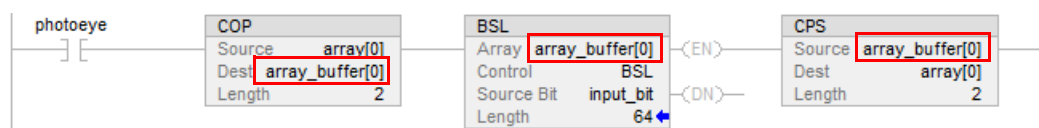
For more information about BSL, BSR, COP, CPS, DDT, FAL, FBC, FFU, and SRT instructions, see the Logix 5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

Scan-dependent Logic

If you use controller-scoped tags and program a lower priority task so that one instruction is dependent on another instruction that occurs elsewhere in your program, a task interrupt and switchover can disrupt your programming. The disruption can occur because the higher priority task can interrupt the lower priority task and then a switchover can occur before the lower priority task is completed.

When the lower priority task is executed from the beginning by the new primary controller after the switchover, the dependent instruction can fail to execute at the most recent value or state.

For example, if a higher priority task interrupts the logic that is shown in this example, the value of scan_count.ACC is sent to the secondary controller at the end of the program in the higher priority task. If a switchover occurs before the primary controller completes the EQU instruction, the new primary controller starts its execution at the beginning of the program and the EQU instruction misses the last value of scan_count.ACC. As a result, any programming that uses the Scan_Count_Light tag can also execute by using incorrect data.

Scan-dependent Logic
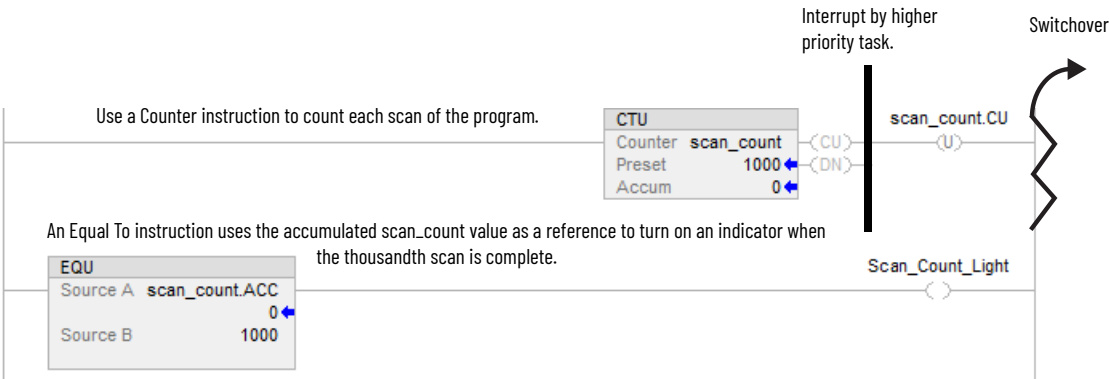
Bind Dependent Instructions with UID and UIE Instructions

If you cannot place scan-dependent instructions in the highest priority task, consider using the User Interrupt Disable (UID) and User Interrupt Enable (UIE) to prevent a higher priority task from interrupting the scan-dependent logic.

For example, if you bind the scan-dependent logic that is previously shown, a higher priority task would not interrupt the dependent instructions and a switchover would not result in inconsistent data.

Scan-dependent Instructions Bound with UID and UIE Instructions
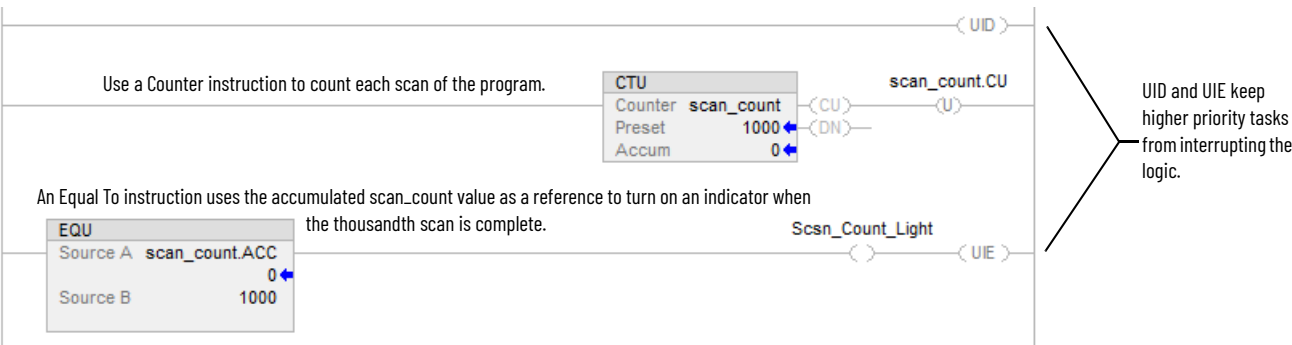
For more information about UID and UIE instructions, see the Logix 5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

Optimize Tasks

To make synchronization, crossloads, and HMI updates as fast as possible, avoid using a continuous task. Instead, the best practice is to use periodic tasks. The fewer the number of periodic tasks used, the better the performance.

IMPORTANT	While the use of a continuous task is fully supported, it is much easier to manage performance without a continuous task. In addition, when using a continuous task certain types of communications performance can be negatively impacted under various conditions, especially when using heavy messaging or HMI data table writes of tags to the controller. For more information on data table writes, see .

If you use multiple periodic tasks, verify the following:

- There should be no task overlaps during synchronized steady state. The execution time of each task should be smaller than its period.
- The total execution time of all your tasks is less than the period of the task with the largest period.
- The lower priority tasks should have longer periods than higher priority tasks to allow time for task interruption by the higher priority tasks.

Example of Periodic Task Configurations

Task	Priority	Execution Time	Period Specified
1	Higher	20 ms	80 ms
2	Lower	30 ms	100 ms
Total execution time: 50 ms			

In this example, the execution time of the highest priority task (Task 1) is smaller than its period. The total execution time of all tasks is less than the specified period of the lowest priority task.

Tuning the Period Specified

Tune the period you specify for your periodic tasks. To check for overlaps, go online with the controller and access the Task Properties dialog box. In the Monitor tab, note the maximum scan time. Verify that the maximum scan time is smaller than the period you specified for the periodic task.

You can also check the Task Overlap Count to see how may task overlaps occurred since the last reset.

IMPORTANT	Task overlaps are expected during qualification so you should only check the number of task overlaps while the controller is in a synchronized steady state.

Programming Considerations

Consider the following when programming your redundant controller.

Data Transfer

IMPORTANT	When you write to a tag, regardless if the data is the same or different, the system crossloads it, along with all of the used memory that is in the same 4096 byte memory page, during the next configured crossload time. For optimal performance, write to tags only when necessary (for example, do not write to tags for HMI reads faster than 2x the update rate).

- For data that is known to change very frequently, we recommend to group it all into a structure. You can then reference each member of this structure by using the alias functionality, with only minor changes to the application programming. This can minimize the amount of data that is required to be transferred.

- Program synch points can be selectively turned off to reduce the frequency of transferred data. For optimal performance have as few synch points as the application allows.

  For more information see .

SSV Instruction Operation

- Modifications made by SSVs are not crossloaded to the secondary while qualifying, locking, or locked.

  Check the module redundancy state, and do not execute SSVs when in these states if it is important that the operation is reflected on the secondary.

Communications Performance

- Controller applications can experience higher communication utilization when large portions of the I/O tree are not physically present (for example, multiple I/O racks). The increased communication utilization can result in an increase in the total time needed to qualify the redundant system.

  The communication utilization can be partially reduced by inhibiting the missing I/O in the configuration tree, but it will still be higher than if the I/O were physically present and operational.

- Frequent and sustained incoming data table writes (>10/s for minutes) to controller tag values of a redundant controller can impact the communications performance of the redundant controller.

  Examples of incoming data table writes include:

  - Executing a message (MSG) instruction with "CIP Data Table Write" message type from another controller targeted to the redundant controller.
  - Writing a tag value from an HMI.
  - Modifying a tag value while online with the Studio 5000 Logix Designer® Application.

  Impacts on communications performance can include:

  - Reduced responsiveness while online with Studio 5000 Logix Designer Application.
  - Error (16#000c) reported when a controller with many consuming tags (>15) attempts to establish connections to the redundant controller's produced tags.

IMPORTANT	FactoryTalk® Linx and FactoryTalk Linx Gateway are optimized to reduce the communications burden on the controller.

Programed-scoped Tags

- Program-scoped tags remove the need for UID/UIE instructions around instructions like bit shifts, and can also improve the performance of the highest priority task.

- Program-scoped tags only help with the performance of higher priority tasks, so they have no impact on performance for applications with only one task.

- The ControlLogix® 5580 controller isolates program-scope data from controller-scope data. At each sync point, the controller transfers the controller-scope data that is flagged for crossloading, along with all of the program-scope data flagged for crossloading for all of the programs that have executed since the last sync point. We recommend to make more use of program-scoped data, especially when using multiple tasks.

> **IMPORTANT** We recommend not using InOut parameters between programs in different tasks. This data may not remain bumpless during switchover.

Redundant System Update (RSU) Operation

- RSU is allowed between all ControlLogix 5580 controller types, provided that the memory size of the controller being migrated to is the same or larger than the controller being migrated from.

> **IMPORTANT** It may not be possible to migrate between some controllers based on application constraints (for instance, some features are only supported on ControlLogix 5580 Process controllers).

- Do not exceed 520 class 3 messages or HMI connections when you attempt to do an update with RSU, or the lock for update could fail.

Instruction Operation

- You should limit the size of the following; making them as small as needed for the application:
  - Data arrays/structures/UDTs
  - AOIs
  - FBD routines

- If using FBD routines, use Function Block Functions when possible. Function Block functions do not have backing tag structures, which reduces the amount of data that requires crossloading.

- BSR, BSL, FAL, FBC, DDT, SRT, and FFU instructions.

  When referencing controller-scoped tags in a lower or same priority task, partial updates can be crossloaded to the secondary as part of the other task's sync point. If switchover occurs, the instruction could have incorrect data. Use UID/UIE pairs around the instruction or use program-scoped tags instead.

- When performing MSG reads, the MSG backing tag and the data tag should be at the same scope so that they are tracked together.

Alarms

- If a substantial number of alarms (including both Logix tag-based alarms AND Logix instruction-based alarms) are changing state often (e.g. every scan cycle), this can prevent redundancy from synchronizing and it can cause the system to be stuck in a qualifying state until the alarms become stable.

  For more information, see the Knowledgebase Technote *ALMA/ALMD instructions limits*

- The alarm burst of a large amount of Logix tag-based alarms can lead to a significant increase of a task scan time on a synchronized redundant controller pair.

  The scan time increase primarily depends on the number of alarm conditions changing state during the alarm burst, and also on the level of nesting of these alarm conditions.

IMPORTANT	Each 1 - 25 tag-based alarm conditions established within one particular scope (each scope is determined by a separate identifier within the alarm fully qualified name) adds roughly 0.4 ms to the program scan time, while each level of nesting can add 0.4 ms in the worst case scenario.

Rockwell Automation recommends the following:

- Minimize the number of the alarm conditions which can change state during a potential alarm burst.
- Avoid excessive nesting of the conditions.
- Perform measurements of potential alarm bursts during system commissioning and make changes in the commissioned project if measured scan times are not acceptable.

Diagnostics

- Use GSV instructions to programmatically track and display redundancy status on an HMI or other user consumable interface. See <u>Monitor System Status on page 90</u>.

Conduct a Test Switchover

Complete these steps to verify that your redundant system switches over as expected. Your system must be fully qualified before you begin.

| **IMPORTANT** | We recommend performing a test switchover prior to placing the redundancy chassis pair in operation to confirm configured settings behave as expected. |

---

1. In the communication software, access the RMCT for the **primary** redundancy module.
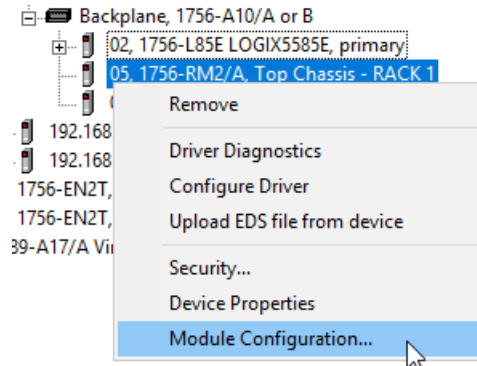
2. On the Synchronization tab, click Initiate Switchover.
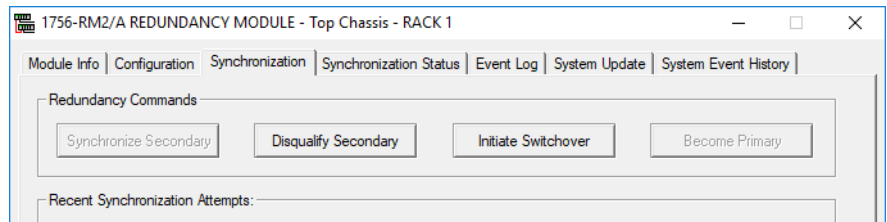
The Redundancy Configuration Tool dialog box opens
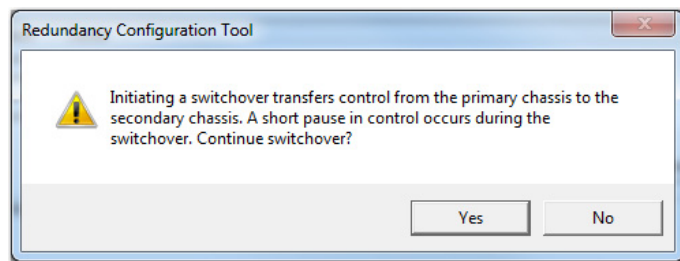
3. Click Yes.

    The switchover begins.

4. To verify that the switchover was successful, monitor the RM2 status indicators or the RMCT. You can also view your HMI or other status-monitoring device.

Synchronization After a Switchover

If your Auto-Synchronization parameter is set to Always, your system begins synchronizing immediately after the switchover.
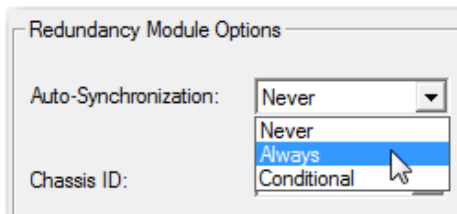
To monitor the synchronization of your system after you initiate the test switchover, you can monitor the synchronization process by using these methods:

- From the RMCT, click the Synchronization Status tab and monitor the Secondary Readiness column. The states No Partner, Disqualified, Synchronizing, and Synchronized indicate the stages of synchronization.

- View the module status display of a **primary** communication module. The states PwNS, PsDS, PwQgS, and PwQS indicate the stages of synchronization. See Table 17 on page 103 for definitions of these qualification status codes.

- View the module status display of the **secondary** redundancy module. The states DISQ, QFNG, and SYNC indicate the stages of synchronization.

- Run a second test switchover where you power off the primary chassis to initiate the switchover.

IMPORTANT	Rockwell Automation recommends you perform a power cycle switchover once per year to proof test the redundancy system which can aid in improving availability calculations.

Program Logic to Run After a Switchover

If your application requires certain logic or instructions to be executed after a switchover, then use programming and tags similar to the values shown in this example.

Figure 19 – Precondition Used to Run Logic After Switchover - Ladder Logic

This GSV instruction obtains the chassis ID of the primary chassis (that is, the chassis that is in control).

```
GSV
Class Name          Redundancy
Instance Name
Attribute Name   PhysicalChassisID
Dest          Prim_Chassis_ID_Now
                                 1
```

If this is the first program scan, then use the current primary chassis ID as the chassis ID for the last scan.

S:FS

```
MOV
Source  Prim_Chassis_ID_Now
                           1
Dest       Prim_Chassis_ID_Last
                           0
```

If a switchover occurs, the chassis ID changes. The NEQ instruction compares the current and last primary chassis ID values. If the values are different, the Switchover_Occurred bit is turned on. In addition, the current primary chassis ID is moved into the last chassis ID.

```
NEQ
Source A  Prim_Chassis_ID_Now
                           1
Source B  Prim_Chassis_ID_Last
                           0
```

Switchover_Occurred
(L)

```
MOV
Source  Prim_Chassis_ID_Now
                           1
Dest       Prim_Chassis_ID_Last
                           0
```

If the Switchover_Occurred bit is on, then the instructions added to this rung are executed and the Switchover_Occurred bit is reset.

Switchover_Occurred

Switchover_Occurred
(U)

Add your switchover-dependent instructions here.

Use Messages for Redundancy Commands

For some applications, consider programming the controller to issue redundancy system commands via the redundancy modules. The sections that follow explain how to configure a MSG instruction to issue a redundancy command.

Verify User Program Control

For a MSG instruction to issue a command via the redundancy modules, the redundancy modules must be configured for user program control.

To verify that the modules are enabled for user program control, access the Configuration tab of the RMCT and verify that Enable User Program Control is checked.

Figure 20 – Enable User Program Control in the RMCT
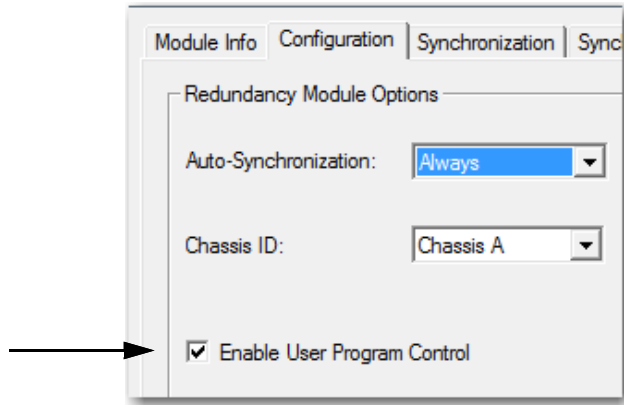
Use an Unconnected Message

When you add your MSG instruction for issuing the command through the redundancy modules, configure it as an unconnected message.
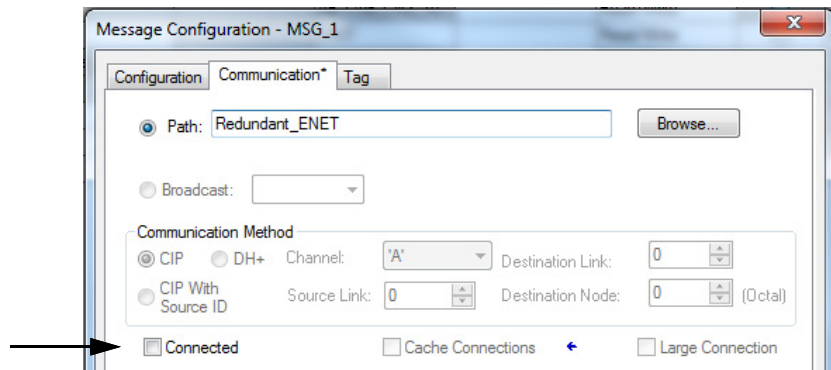
Configure the MSG Instruction

Use the MSG configuration settings that correspond to the command you intend to issue to the redundancy modules.

If you must	See page
Initiate a Switchover	79
Disqualify the Secondary Chassis	80
Synchronize the Secondary Chassis	81
Set the Redundancy Module Date and Time	81

Initiate a Switchover

To initiate a switchover, use the MSG instruction parameters that are listed in Table 6.

Table 6 - MSG Instruction to Initiate a Switchover

In this tab	Edit this element	To use this value
Configuration	Message Type	CIP™ Generic
	Service Type	Custom
	Service Code	4e
	Class	bf
	Instance	1
	Attribute	None - no value needed
	Source Element	INT tag with a value of 1
	Source Length	2
	Destination Element	None - no value needed.
Communication	Path	1, the slot number of the redundancy module (for example: 1,1 for a redundancy module in slot 1 of the chassis).
	Connected box	Leave the Connected checkbox unchecked.

Use Table 7 when using MSG instructions during a switchover.

Table 7 - MSG Instruction Behavior During a Switchover

If the MSG instruction is	Then
From a redundant controller	In a redundant controller, any MSG instruction that is in progress during a switchover experiences an error. (The ER bit of the instruction turns on.) After the switchover, normal communication resumes.
To a redundant controller	For any MSG instruction from a controller in another chassis to a redundant controller, cache the connection: Properties of the Message to the Redundant Controller

Configured Message Instructions	
If the MSG instruction originates from a redundant controller	**Then**
During a switchover	The message instructions status bits are updated asynchronously to the program scan. Consequently, you cannot crossload your message instructions status bits to a secondary controller. During a switchover, any active message instructions become inactive. When this change occurs, you must reinitialize the execution of your message instructions in the new primary controller.
During qualification	The scrolling display changes from CMPT for compatible to Qfng for qualifying. • If a configured message is cached, the primary controller automatically establishes a connection with no errors. • If a configured message is uncached or unconnected, the primary controller receives **Error 1 Extended Error 301, No Buffer Memory**.

Table 7 - MSG Instruction Behavior During a Switchover (Continued)

If the message is targeted to a redundant controller	Then
During the erroring out of a message	All message communication ceases. This stoppage lets the redundant controller receive the message instruction that is required to perform a switchover or any diagnostics. **Important:** If any of your messages are active during a switchover, you can expect one of these things to happen: • Cached and connected messages cause the message instruction to pause for 7.5 seconds because the initiating controller has not received a response from the targeted controller. For cached messages, the message instruction tries to execute three more times, each attempt followed by a pause of 7.5 seconds. If, after 30 seconds pass, the targeted controller does not respond to the initiating controller, then the switchover errors out with connected time-out **Error 1 Extended Error 203**. An example of a connected message would be CIP data table read-and-write messages after a connection has been established. • Uncached messages error out after 30 seconds if you have initiated them because the initiating controller never received a reply to the forward-open request. The error is **Error 1F Extended Error 204**, an unconnected time-out. Examples of uncached messages would include CIP generic messages and messages that are captured during the connection process.
During qualification	Cached messages that run with no errors. A connection has been established. Connected, but uncached, messages or unconnected messages error out with **Error 1 Extended Error 301, No Buffer Memory**.

Disqualify the Secondary Chassis

To disqualify the secondary chassis, use the MSG instruction parameters that are listed in .

Table 8 - Disqualify the Secondary Chassis

In this tab	Edit this element	To use this value
Configuration	Message Type	CIP Generic
	Service Type	Custom
	Service Code	4d
	Class	bf
	Instance	1
	Attribute	None - no value needed
	Source Element	INT tag with a value of 1
	Source Length	2
	Destination Element	None - no value needed.
Communication	Path	1, the slot number of the redundancy module (for example: 1,1 for a redundancy module in slot 1 of the chassis).
	Connected box	Leave the Connected checkbox unchecked.

Synchronize the Secondary Chassis

To synchronize the secondary controller, use the MSG instruction parameters that are listed in Table 9.

Table 9 - Synchronize the Secondary Chassis

In this tab	Edit this element	To use this value
Configuration	Message Type	CIP Generic
	Service Type	Custom
	Service Code	4c
	Class	bf
	Instance	1
	Attribute	None - no value needed
	Source Element	INT tag with a value of 1
	Source Length	2
	Destination Element	None - no value needed.
Communication	Path	1, the slot number of the redundancy module (for example: 1,1 for a redundancy module in slot 1 of the chassis).
	Connected box	Leave the Connected checkbox unchecked.

Set the Redundancy Module Date and Time

To set the WallClockTime of the 1756-RM2 module, use the MSG instruction parameters that are listed in Table 10.

Table 10 - Set WallClockTime

In this tab	Edit this element	To use this value
Configuration	Message Type	CIP Generic
	Service Type	Custom
	Service Code	10
	Class	8b
	Instance	1
	Attribute	b
	Source Element	WallClockTime[0] **WallClockTime** is a DINT[2] array that stores the CurrentValue of the WallClockTime object
	Source Length	8
	Destination Element	None - no value needed.
Communication	Path	1, the slot number of the redundancy module (for example: 1,1 for a redundancy module in slot 1 of the chassis).
	Connected box	Leave the Connected checkbox unchecked.

Download the Project

Download the project only to the primary controller. When the secondary controller is synchronized, the system automatically crossloads the project to the secondary controller.

> **IMPORTANT** If the secondary chassis was qualified and becomes disqualified after you download the project, verify that you have enabled the controller for redundancy.
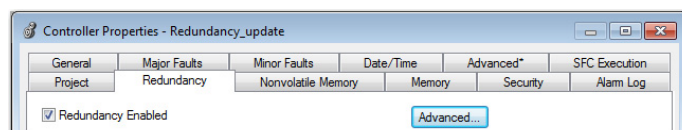
Store a Redundancy Project to Nonvolatile Memory

Use this procedure to store an updated project and firmware to the nonvolatile memory card of the controller.

This section describes how to store a project to nonvolatile memory in either of these conditions:

- [Store a Project While the Controller is in Program or Remote Program Mode](#)
- [Store a Project While a System is Running](#)

IMPORTANT   We recommend that you store the same project on the nonvolatile memory cards of both controllers. By doing so, you can be assured that if a controller, primary or secondary, loses the project from its internal memory, you can load the most recent project back onto that controller.
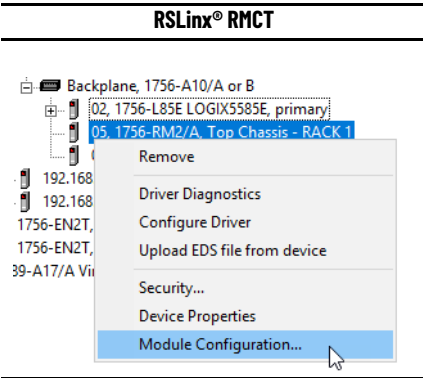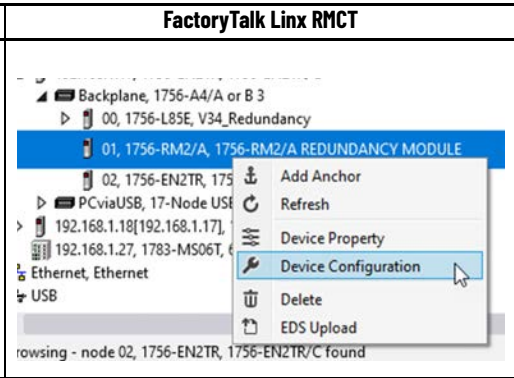
If you store the same project on the nonvolatile memory cards of both controllers, while the process is running, you must save the project on the controllers while they are in the secondary controller state. To do so, you save the project on the secondary controller, conduct a switchover, and save the project on the new secondary controller. Even if you do not plan to use the SD card, leave the card installed in the controller to collect diagnostic information that you can provide to Rockwell Automation Technical Support.

For more information, see the steps in [Store a Project While the Controller is in Program or Remote Program Mode on page 82](#) or [Store a Project While a System is Running on page 83](#).

Store a Project While the Controller is in Program or Remote Program Mode

If you want to store your controller project in nonvolatile memory while your redundant system is not running, complete these steps. Before you begin, verify that a controller communication path has been specified and that you are able to go online with the primary controller.

1. Verify that the redundant chassis are synchronized. If they are not synchronized, synchronize them.
2. To put the primary controller into Program or Remote Program mode, use programming software or the keyswitch.
3. In the communication software, right-click the redundancy module and choose the Configuration option to open the RMCT.

RSLinx® RMCT	FactoryTalk Linx RMCT

If you cannot see the Configuration option in the list, then the compatible version of the RMCT is not installed.

4. In the Configuration tab, set the Auto-Synchronization parameter to Conditional.
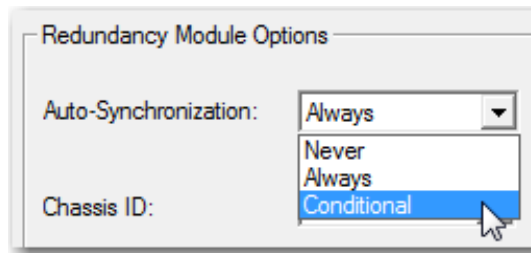
5. On the Synchronization tab, click Disqualify Secondary.
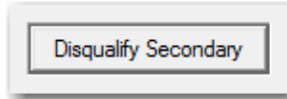
6. In the programming software, access the Controller Properties dialog box and click the Nonvolatile Memory tab.
7. Click Load/Store.
8. Click <-- Store and then click Yes.

When the store is complete, go online with the secondary controller.

9. Complete steps 6...8 to store the project in nonvolatile memory of the secondary controller.
10. In the communication software, open the RMCT for one of the redundancy modules in the redundant pair.
11. In the Synchronization tab, click Synchronize Secondary.
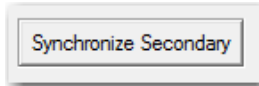
12. In the Configuration tab, set the Auto-Synchronization option to your desired setting.

Store a Project While a System is Running

If you want to store your controller project in nonvolatile memory while your redundant system is running, complete these steps.

1. Verify that the redundant chassis are synchronized.
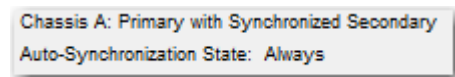
2. In the RMCT, access the Configuration tab and set the Auto-Configuration parameter to Never.
3. In the Synchronization tab, click Disqualify Secondary.
4. Go online with the secondary controller.
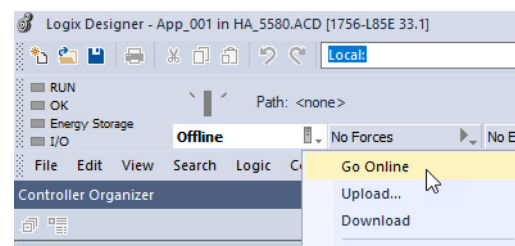
IMPORTANT	Do not go online with the primary controller until you have completed this procedure.

5. Open the Controller Properties dialog box and click the Nonvolatile Memory tab.

6. To store the project in nonvolatile memory, click Load/Store then <--Store.

7. In the RMCT, click the Synchronization tab.

8. Click Synchronize Secondary and wait for the system to synchronize.

9. Click Initiate Switchover.
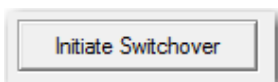
10. Go online with the new secondary controller.

11. Complete step 5 and step 6 to store the project.

12. In the RMCT, click the Configuration tab and set the Auto-Configuration to your desired setting.

13. In the Synchronization tab, click Synchronize Secondary.

    You have completed the steps that are required to store your project while online.

Load a Project

If you must load a project from nonvolatile memory, you must first disqualify your redundancy system. You then load the project from the nonvolatile memory card to the primary controller, and resynchronize the redundant chassis once the load is complete.

For details about loading a project from nonvolatile memory, see the Logix 5000 Controllers Nonvolatile Memory Card Programming Manual, publication 1756-PM017.

Online Edits

You can edit the redundant controller program while the system is online and running. However, considerations specific to redundancy must be made with considerations described in the Logix 5000 Controllers Quick Start, publication 1756-QS001.

Partial Import Online (PIO)

Consider these points when using PIO with redundancy systems:

- If you select **Import Logix Edits as Pending** or **Accept Program Edits** when executing a PIO, the primary controller treats the PIO feature as a set of multiple test edits where, after the import is complete, you can switch between testing the edits or not.

- We recommend that you do not use **Finalize All Edits in Program** when you import edits. If you use this option, any failure due to the import causes a failure on the new primary controller after a switchover. If the new edits cause the controller to major fault, both the primary and secondary will major fault, resulting in loss of control.

- If edits exist in the primary controller due to a PIO, they are treated the same as normal test edits regarding the 'Retain Test Edits at Switchover' selection and Redundancy System Update.

- If a PIO is in progress, the primary controller rejects any attempt to qualify.

- If you attempt to initiate a PIO on a primary controller in the process of qualifying the system, that PIO is rejected.

- If a switchover occurs while the PIO is still in process, a PIO to the new primary controller can either fully abort or fully complete, depending on how far the PIO had proceeded at the time of switchover.

    If the PIO does not complete due to the switchover, reattempt the PIO after the system has synchronized.

There are additional considerations necessary to performing online edits:

- Plan for Test Edits
- Assemble Edits with Caution

Plan for Test Edits

Before you begin editing your redundant program while your system is running, verify that the Retain Test Edits on Switchover setting meets your application requirements.

IMPORTANT	We recommend that you leave the Retain Test Edits on Switchover setting at the default (that is, unchecked) to avoid faulting both controllers when testing your edits.

If you enable the system to retain the test edits on a switchover (that is, you check Retain Test Edits on Switchover), faults that result from the test edits can also occur on the new primary controller after a switchover.

If you do not enable the system to retain the test edits on a switchover (that is, you leave Retain Test Edits on Switchover unchecked), faults that result from the test edits are not carried over to the new primary controller in the event of a switchover.

Use this table to determine the Retain Test Edits on Switchover setting that suits your application.

If you must	Then
Prevent a test edit from faulting both the primary and secondary controller	Leave Retain Test Edits on Switchover unchecked
Keep test edits active, even in the event of a switchover and at the risk of faulting both controllers	Check Retain Test Edits on Switchover

To change the Retain Test Edits on Switchover setting, click the Redundancy tab in the Controller Properties then click Advanced.

Figure 21 - Retain Test Edits on Switchover
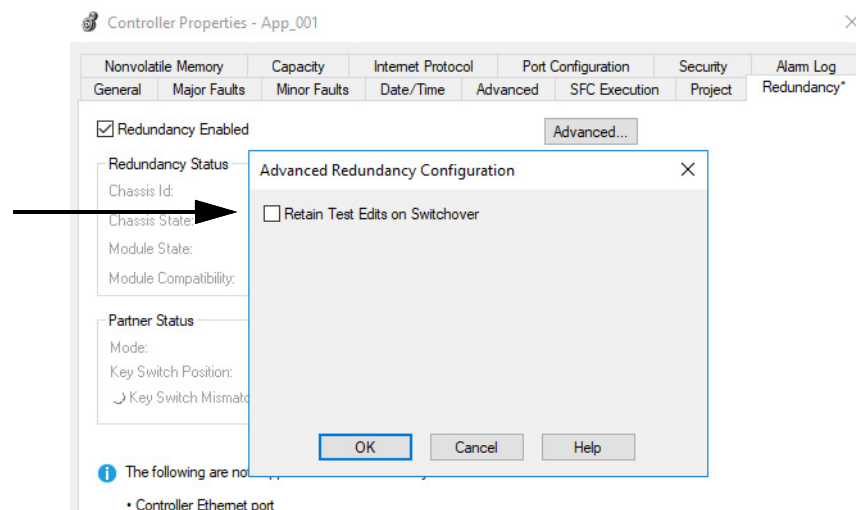
Assemble Edits with Caution

When you assemble edits to your program while online, the original program that existed before the changes were made is deleted. As a result, if the edits you assemble cause a fault on the primary controller, the new primary controller also faults after the switchover. Also, when you assemble edits in the primary controller, the edits are also assembled in the secondary controller.

Before you assemble any edits to your program, test the edits to verify that faults do not occur.

1. In the Controller Organizer, open the routine you must edit.
2. Make the appropriate changes to your routine.
3. Click the Verify Routine button.
4. Click the Accept Pending Program Edits button.

Figure 22 - Test Edits Before Finalizing
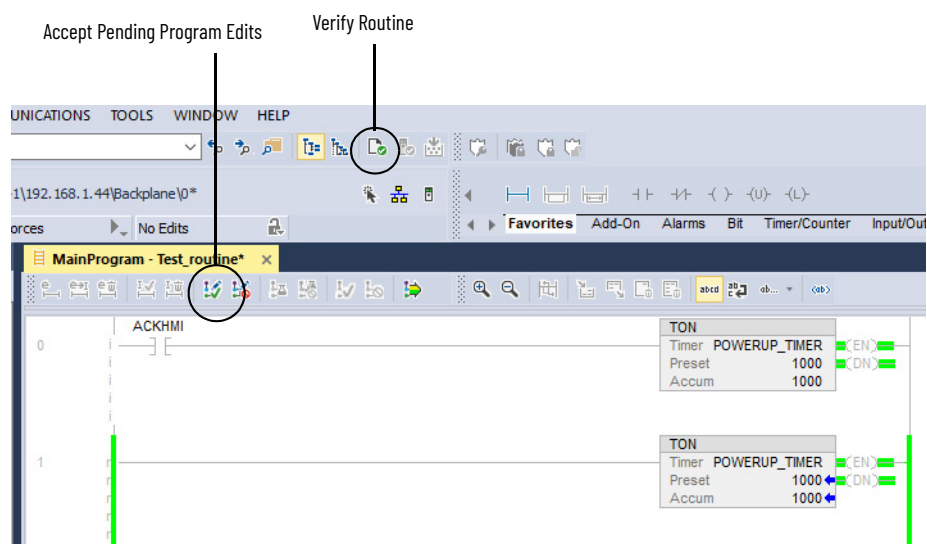
Even if you have not enabled the Retain Test Edits on Switchover property, faults can still occur on the primary and secondary controllers if the edits are assembled.

The Retain Test Edits on Switchover property affects only edits that are being tested. The Retain Test Edits on Switchover does not affect the redundant controllers that are running assembled edits.

5. At the Accept the Pending Edits dialog box, click Yes.
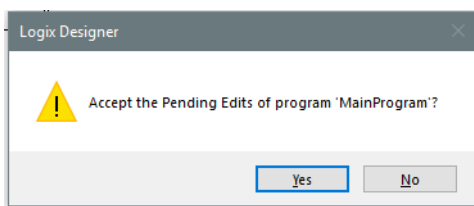
6. Click Test Accepted Program Edits.

Test Accepted Program Edits
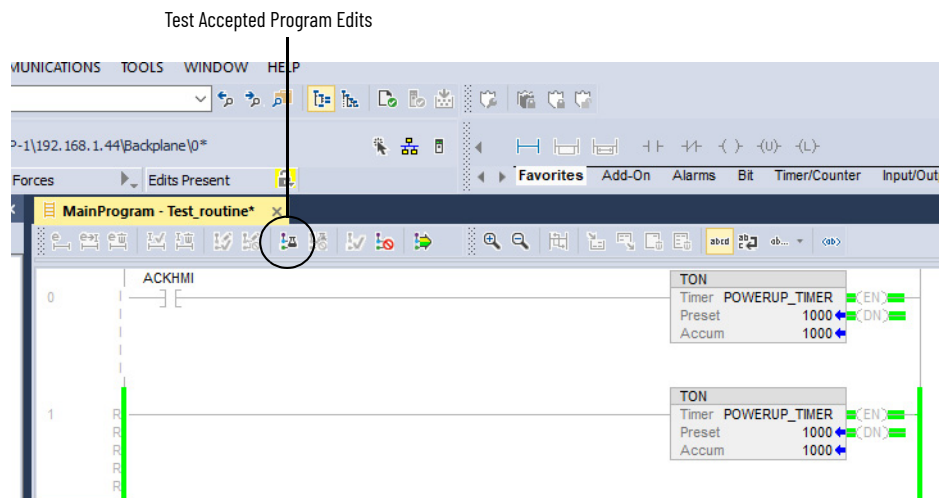
7. At the dialog box, click Yes.
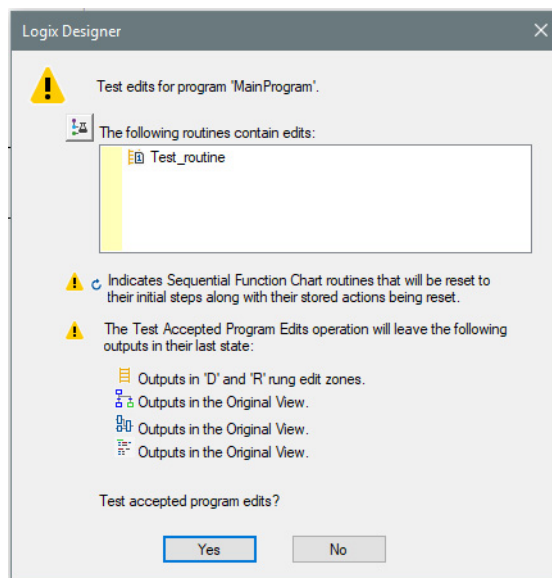
8. Click Assemble Accepted Program Edits.

Finalize All Edits
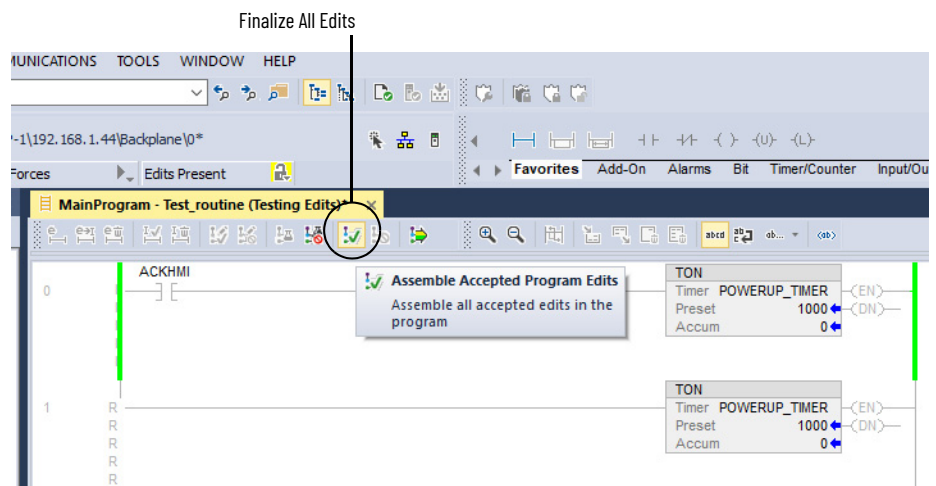
9. At the dialog box, click Yes.
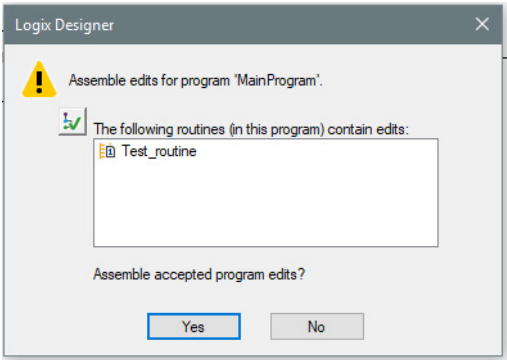
Your edits are now assembled.
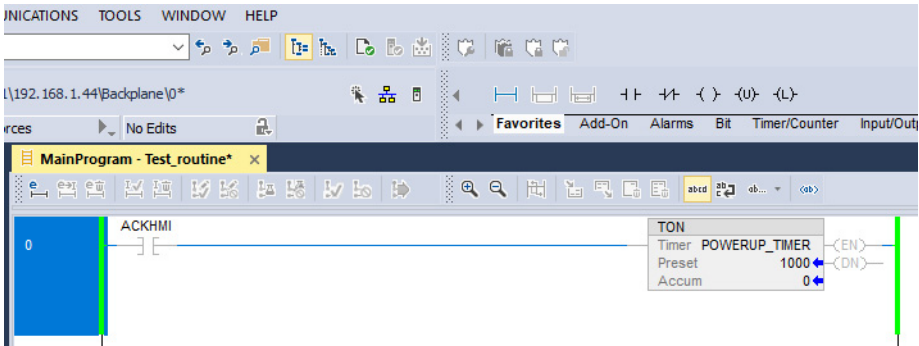
Monitor and Maintain a Redundancy System

This chapter describes some of the key tasks to complete to monitor and maintain your redundancy system.

Controller Logging

Controller logging provides a way to detect and log changes. These changes include programming software and controller keyswitch interactions made to ControlLogix® 5580 controllers, without adding any auditing software.

With controller logging, the controller can perform these tasks:

- Detect changes and create log entries that contain information about the changes.
- Store the log entries to a Secure Digital (SD) card for later review.
- Provide programmatic access to log entry counters to provide change detection information remotely.

Controller Log

A controller log is the record of changes. The log is stored on the NVS memory of the controller automatically. You can move the log to an SD card on an as-needed basis or automatically at predefined times. The NVS memory of the controller and each external memory card type has a maximum number of entries that they can store. Specific events are stored in the log of the controller.

For more information on controller logging, see the Logix 5000® Controllers Information and Status Programming Manual, publication [1756-PM015](#).

Controller Logging in Redundancy Systems

Because redundancy systems operate with partnered controllers, there are considerations that you must consider regarding controller logging:

- The primary and secondary controllers maintain separate logs.
- You do not need to synchronize the logs.
- On the primary controller, controller logging occurs exactly as it does on a controller in a non-redundant system, regardless of whether the system is qualified and synchronized or disqualified.
- A secondary controller logs the removal or insertion of an SD card, in any operating state. Otherwise, the secondary controller only logs events that occur when the controller is in a disqualified state.

Component Change Detection

Component tracking allows you to determine whether tracked routines, Add-On Instructions, and constant tags have been changed. The Studio 5000 Logix Designer® application creates a tracked value to indicate the current state of all components.

For more information, see the Logix 5000 Controllers Information and Status Programming Manual, publication [1756-PM015](#).

Monitor System Status

IMPORTANT	When programming your redundancy system, program so your redundancy system status is continually monitored and displayed on your HMI device.
	If your redundancy system becomes disqualified or a switchover occurs, the change in status is not automatically annunciated. You must program the system to communicate the change in status via your HMI or other status-monitoring device.

For most redundant applications, you must program to obtain the status of the system. Program to obtain system status when you do the following:

- Program HMI to display the system status
- Precondition logic to execute based on the system status
- Use the diagnostic information to troubleshoot the system

To obtain the status of your redundant system, use a Get System Value (GSV) instruction in your program and plan for the tags you are writing the values to.

In this example, the GSV instruction is used to obtain the chassis ID of the chassis that is functioning as the primary. The **PhysicalChassisID** value is stored in the **PRIM_Chassis_ID_Now** tag. The **PhysicalChassisID** value that is retrieved matches the Chassis ID indicated in the Controller Properties dialog box.

If the Physical Chassis ID Value is	Then the Chassis ID is
0	Unknown
1	Chassis A
2	Chassis B

Figure 23 - GSV Instruction to Get Chassis ID

For more information about the REDUNDANCY object attributes, see Appendix B, Redundancy Object Attributes on page 133.

View the 1756-RM2 Fiber Channel Status

You can use a CIP Generic Get Attribute message to retrieve the status of the 1756-RM2 fiber channels. Message instruction details are below.

CIP Generic Message - Get Attribute Single

- Class: 305
- Instance: 1
- Attribute: 4E (Channel 1) or 4F (Channel 2)

Return Value is a signed DINT, Value Equals:

- 1 = ACTIVE
- 2 = REDUNDANT
- 3 = LINK_DOWN
- 4 = TRANSCEIVER_NOT_INSTALLED
- 5 = TRANSCEIVER_FAILED
- 7 = UNKNOWN

For more information, see Knowledgebase Technote *Viewing the 1756-RM2 Fiber Channel Status From a Logix Application*.

Verify Date and Time Settings

Verify that the Redundancy Module Date and Time information matches the date and time of your system after you have configured and downloaded your redundant system to the controller.

> Consider checking the Redundancy Module Date and Time as a part of your regular maintenance procedures. Regular verification of the date and time information keeps the event logs of the redundancy modules accurate.

If the date and time are not correct, the redundant system event logs do not match the date and time information for the rest of the system. Incorrect date and time information complicates troubleshooting if an event or error occurs on your redundant system.

IMPORTANT   If power to one of the redundancy modules is cycled, the redundancy module powers up with the time set to when the power was lost. If the partner redundancy module has remained active during this time, the time set in that module is automatically transferred to the powering-up module. If a power failure event happens so that both modules are shut off, reset the time and date in the RMCT.

If you set and verify the date and time settings after a power loss, it helps with troubleshooting if an error or event occurs.

Verify System Qualification

After you have completed programming your redundant system and have downloaded your program to the primary controller, check the system status to verify that the system is qualified and synchronized.

The system qualification process can take several minutes. After a qualification command or a switchover, allow time for qualification to complete before acting based on the qualification status.

Check Qualification Status Via Module Status Displays

You can view qualification status by using the status displays and indicators of the secondary redundancy module and the primary and secondary EtherNet/IP™ communication modules.

Table 11 - Synchronized System

Primary Chassis Display		Secondary Chassis Display	
Redundancy Module	**Controller and Communication Module**	**Redundancy Module**	**Controller and Communication Module**
PRIM	PwQS	SYNC	QS

Table 12 - Qualifying System

Primary Chassis Display		Secondary Chassis Display	
Redundancy Module	**Controller and Communication Module**	**Redundancy Module**	**Controller and Communication Module**
PRIM and QFNG	PQgS	QFNG	QgS

Table 13 - System with a Primary and Disqualified Secondary

Primary Chassis Display		Secondary Chassis Display	
Redundancy Module	**Controller and Communication Module**	**Redundancy Module**	**Controller and Communication Module**
PRIM	PwDS	DISQ	Either: • CMPT (modules are compatible) • DSNP (no partner is present)

Example of Qualified and Disqualified Status Indicators

This example shows status display messages and status indicators that can appear differently depending on the qualification status of the redundant chassis. The following are only two examples of status display message and indicator combinations for both the qualified and disqualified states

Qualified Redundant Chassis	Disqualified Redundant Chassis
Primary Chassis	Primary Chassis
Secondary Chassis	Secondary Chassis
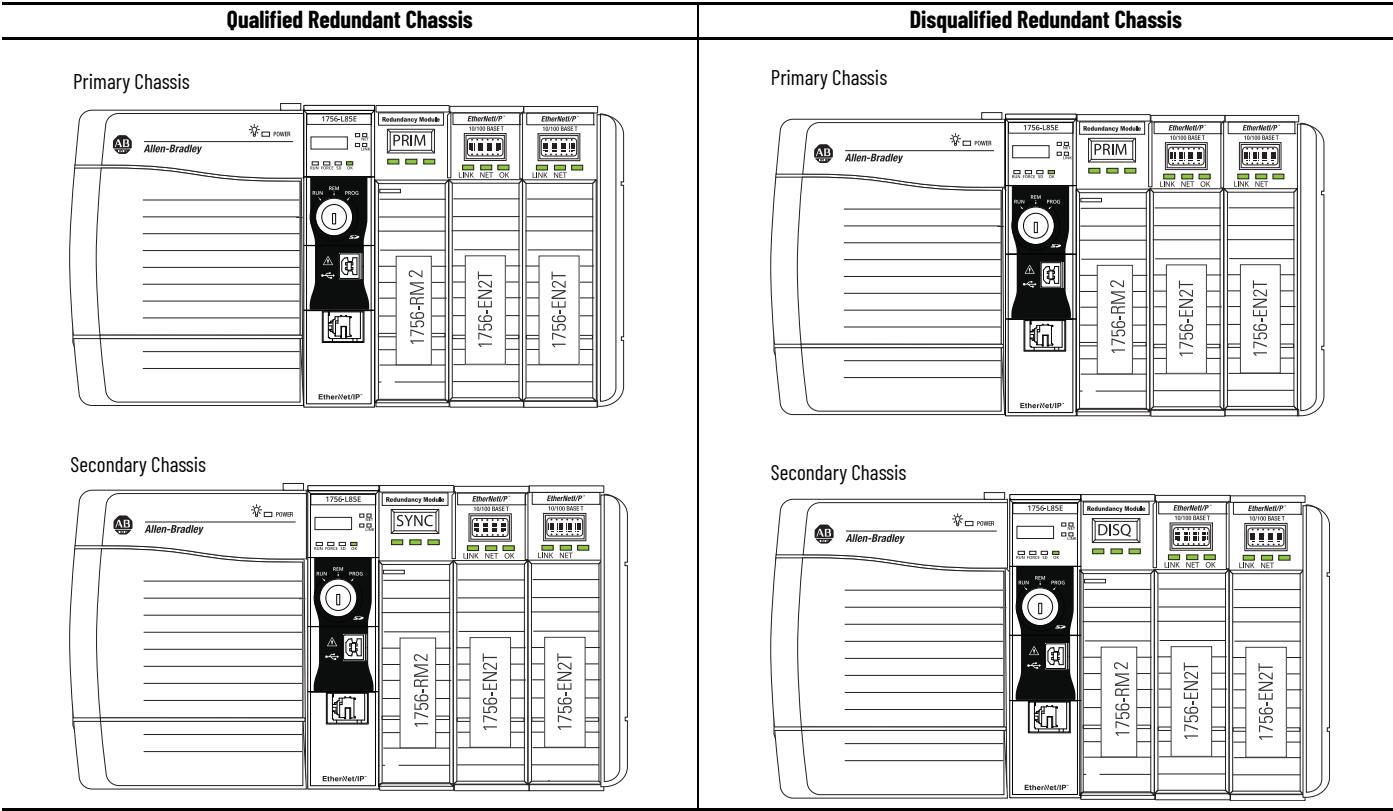
Check Qualification Status Via the RMCT

To determine the qualification status of your system by using the RMCT, open the RMCT and view the qualification status in the bottom-left corner of the tool.
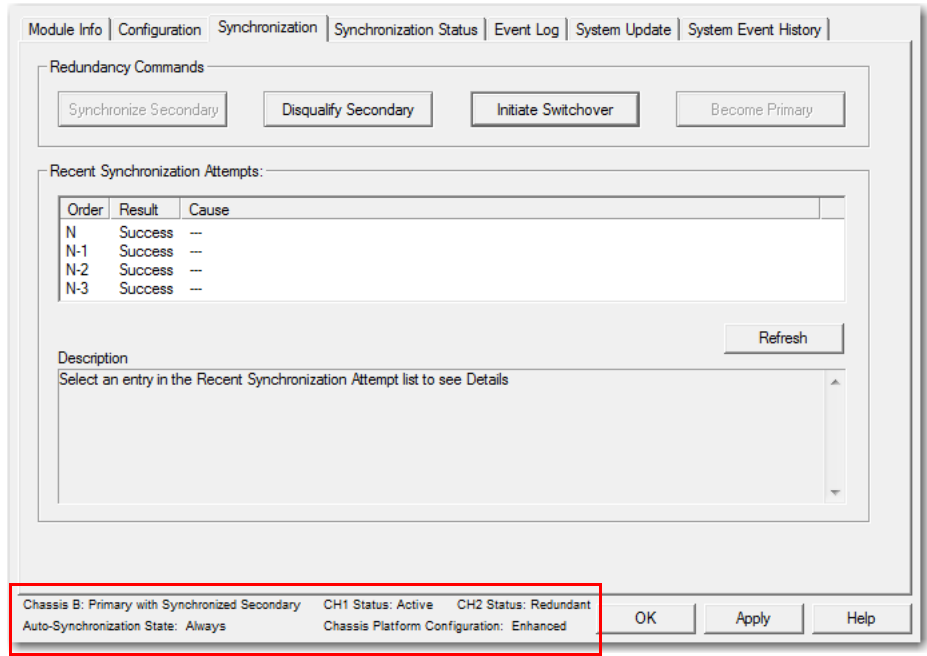
Check the EtherNet/IP Module Status

After you have programmed your redundant system and configured your EtherNet/IP network, check two statistics specific to your EtherNet/IP modules. These statistics include the CPU usage and the connections used.

To view the CPU usage and the number of connections that are used, access the diagnostic web pages on the EtherNet/IP module. To access the diagnostic webpages, see the ControlLogix EtherNet/IP Network Devices, publication 1756-UM004.

CPU Usage

The CPU usage of the EtherNet/IP modules must be at 80%, or less. CPU usage below 80% reserves enough CPU functionality for the EtherNet/IP module to facilitate a switchover.

If the CPU usage is above 80%, the secondary chassis can fail to synchronize with the primary chassis after a switchover occurs. In addition, unscheduled communication can be slowed.

If you must reduce the CPU usage of your EtherNet/IP modules, consider making the following changes:

- Review the Requested Packet Interval (RPI) of your connections.
  - The RPI rate of a connection effects the loading on the associated communications modules.
  - Before changing RPI rates, see the 'Guidelines to Specify an RPI Rate for I/O Modules' section of the Logix 5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.
- Reduce the number of devices that are connected to your module.
- You can add up to seven communications modules in the Redundant Chassis Pair to distribute the load.
- Configure digital I/O using rack optimized connections instead of direct connections.
- Take steps to reduce your CPU utilization. See the EtherNet/IP Network Devices User Manual, publication ENET-UM006.

Connections Used

If the connections of your EtherNet/IP modules that are used are near the limits of the module, you can experience difficulty when attempting to go online with the system. This difficulty arises because going online with a processor also consumes a connection, if the attempts to go online are through the communication module that is near the limit. You can also experience difficulty when attempting to add modules to the system.

Troubleshoot a Redundant System

General Troubleshooting Steps

When an error or other event occurs on the redundancy system, several steps can be executed to determine the cause. After an error or event, you can perform these steps:

1. Check the module status indicators.
2. View diagnostic information in the programming software.
3. Access status and event information in the Redundancy Module Configuration Tool (RMCT).
4. Use communication software to view network status.

Check the Module Status Indicators

If an error or event occurs in the redundancy system, check the module status indicators to determine which module is causing the error or event.

If any of the modules have status indicators that are steady or blinking red, then examine that module status display and the RMCT or other software to determine the cause.

Figure 24 - Steady or Flashing Red Indicators Indicate Errors on 1756-RM2 or 1756-RM2XT Modules
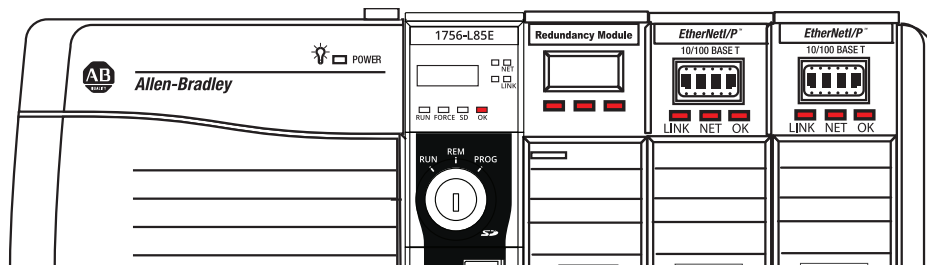
Figure 25 - Module Status Displays for Chassis with ControlLogix® 5580 and Controllers
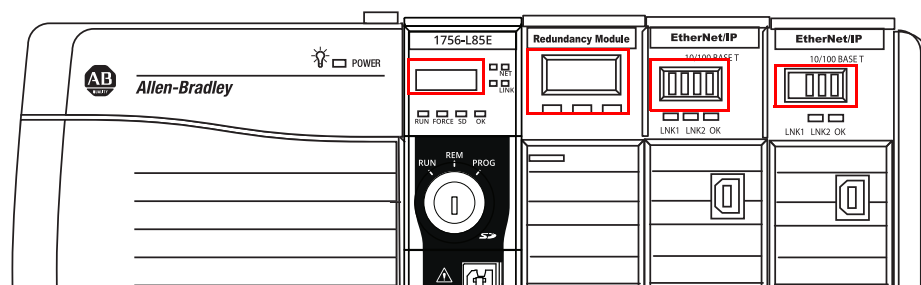
For more information about module status indicators, see Redundancy Module Status Indicators on page 124.

Use Programming Software to View Errors

To view redundancy status by using programming software, complete these steps.

1. Go online with the redundant controller.
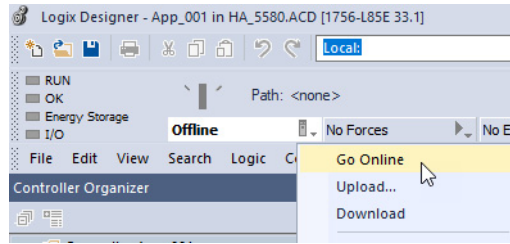
2. Either click Primary or Secondary, depending on the controller you are online with.

Primary Controller
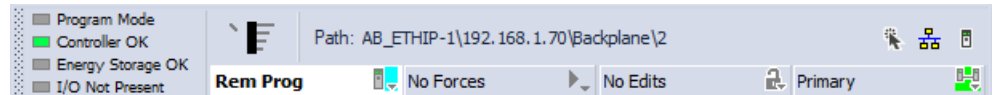
Secondary Controller

The redundant controller ID and status are displayed.

Primary Controller

Secondary Controller
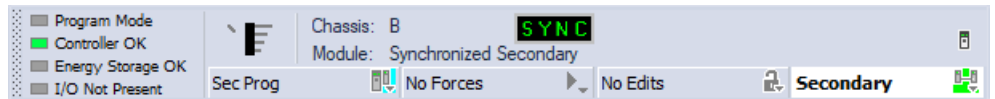
3. If further information is required, click Controller Properties.
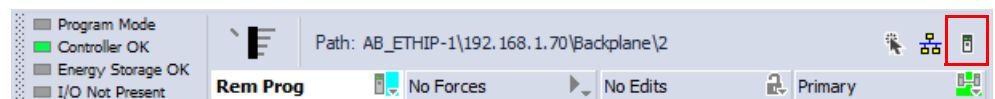
4. Click the Redundancy tab.
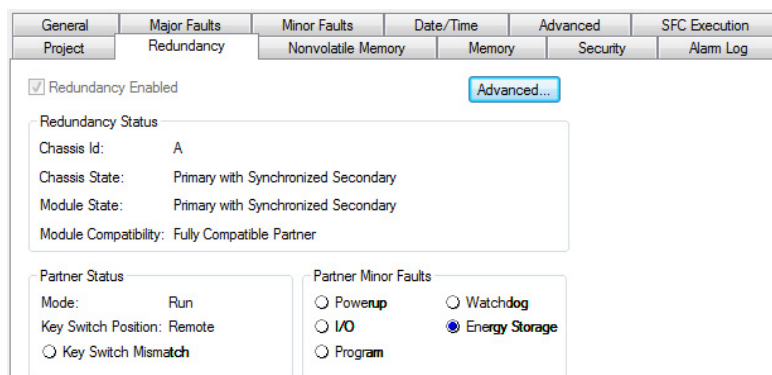
5. If controller fault details are needed, click the Major Faults and Minor Faults tabs to view fault types and codes.

   These fault bits are status bits that the controller sets. You can set these fault bits for testing, but that is not the main purpose of these bits.

Fault details display here:
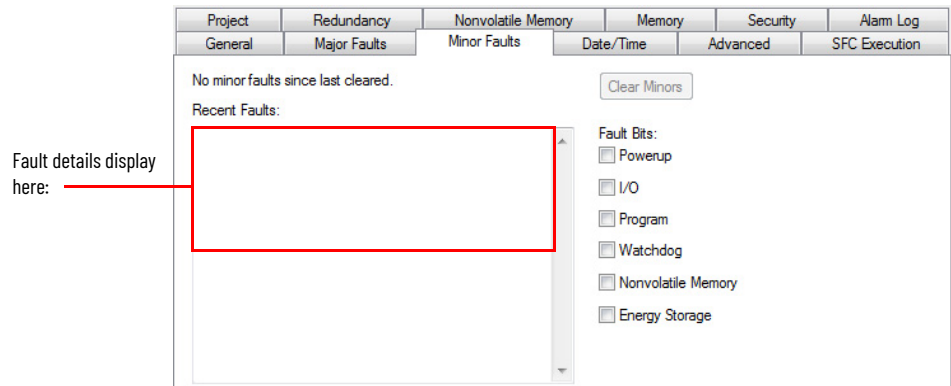
6. If necessary, reference these resources:

   - Redundant Controller Major Fault Codes
   - Logix 5000® Controllers Major and Minor Faults Programming Manual, publication 1756-PM014 (describes all major and minor fault codes)

Redundant Controller Major Fault Codes

The fault codes that are listed and described in Table 14 are specific to redundant controllers. For information about all controller major and minor fault codes, see the Logix 5000 Controllers Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014.

Table 14 - Redundant Controller Major Fault Codes

Type	Code	Cause	Recovery Method

12	32	A disqualified secondary controller was power cycled and no partner chassis or controller was found upon powerup.	Verify that these conditions exist:
			• A partner chassis is connected.
			• Power is applied to both redundant chassis.
			• Partnered controllers have the same:
			  – Catalog number
			  – Slot number
			  – Firmware revision

12	33	An unpartnered controller has been identified in the new primary chassis after a switchover.	Use either of these methods: • Remove the unpartnered controller and troubleshoot the cause of the switchover. • Add a partner controller to the secondary chassis, troubleshoot the cause of the switchover, and synchronize the system.
12	34	Before switchover, a keyswitch mismatch was present. The old primary controller was in Program mode and the keyswitch of the secondary partner was in the Run position. Instead of the switchover transitioning the new primary controller to go to Run mode, the new primary controller transitions to a faulted state after the switchover.	Use either of these methods: • Change the keyswitches from Run mode to Program mode and back to Run mode twice to clear the fault. Make sure that the keyswitch positions for both controllers in a partnered set match. • Use the programming software to go online with the controllers. Then, clear the faults and change the keyswitch positions for both the controllers in the partnered set to Run.

Use the RMCT for Synchronization Attempts and Status

When troubleshooting your redundant system for anomalies with qualification and synchronization, check the Synchronization and Synchronization Status tabs of the RMCT.

Recent Synchronization Attempts

The Synchronization tab provides a log of the last four synchronization attempts. If a synchronization command was unsuccessful, the Recent Synchronization Attempts log indicates a cause.

For more information about how to resolve the synchronization conflict, click the attempt and view the Description in the lower box.

Figure 26 - Example of an Unsuccessful Synchronization Attempt
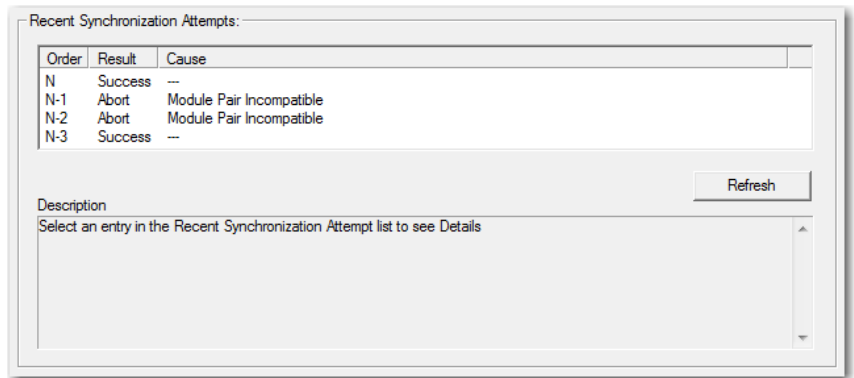
For more information about how to interpret the Recent Synchronization attempts log, see .

Module-level Synchronization Status

The Synchronization Status tab provides a module-level view of redundant chassis and can be used to identify what module pair can be causing a synchronization failure.

Depending on the type of synchronization failure, you can need to open the Synchronization Status tabs for the primary and secondary redundancy modules.

- If there is a difference between major revisions of the controllers or modules, the Compatibility column shows **Incompatible**, as shown in this example.

Primary Chassis

Secondary Chassis

- If there is a difference between minor revisions of the controllers or modules, the Compatibility column also shows **Incompatible**, as shown in the following graphic.

Primary Chassis

Slot	% Complete	Module Name	Module Revision	Secondary Readiness	State	Compatibility
0	0	1756-L85E	33.11	Disqualified	Primary	Full
1	0	1756-RM2/A REDUNDAN...	20.30	No Partner	Primary	Incompatible
2	0	1756-EN2TR/C 217021900	11.02	Disqualified	Primary	Full

(Tabs: Module Info | Configuration | Synchronization | Synchronization Status | Event Log | System Update | System Event History)

Secondary Chassis

Slot	% Complete	Module Name	Module Revision	Secondary Readiness	State	Compatibility
0	0	1756-L85E	33.11	Disqualified	Secondary	Full
1	0	1756-RM2/A REDUNDAN...	20.5	No Partner	Secondary	Incompatible
2	0	1756-EN2TR/C 217021900	11.02	Disqualified	Secondary	Full

(Tabs: Module Info | Configuration | Synchronization | Synchronization Status | Event Log | System Update | System Event History)

Use the RMCT Event Log

When troubleshooting your redundant system, access the Event Log to determine the cause of an event, error, switchover, or major fault.

> **IMPORTANT** Messages in the Event Log are for Rockwell Automation development engineering to debug redundancy system events after the fact. Anyone who is not part of the development engineering team can have difficulty interpreting the meaning of many of the events in the Event Log. For user facing messages, see . These messages are designed for the user.
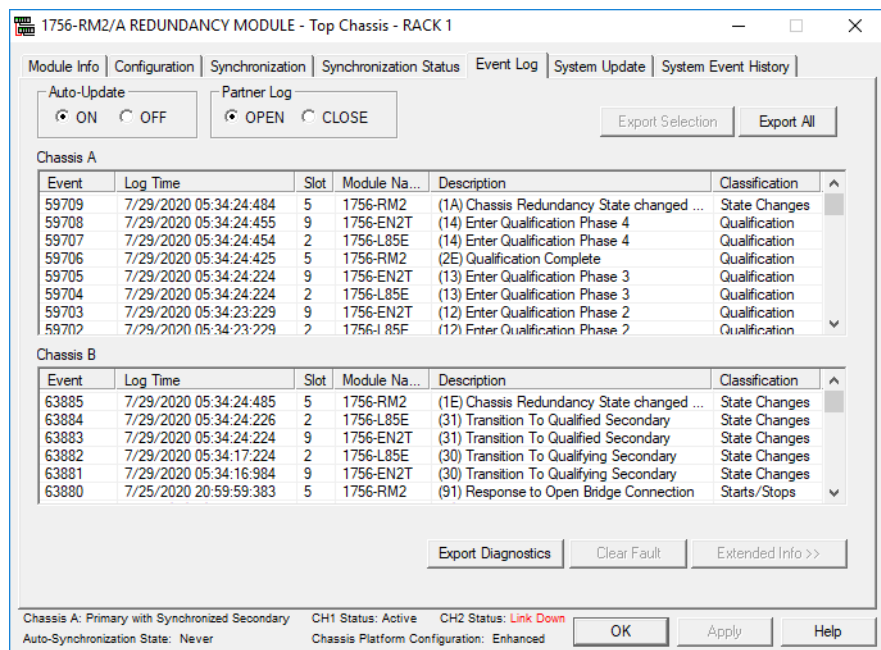
The Event Log tab provides a history of events that have occurred on the redundant chassis.

These system events are indicated in the event logs:
- Qualification stages that are entered and completed
- Module insertion/removal
- Firmware errors
- Communication events and errors
- Configuration changes
- Other system events that affect qualification and synchronization

IMPORTANT	The events that are logged in this tab are not always indicative of an error. Many of the events that are logged are informational only.
	To determine if additional action or troubleshooting is required in response to an event, see Table 16 on page 101.

The Event Log tab can be customized to view the log specific to only one chassis or the event logs of both redundant chassis. You can alter your view of the event logs by changing the Auto-Update and Partner Log parameters.

Table 15 - Settings for Event Log Views

Use This Setting	To
Auto-Update	Keep the log from updating while you are viewing it.
Partner Log	View only the event log for the module you are accessing.

Figure 27 - Settings for Event Log Views

Check On to keep the log updating automatically.   Check Close to view only the log of one redundancy module.
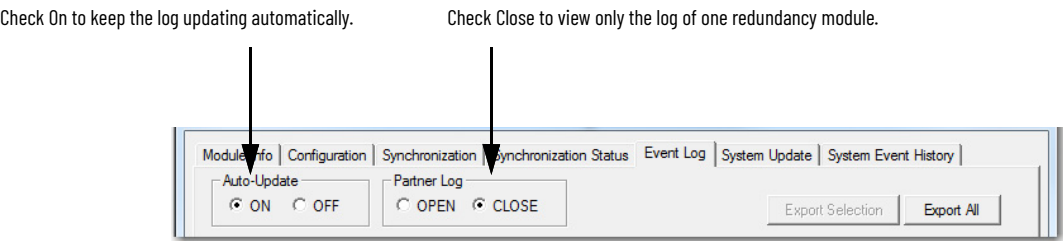
Controller Events

Occasionally, controller-related events can be logged in the RMCT Event Log. In some cases, the events are strictly status updates and are not indicative of an anomaly that requires troubleshooting.

In other cases, the event description can indicate Program Fault Cleared, or a similar description of a resolved anomaly. If state changes or switchovers do not follow these types of events, then they are not indicative of an anomaly that requires additional troubleshooting.

If a state change or switchover follows an event that is logged for a controller in the redundant system, use the programming software to go online with the controller and determine the cause of the fault. For more information about how to use programming software to troubleshoot a fault, see the section titled Use Programming Software to View Errors on page 96.

Event Classifications

Each event that is identified and logged is classified. You can use these classifications to identify the severity of the event and determine if additional action is required.

Figure 28 - Event Classifications in the Event Log Tab
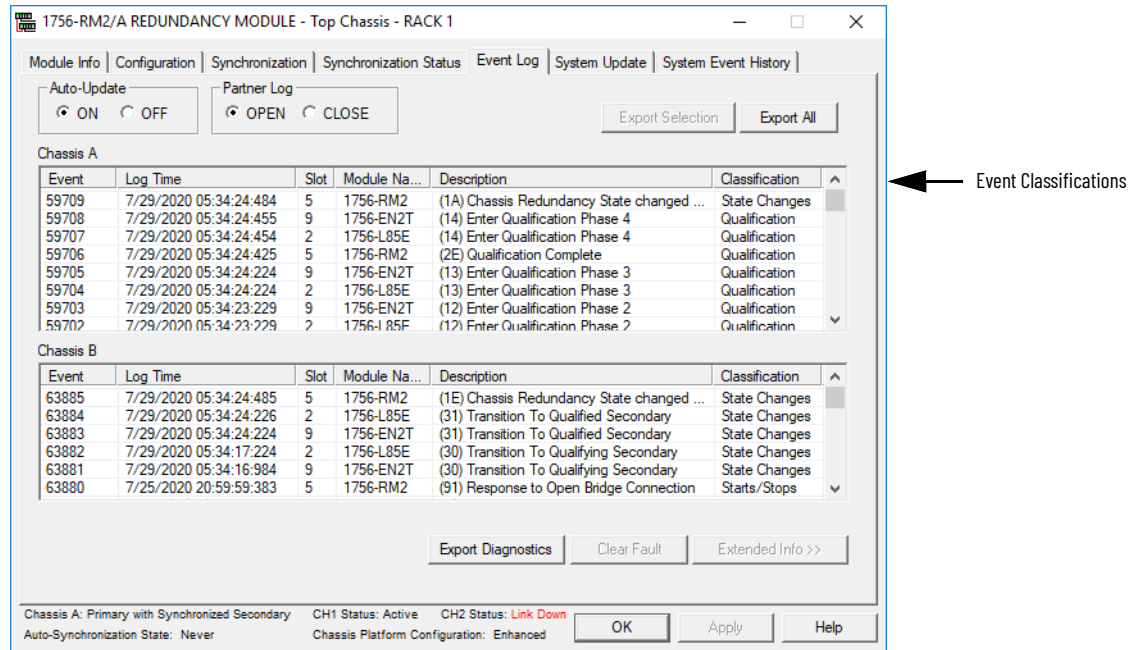
Use Table 16 to determine what an event classification indicates and if corrective action is required.

Table 16 - Classification Types

Classification Type	Description	Action Required
Configuration	A redundancy module configuration parameter has been changed. For example, if you change the Auto-Synchronization parameter from Always to Never, an event that is classified as Configuration is logged.	No corrective action is required. This event is provided for informational purposes and does not indicate serious anomaly with the redundancy system.
Command	An event that is related to commands that are issued to the redundant system has occurred. For example, if you change the Redundancy Module Date and Time parameters, a WCT time change event of the Command classification is logged.	No corrective action is required. This event is provided for informational purposes and does not indicate serious anomaly with the redundancy system.
Failure	A failure on the redundancy module has occurred. For example, an internal Firmware error event that is classified as a Failure can be indicated in the event log.	Action can be required to determine the cause of the failure. If Switchover or Major Fault event does not precede a failure, then the module could have corrected the error internally and additional action is not required. To determine if corrective action is required, double-click the event to see Extended Event Information and the suggested recovery method, if applicable.
Major Fault	A major fault has occurred on one of the redundancy modules.	Action can be required to determine the action that is necessary to correct the fault. Double-click the event to see Extended Event Information and the suggested recovery method, if applicable.
Minor Fault	A minor fault has occurred on one of the redundancy modules.	No corrective action is required. This event is provided for informational purposes and does not indicate a serious anomaly with the redundancy system.
Starts/Stops	Various internal chassis and module processes have started or stopped.	No corrective action is required. However, if an event that is classified as a Failure, State Change, or Major Fault occurs after the Starts/Stops event, view the Extended Event Information of both events to determine if the events are related.

Table 16 - Classification Types (Continued)

Classification Type	Description	Action Required
State Changes	A chassis or module state change has occurred. For example, if the chassis designation changes from being a disqualified secondary to a qualified secondary, a State Change event is logged.	No corrective action is required. However, if an event that is classified as a Failure, or Major Fault occurs after the State Changes event, view the Extended Event Information of both events to determine if the events are related.
Switchover	An event that is related to a chassis switchover has occurred. For example, if an Initiate Switchover command is issued, an event that is classified as Switchover is logged.	Action can be required to determine the cause of the switchover and potential correction methods. Double-click the event to see Extended Event Information and the suggested recovery method, if applicable.
Synchronization	An event that is related to chassis synchronization has occurred. For example, if the Synchronization command has been issued, a Network Transitioned to Attached event is logged and classified as Synchronization.	No corrective action is required. This event is provided for informational purposes and does not indicate a serious anomaly with the redundancy system.

Access Extended Information about an Event

Events that are logged in the Event Log tab can have additional information available. To access additional information about an event, double-click an event that is listed in the log.

Interpret Extended Information for an Event

The information that is listed in this table can be provided (depending on the type of event) after you have accessed the Extended Information Definition dialog box.

Information Type	Description
Event Information	The redundancy system assigns this event information: • Event number • Date and time the event occurred • Event classification
Submitter Information	This information reflects information specific to the module that reported the event. Information that is provided in this section includes the: • Name of the module that originated the event • Slot number of the module that originated the event • Serial number of the module that originated the event
Event Details	This section provides these additional details about the event: • Description of the event • Examine the Extended Data Definition, which provides an explanation of the event and bytes, for errors • Extended Data Bytes (in Hexadecimal) that provides further details the event

Interpret Event Log Information

Use this procedure to view and interpret Event Log information.

Table 17 - Possible Qualification Status Indicators

Status Code	Description
PwQS	Primary with qualified (synchronized) secondary partner
PwQgS	Primary with qualifying secondary
QSwP	Qualified (synchronized) secondary with primary partner
DSwP	Disqualified secondary with primary partner
DSwNP	Disqualified secondary with no partner
PLgU	Primary locking for update
PLU	Primary locked for update
PwDS	Primary with disqualified secondary partner
PwNS	Primary with no secondary partner
SLgU	Secondary locking for update
SLU	Secondary locked for update

1. Open the RMCT and click the Event Log tab.
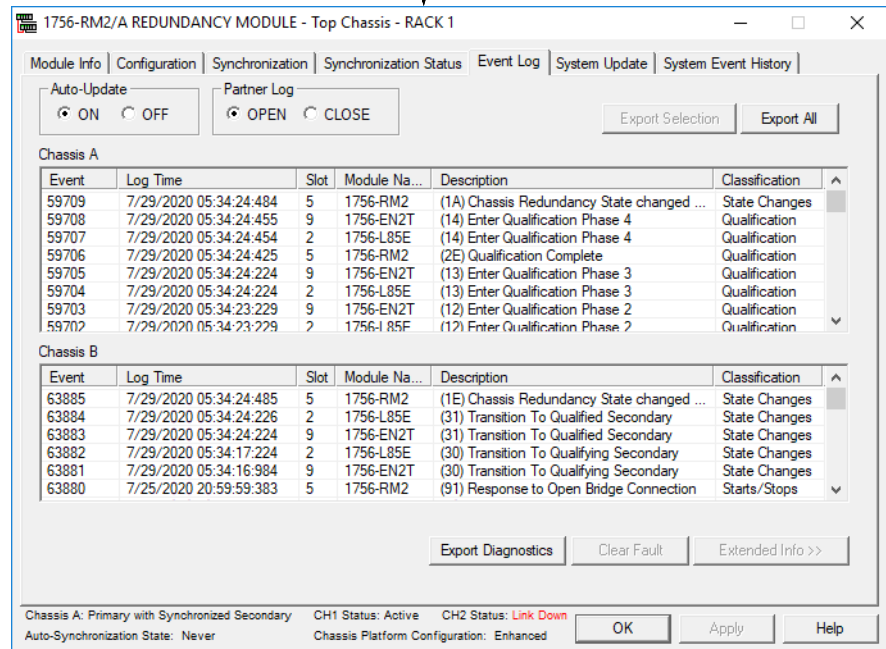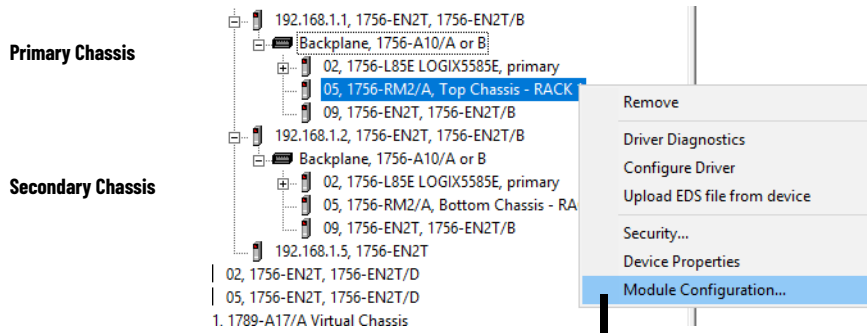
2. If an event occurred, open the Event Log for both chassis (A and B).

3. Locate the Event line that shows the qualification code, start date, and time of the event, in the A chassis event log.
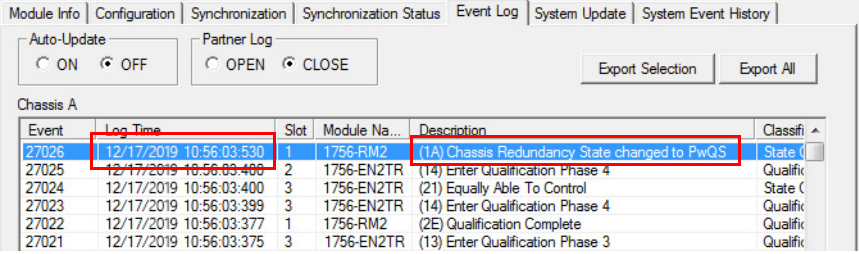
    This entry is the last time the redundancy module was working properly.

    Multiple codes could be displayed if multiple errors occurred. Additionally, if a secondary redundancy module is not present, then a code can fail to be seen at all. See .

4. Then, locate the matching time entry in the B chassis event log. This entry displays the disqualification code on the Event line.
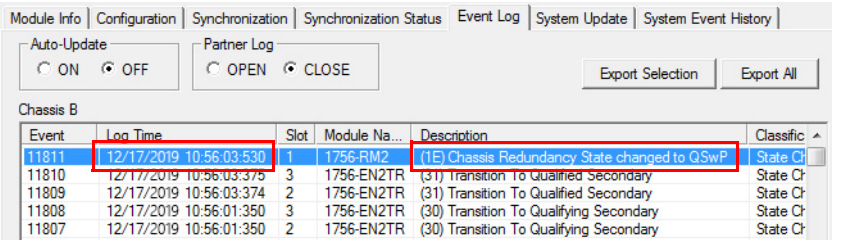
Chassis A

PwQS and start date and start time in Chassis A. This is the last time the redundancy module was working properly.

Chassis B

QSwP and start date and start time in Chassis B. This is the last time the redundancy module was working properly, and by time, must match up with Chassis A.
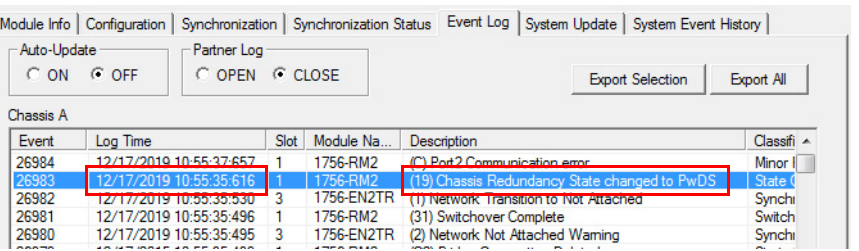
5. Work back in time (up the lines of preceding events) to locate the point that a switchover or disqualifying event occurred.

    This is the end date and time of the event, and is indicated on the Event line in the A chassis event log, with a disqualification code that the secondary has been disqualified, and a corresponding disqualification code in the B chassis event log. Again, if no secondary is present, the event log can display no secondary disqualification codes at all. See Table 17 on page 103.
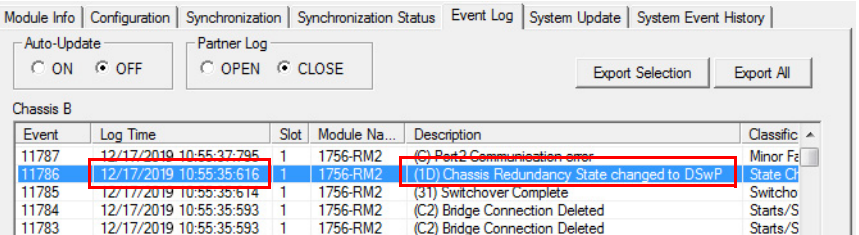
Chassis A

PwDS and end date and end time in Chassis A. This is the time the redundancy module experienced a disqualifying event or switchover.

Chassis B

DSwP and matching end date and end time in Chassis B. This is the time the redundancy module experienced a disqualifying event or switchover.

6. To find the error that caused the disqualification, examine the range of time in between the start of the event and the end of the event.

> **IMPORTANT**   This range of time can be large depending on how much time has passed since the last disqualifying event.

You can also use the Log Time column to identify a significant event. Scan within a time range that corresponds to the time an event was reported or annunciated.

In addition, you can also attempt to identify events by finding differences between times logged. Such gaps in time often identify events that require troubleshooting. When troubleshooting by identifying gaps in the time entries, remember that gaps in months, days, or minutes can indicate a significant change to the system.

Not all events that are logged are indicative of an anomaly that must be corrected. For example, events that are classified as Minor Faults do not warrant corrective behavior unless they occur just before a switchover, major fault, or state change **and** can be identified as contributing to successive events.

7. After you have located an event entry that is related to the anomaly you are troubleshooting, double-click the event to view Extended Event Information.

Chassis A					
Event	Log Time	Slot	Module Na...	Description	Classifi
59865	9/9/2020 10:17:42:973	5	1756-RM2	(90) Request to Open Bridge Connection	Starts/
59864	9/9/2020 10:17:16:784	5	1756-RM2	(1D) Chassis Redundancy State changed to DSwP	State C
59863	9/9/2020 10:17:16:784	5	1756-RM2	(BC) Chassis Platform Identity Updated	Configu
59862	9/9/2020 10:17:16:783	2	1756-L85E	(105F) Firmware Diagnostic Entry	State C
59861	9/9/2020 10:17:16:732	5	1756-RM2	(23) Disqualified Secondaries Rule	Starts/

Double-click to view more information.

Extended Information Definition - Chassis A   ✕

Event Information
Event Number   59864   Log Time   9/9/2020 10:17:16:784   ↑
Event Class   State Changes   ↓

Submitter Information
Module Type   1756-RM2   Slot No   5
Serial No (in Hex)   F05482

Event Details
Description   (1D) Chassis Redundancy State changed to DSwP

Extended Data Definition
Extended Information Unavailable

Extended Information Bytes (in Hex)

The Description provides more information about the state change that occurred.

No recovery method is described. This indicates that action is not required in response to this event.

8. View the Description and Extended Data Definitions.

    The Description and Extended Data Definitions can be used to obtain further event information and can indicate a recovery method.

Export Event Log Data

After you have viewed extended information about an event, you could need to export event data. You can export data with either of these options:

- Export Selection
- Export All

Export Selection

Use this feature to export event log data for single or multiple events that occur on a primary or secondary redundancy module.

Complete these steps to export event data for an event.

> If the redundancy modules are not available in the communication software after a fault, you must apply the recovery method that the module indicates before attempting to export the Event Log data.

1. Launch the communication software and browse to the redundancy modules.
2. Right-click the **primary** redundancy module and choose the Configuration option.

RSLinx® RMCT	FactoryTalk® Linx RMCT
Backplane, 1756-A10/A or B 02, 1756-L85E LOGIX5585E, primary 05, 1756-RM2/A, Top Chassis - RACK 1 Remove Driver Diagnostics Configure Driver Upload EDS file from device Security... Device Properties Module Configuration...	Backplane, 1756-A4/A or B 3 00, 1756-L85E, V34_Redundancy 01, 1756-RM2/A, 1756-RM2/A REDUNDANCY MODULE 02, 1756-EN2TR, 175 Add Anchor PCviaUSB, 17-Node USB Refresh 192.168.1.18[192.168.1.17], Device Property 192.168.1.27, 1783-MS06T, Device Configuration Ethernet, Ethernet Delete USB EDS Upload rowsing - node 02, 1756-EN2TR, 1756-EN2TR/C found
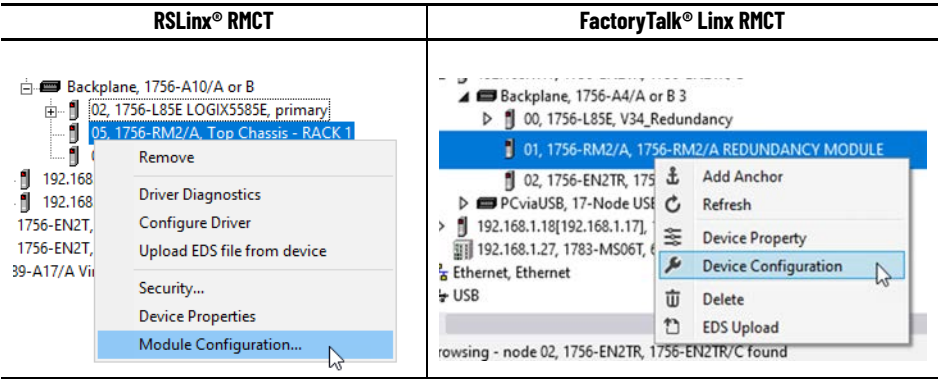
> If you cannot see the Configuration option in the list, then the compatible version of the RMCT is not installed.

3. In the Auto-Update area, click Off to keep the log from updating.

Auto-Update
○ ON   ◉ OFF
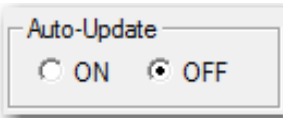
4. In the Partner Log area, click Close.

   This action closes the event log of the partner module.

Partner Log
○ OPEN   ◉ CLOSE
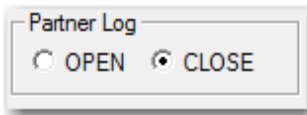
5. Select one event or multiple events for which you want to export data. To select multiple events, select a start event, press SHIFT, and select an end event.
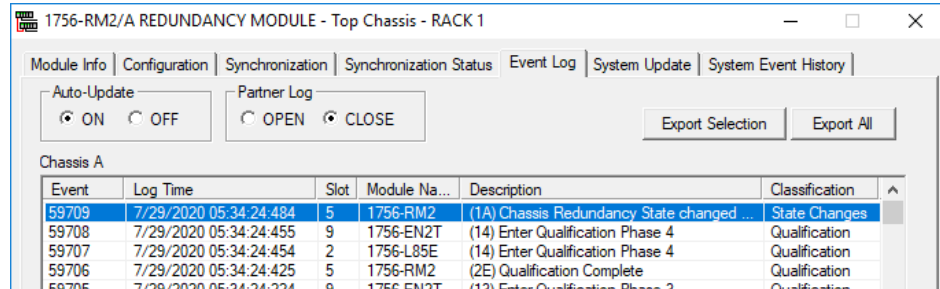
6. Click Export Selection.
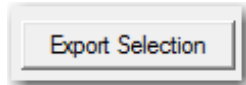
The Export Event Log dialog box opens.

7. Complete these steps on the Export Event Log dialog box.

    a. Specify a file name and location or use the default name and location.

    b. Check CSV (Comma-Separated Value).

> If you are sending the exported Event Log files to Rockwell Automation Technical Support, you must use the CSV file type.

    c. Check Include Extended Information.

> If you are sending the exported Event Log files to Rockwell Automation Technical Support, include the diagnostic data and extended information.
>
> If you include this data, Rockwell Automation Technical Support can analyze module and system failures more effectively.

8. Click Export.
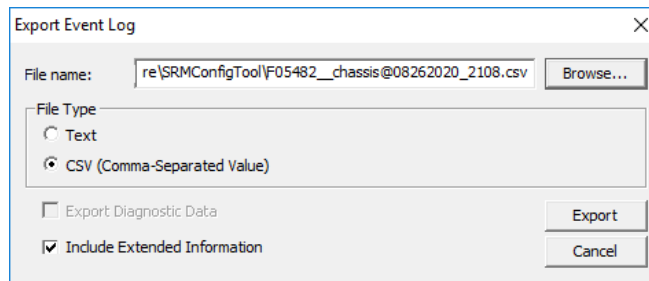
The event log is exported. The log can take a few minutes to export.
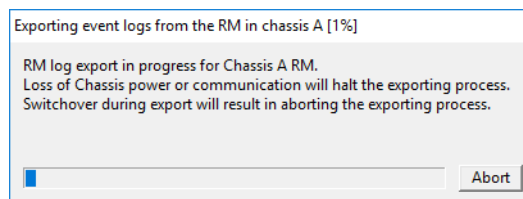
9. If you want to export the secondary redundancy module log for a complete system view complete step 1…step 8.

IMPORTANT	We recommend that you get the logs by choosing export all with the CSV file type.
	If you are exporting event data to provide to Rockwell Automation Technical Support to troubleshoot an anomaly, you must obtain the event logs for both the primary and secondary redundancy modules. Rockwell Automation Technical Support needs the event logs to troubleshoot the anomaly.
	If you cannot access the event log for the secondary redundancy module, export it from the partner event log via the primary redundancy module.
	Keep in mind, though, that the view the primary redundancy module has of the event log of the secondary redundancy module is typically limited. To troubleshoot an anomaly with Rockwell Automation Technical Support, you must obtain the event log of the secondary redundancy module from the view of the module itself.

Export All
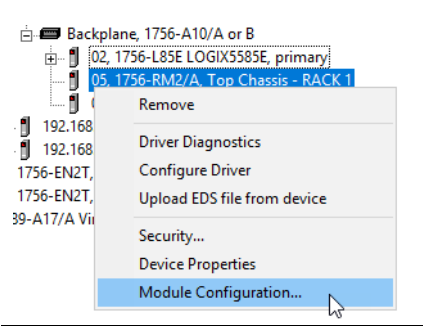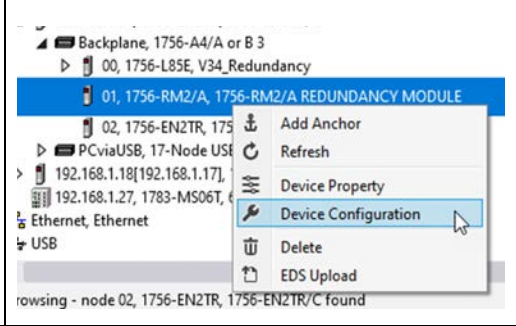
Use this feature to export all available event log data for events in both of the redundancy modules of the redundant chassis pair automatically.

We recommend that you use this feature when troubleshooting system-related anomalies, where the location of a fault could have occurred a lengthy period before the current event.
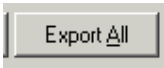
Complete these steps to export event log data for one event.

> If the redundancy modules are not available in the communication software after a fault, you must apply the recovery method that the module indicates before attempting to export the Event Log data.

1. Launch the communication software and browse to the redundancy modules.

2. Right-click the **primary** redundancy module and choose the Configuration option.

RSLinx RMCT	**FactoryTalk Linx RMCT**

> If you cannot see the Configuration option in the list, then the compatible version of the RMCT is not installed.

3. On the Event Log tab, click Export All.

> Export All

4. At the Export All dialog box, click OK.

5. At the communication software window, select the redundancy module in the partner redundant chassis, click OK.

6. Complete these steps on the Export Event Log dialog box and click OK.

   a. Specify a file name and location or use the default name and location.

   b. Check CSV (Comma-Separated Value).

   > If you are sending the exported Event Log files to Rockwell Automation Technical Support, you must use the CSV file type.

   c. Check Export Diagnostic Data.

   d. Check Include Extended Information.

   > If you are sending the exported Event Log files to Rockwell Automation Technical Support, include the diagnostic data and extended information.
   >
   > If you include this data, Rockwell Automation Technical Support can analyze module and system failures more effectively.

7. Click Export.
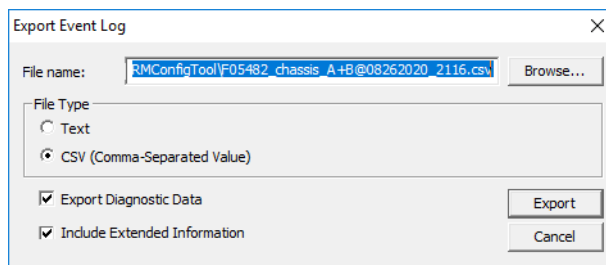
The event log is exported. The log can take a few minutes to export.
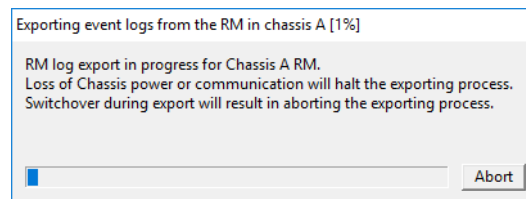
Wait for this dialog box to appear.
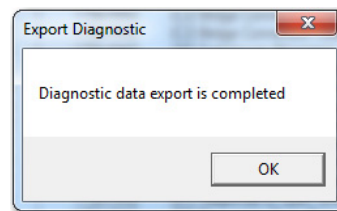
8. Click OK.

   A .csv and a .dbg file is in the folder location specified. Make sure to provide the .csv file to Rockwell Automation Technical Support when troubleshooting an anomaly.

Export Diagnostics

IMPORTANT	Only Export Diagnostics when requested to do so by Rockwell Automation Technical Support.

You can also click Export Diagnostics if there is a module fault in the redundancy module. Click Export Diagnostics to collect and save diagnostic data from the redundancy module and its partner, if an unrecoverable firmware fault occurs. A red 'OK' light on the front of the redundancy module indicates a nonrecoverable fault, and a fault message scrolls across the marquee display. When you click Export Diagnostics, information is recorded that Rockwell Automation engineering can use to determine the cause of the fault.

Because diagnostic information is recorded for the redundancy module and its redundancy partner, a communication path to the partner redundancy module is also part of the process to obtain the diagnostics.

Follow these steps.

1. Click Clear Fault if it is enabled, as it can first be necessary to clear any faults before using Export Diagnostics.
2. Click Export Diagnostics.
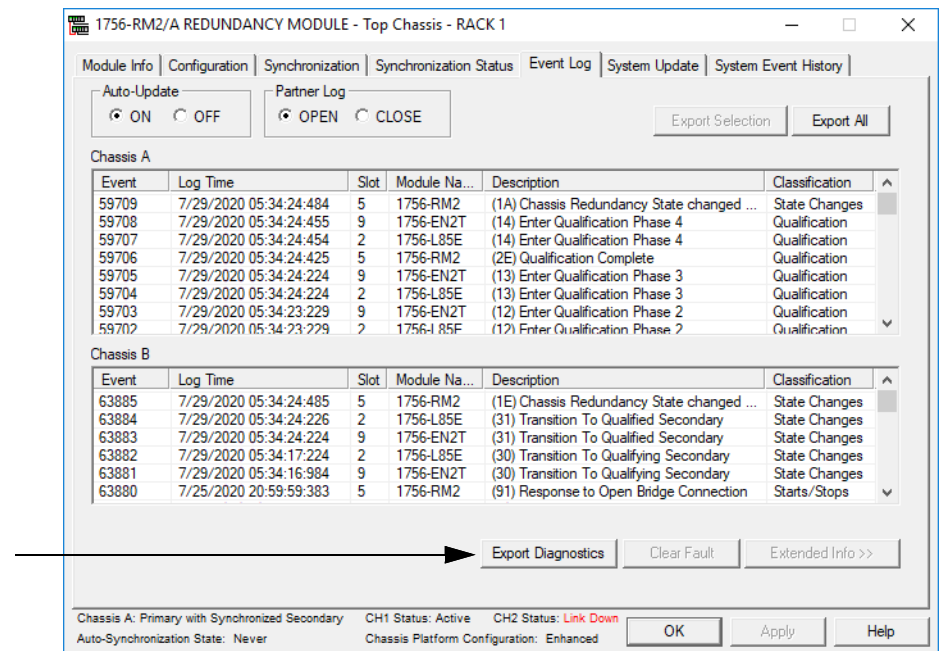
The Export Diagnostics dialog box appears and asks you to continue specifying a communication path.
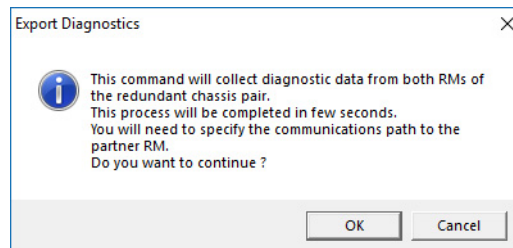
3. Click OK to specify the communication path via RSWho software.

4. Select the communication path to the partner or secondary module and click OK.

```
A, Ethernet
    192.168.1.1, 1756-EN2T, 1756-EN2T/B
        Backplane, 1756-A10/A or B
            02, 1756-L85E LOGIX5585E, primary
            05, 1756-RM2/A, Bottom Chassis - RACK 1
            09, 1756-EN2T, 1756-EN2T/B
    192.168.1.2, 1756-EN2T, 1756-EN2T/B
        Backplane, 1756-A10/A or B
            02, 1756-L85E LOGIX5585E, primary
            05, 1756-RM2/A, Top Chassis - RACK 1
            09, 1756-EN2T, 1756-EN2T/B
    192.168.1.5, 1756-EN2T
```
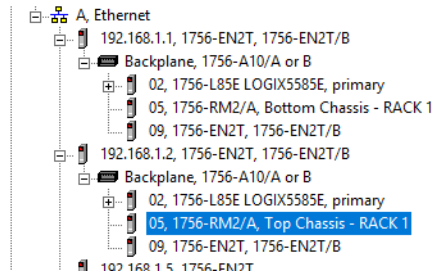
The Export Diagnostics dialog box appears and prompts you to specify a location to save the export file.

```
Export Diagnostics                                      ×

File name :   MConfigTool\F05395_chassis_B+A@09242020_1050.dbg    Browse

                                                        Export

                                                        Cancel
```
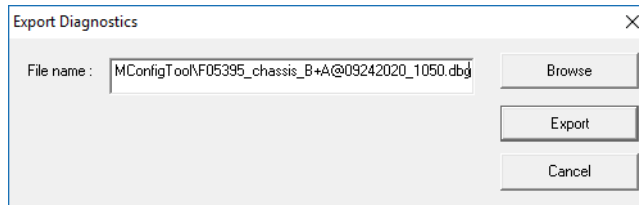
5. Name and save the export file.
6. Click Export.

    It can take several minutes to export the data.

    The Export Diagnostic Complete dialog box appears once the export has completed.

```
Export Diagnostic                    ×

Diagnostic data export is completed

                OK
```
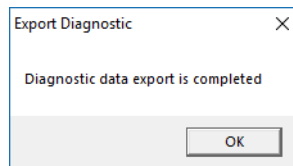
7. Click OK.

Forward this diagnostics file to Rockwell Automation Technical Support only if requested to do so.

Contact Rockwell Automation Technical Support

If you tried to use the event logs to troubleshoot your redundant system and are unsuccessful, prepare to contact Rockwell Automation Technical Support by exporting all of the event logs of **both** the primary and secondary redundancy modules. The technical support representative who assists you uses those files to help determine the cause of a switchover or other anomaly.

For more information about how to export all of the event logs, see <u>Export All on page 110</u>.

Clear a Fault

You can use the Clear Fault button on the Event Log tab to clear major faults that occur on a redundancy module.

With this feature, you can remotely restart the redundancy module without physically removing and reinserting it from the chassis. The module restart clears the fault.

IMPORTANT   Export all event and diagnostic data from the module before you clear major faults from the module. Clear Fault is active only when the redundancy module is in a major faulted state.

Module faults are displayed on the Module Info tab.

Fault details display here:
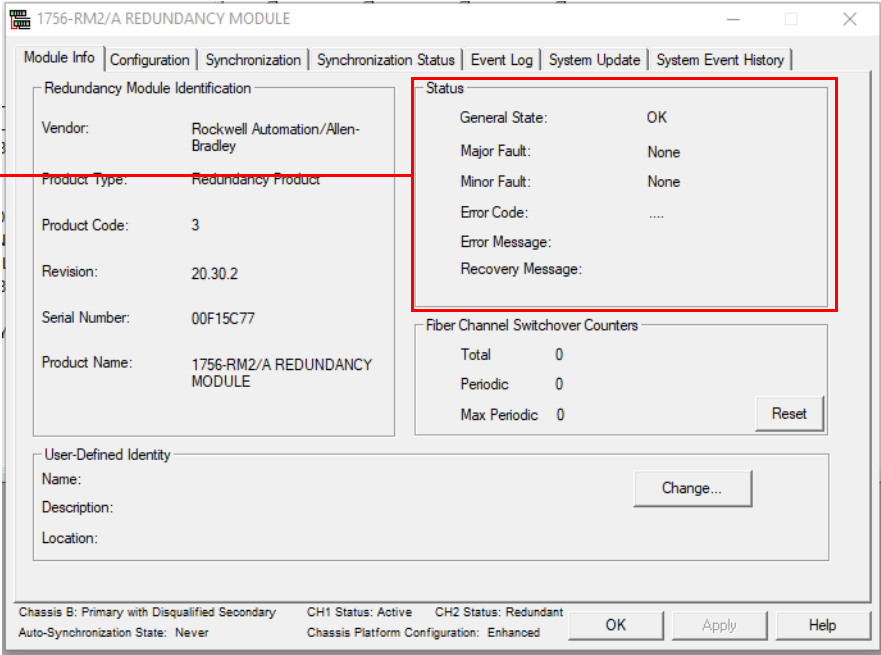
System Event History

The System Event History tab is designed to give a user with limited knowledge of ControlLogix® Redundancy systems an event history.

These events include the following:

- Qualification - The ControlLogix Redundancy system can now switchover to the secondary redundancy chassis if necessary.
- Disqualification - The secondary redundancy chassis is not ready to accept control of the system. The ControlLogix Redundancy system cannot switchover.
- Switchovers - The secondary chassis has now become the primary chassis and is now controlling the system.
- Module faults - A module has faulted in the ControlLogix Redundancy system.

The last 20 events are logged in the System Event History tab. There are 10 events from each redundancy module.

System Event History Column Descriptions

For each event logged, this information is provided:

- Attempt - Event count, this will be from N to N-19 for the maximum of 20 events.
- Initiation Time - The time and date of the event from the redundancy module clock.
- Event Class - Qualification, Disqualification, or RM FAULT (Redundancy Module fault).
- Basic Info - Information about the origin of the event (for example, Commanded or Auto Qualification).
- Extended Info-A - A short text description of the event.
- Extended Info-B - Additional details on the event.
- User Comment - An editable user comment for the event.

Edit a User Comment for a System Event

To edit the User Comment that is associated with a system event, complete these steps.

1. Select the event.
2. Click Edit.
3. In the Description field, type your event description.
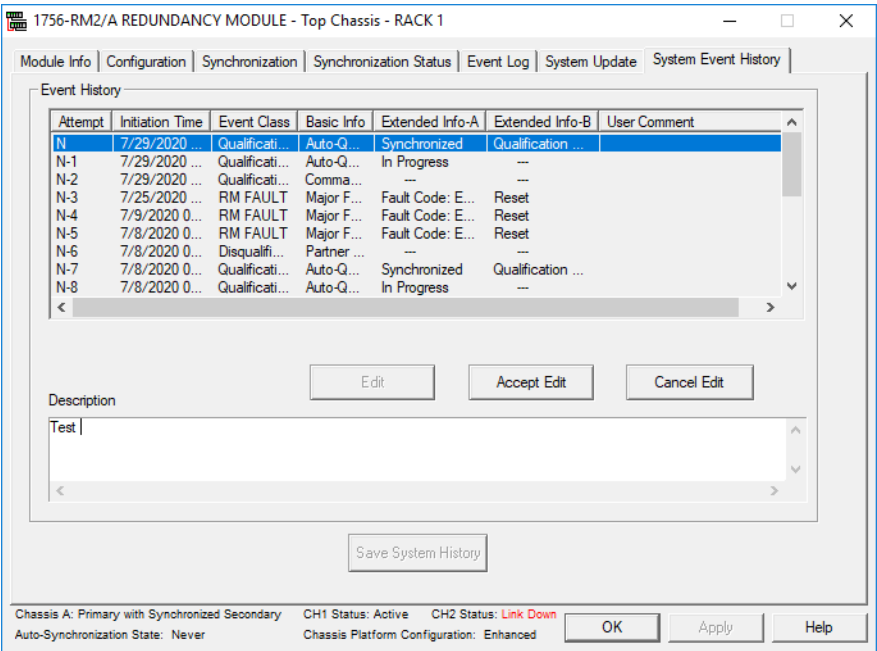
4. Click Accept Edit.
5. At the Accept Edit dialog box, click OK.
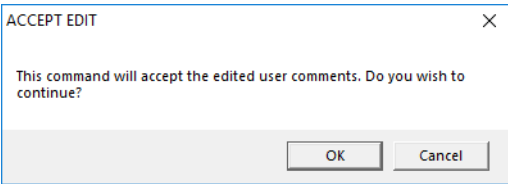
Save System Event History

If you want to save the system event log to the nonvolatile memory of the redundancy module, click Save System History at the bottom of the System Event tab. If you save this history, it can assist with troubleshooting the system later.
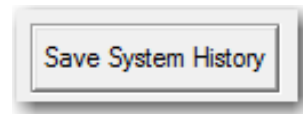
Event Examples

This section contains example System Event History records for typical system events.

Table 18 - Manual Switchover

Event Class	Basic Info	Extended Info-A	Extended Info-B
Switchover	Commanded	–	–

Table 19 - Disqualify Secondary

Event Class	Basic Info	Extended Info-A	Extended Info-B
Disqualification	Commanded	–	–

Table 20 - Qualification Successful

Event Class	Basic Info	Extended Info-A	Extended Info-B
Qualification	Auto-Qualification	Synchronized	Qualification Complete
Qualification	Auto-Qualification	In Progress	–

Table 21 - Qualification Failed Due to Incompatible Module

Event Class	Basic Info	Extended Info-A	Extended Info-B
Qualification	Auto-Qualification	In Progress	–
Qualification	–	Qual Abort	Cause: module pairs are incompatible

Table 22 - Switchover Due to Module Removal from Primary

Event Class	Basic Info	Extended Info-A	Extended Info-B
Disqualification	Module Fault	Chassis B	SYS_FAIL_L Asserted in Secondary Chassis
Switchover	Module Removal	Chassis B - Slot No:2	–

Table 23 - Switchover Due to Network Cable Removal in Primary

Event Class	Basic Info	Extended Info-A	Extended Info-B
Switchover	Module Fault	Chassis B - Slot No: xx[1]	Possible Causes: 1. Network cable removal 2. Controller program fault

(1)   xx = module slot number.

Table 24 - Switchover Due to Chassis Power Fault in Primary Chassis

Event Class	Basic Info	Extended Info-A	Extended Info-B
Switchover	Partner RM Power Failure	–	–

Table 25 - Disqualification Due to Network Connection Lost between Primary and Secondary Chassis

Event Class	Basic Info	Extended Info-A	Extended Info-B
Switchover	Module Fault	Chassis B - Slot No: xx[1]	Possible Causes: 1. Network Cable Removal[2] 2. Controller Program Fault

(1)   xx = module slot number.
(2)   This lost connection is not a network cable removal issue. The communication modules not being able to see each other over the network has caused the lost connection.

Table 26 - Disqualification Due to Partner Chassis Power Fault

Event Class	Basic Info	Extended Info-A	Extended Info-B
Disqualification	Partner RM Power Failure	–	–

Table 27 - Disqualification Due to Partner Chassis Module Removal

Event Class	Basic Info	Extended Info-A	Extended Info-B
Disqualification	Module Removal	Chassis A - Slot No: xx[1]	–

(1)   xx = module slot number.

Table 28 - Disqualification Due to Partner Chassis Redundancy Module Fault

Event Class	Basic Info	Extended Info-A	Extended Info-B
RM FAULT	Major Fault	Fault Code: EE05	Reset
Disqualification	Partner RM Power Failure	–	–

Table 29 - Disqualification Due to Redundancy Module Fiber Cable Disconnected or Faulted

Event Class	Basic Info	Extended Info-A	Extended Info-B
Disqualification	RM Fiber Cable Disconnect	–	–

Partner Network Connection Lost

If a partner network connection between a redundant chassis pair is lost, a state change or switchover can occur. These state changes can result:

- Primary with qualified secondary changes to primary with disqualified secondary.
- Qualified secondary with primary to disqualified secondary with primary.

To use the Event Log to determine if a lost partner network connection caused a state change, complete these steps.

1. Open the communication software and access the RMCT of the primary redundancy module.

   This chassis is the chassis that was previously the secondary but is now the primary.
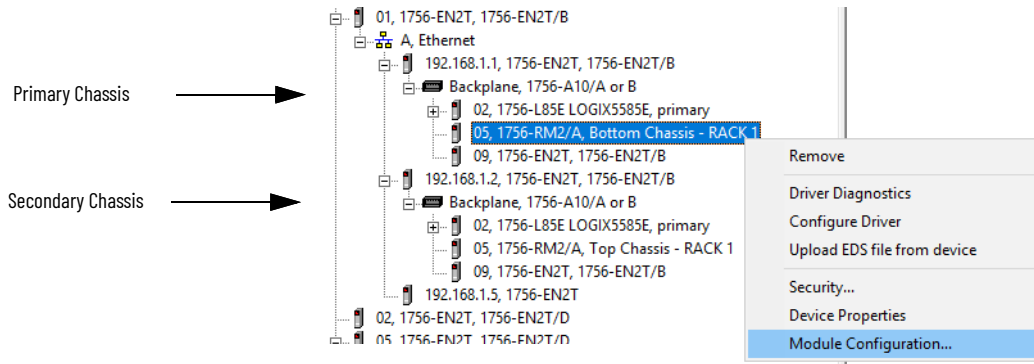
2. Locate the last event that indicates successful qualification and status.

Primary Chassis Event Log

3. Open the Event Log for the secondary chassis because the cause of the switchover is not apparent.

4. Use the time of the switchover event that is found in the primary chassis to identify the corresponding event in the secondary chassis.

   The switchover indicated in the primary chassis log occurred at 04:37:22.

Secondary Chassis Event Log

The corresponding events in the secondary chassis log indicate that the network is not attached and that the SYS_FAIL_LActive backplane signal is active. Both these events indicate an error in the connection of the Ethernet module to the network.

5. Confirm the Ethernet connection error by browsing the network in the communication software.

This node is no longer connected.

An attempt to access the secondary RMCT fails and this error is indicated.
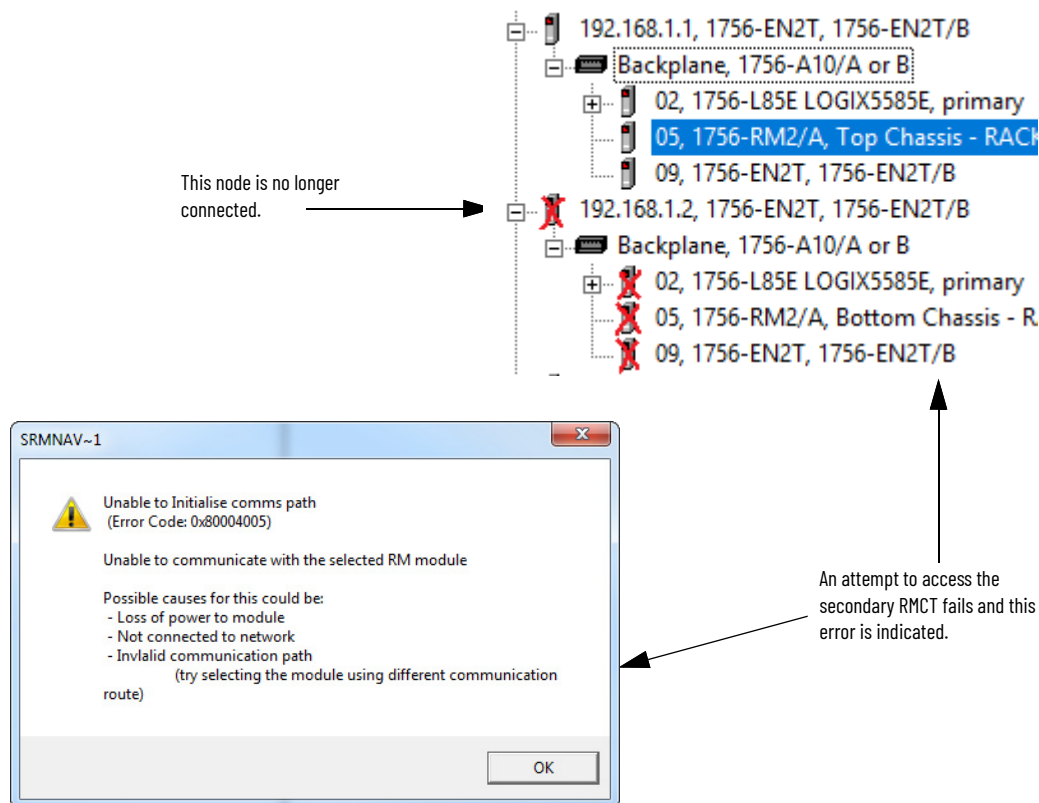
To recover from a EtherNet/IP™ network disconnection, perform the following:

*   Check all EtherNet/IP network and switch connections.
*   If the Auto-Synchronization parameter is not set to Always, use the commands in the Synchronization tab of the RMCT to synchronize your chassis.

For more information about troubleshooting EtherNet/IP network anomalies, see the EtherNet/IP Network Devices User Manual, publication ENET-UM006.

Redundancy Module Connection Lost

To determine if the connection between the redundancy modules caused a switchover or state change, open the Event Log of the redundancy module that is the primary.

The Event Log clearly indicates that one of the redundancy modules has been disconnected. In addition, the dimmed secondary chassis log indicates that the module is not connected.
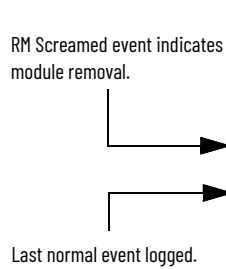
To resolve this anomaly, check the intermodule cable that connects the redundancy modules. Verify that it is properly connected and is not severed.

Also, if the Auto-Synchronization parameter of this system is not set to always, use the commands in the Synchronization tab to synchronize that chassis once the anomaly is resolved.

Redundancy Module Missing

To determine if a missing redundancy module caused a state change and switchover, access the Event Log of the chassis that is the primary chassis.

Figure 29 - Event Log with Partner RM Screamed Event

The redundancy module logs the Partner RM Screamed even just before it is disconnected. Depending on the cause of the missing module, the Partner RM Screamed event can fail to be logged before the module is lost.

You can also browse to the redundancy module in the communication software to determine if it is connected to the network. A red X over the redundancy module indicates that the module is not reachable.

Figure 30 - Missing Redundancy Module
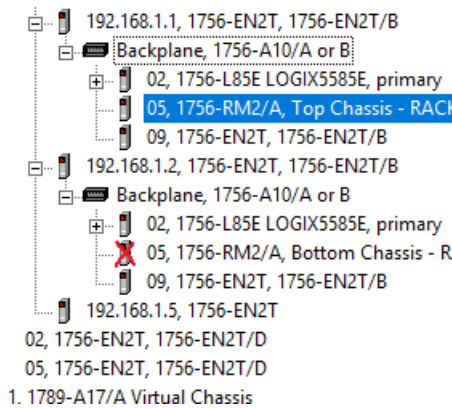
To correct the missing module anomaly, first verify that the redundancy module is correctly installed in the chassis and it is properly powered. Then check the intermodule cable that connects the redundancy modules.

After you have verified that the module is installed and powered, may need to synchronize the chassis by using the synchronization commands in the Synchronization tab. Use the synchronization commands if your Auto-Synchronization parameter for the chassis is not set to Always.

Qualification Aborted Due to a Non-redundant Controller

If you place a controller that is not enabled for redundancy into the redundant chassis, the qualification and synchronization fail. To determine if your synchronization failure is due to a non-redundant controller, complete these steps.

1. If not already open, open the RMCT of the primary module.
2. Click the Synchronization tab and view the Recent Synchronization Status Attempts log.

   The log indicates that there is a Module Configuration Error.
3. To view the description, select the aborted attempt.
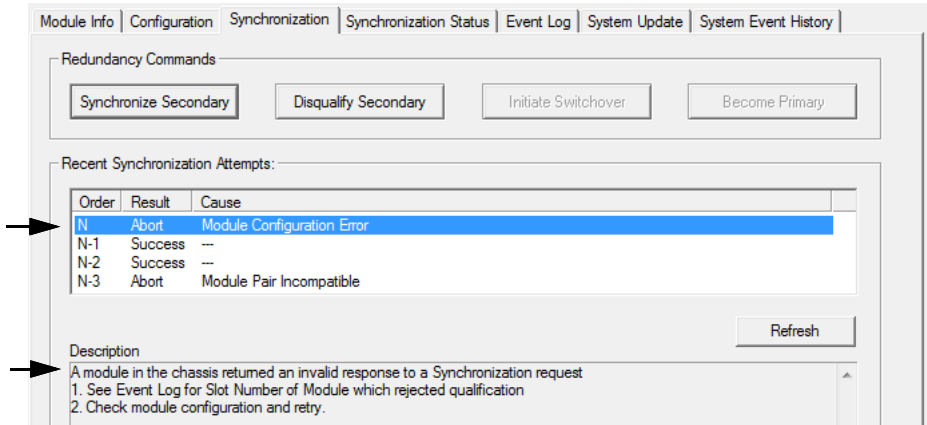
4. Click the Synchronization Status tab to check the compatibility between modules.
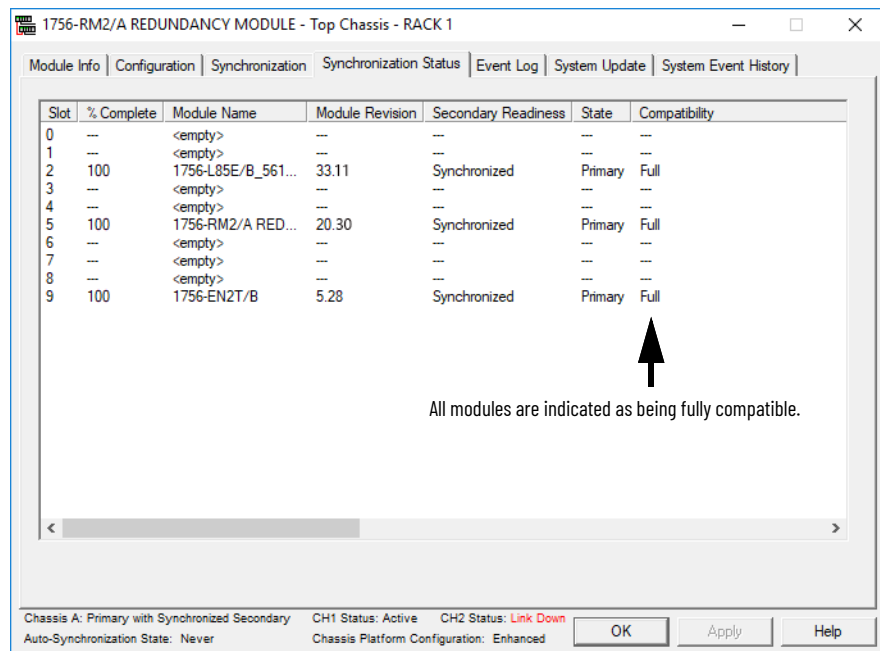
All modules are indicated as being fully compatible.

5. Open the programming software and go online with the primary controller in your system.

6. Open the controller properties and verify that Redundancy Enabled is checked.

This controller is not enabled for use in a redundant system.
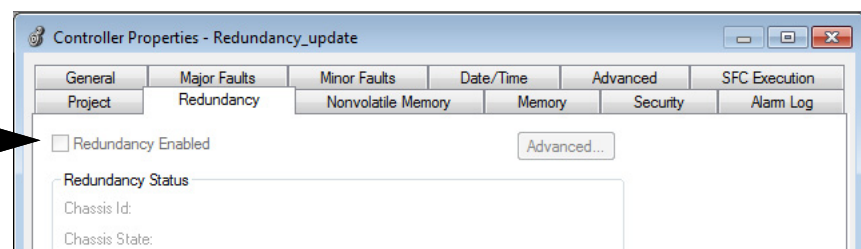
If Redundancy Enabled is **not** selected, then perform the following:

- Do one of the following:
- Remove the controllers that are not Redundancy Enabled.
- Enable the controller for redundancy and make other program changes to accommodate redundancy.
- After you remove or correct the Redundancy Enabled setting, attempt to synchronize your redundant system again.

Redundancy Module Status Indicators

The redundancy modules have these diagnostic status indicators.

1756-RM2 and 1756-RM2XT Status Indicators

Figure 31 - Redundancy Module Status Indicators for 1756-RM2 and 1756-RM2XT Modules
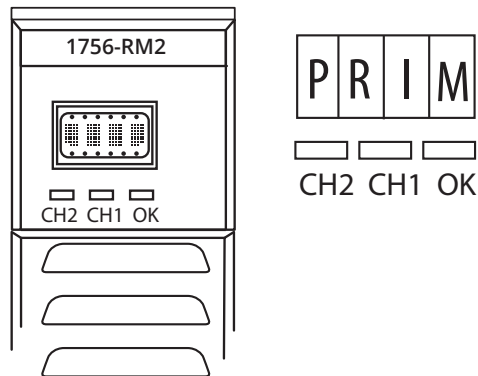
Module Status Display

The module status display provides diagnostic information.

Table 30 - Module Status Display

Module Status Display	Description
▨▨▨▨	Four-character display executing self-test at powerup. No action necessary.
Txxx	The redundancy module is executing a self-test at powerup. (xxx represents a hexadecimal test identification number.) Wait for self-test to finish. No action is required.
XFER	Application firmware update is in progress. Wait for firmware update to finish. No action is required.
ERAS	Boot mode - Erasing current redundancy module firmware
PROG	Flash mode - Updating redundancy module firmware Wait for firmware update to finish. No action is required.
????	Resolving initial redundancy module state Wait for state resolution to finish. No action is required.
PRIM	Primary redundancy module. The module is operating as the primary module. No action is required.
DISQ	Disqualified secondary redundancy module. Check the type and revision of the secondary partner module.
QFNG	Qualifying secondary redundancy module. Redundant system status. No action is required.
SYNC	Qualified secondary redundancy module. Redundant system status. No action is required.
LKNG	Secondary redundancy module that is in process of locking for update.
LOCK	Secondary redundancy module that is locked for update.
Exxx	Major fault has occurred (xxx represents an error or fault code, with the two least-significant characters in decimal). Use the Error ID code to diagnose and address the error. For more information on error codes, see Redundancy Module Fault Codes and Display Messages on page 127.
EEPROM Update Required	Onboard EEPROM is empty. Replace the module.
BOOT Erase Error	Error in erasing NVS device while updating boot image. Cycle power to the module. If the error persists, replace the module.
BOOT Program Error	Error in writing in NVS device while updating boot image. Cycle power to the module. If the error persists, replace the module.
APP Erase Error	Error in erasing NVS device while updating application image. Cycle power to the redundancy module. If the error persists, replace the module.
APP Program Error	Error in writing in NVS device while updating application image. Cycle power to the redundancy module. If the error persists, replace the module.

Table 30 - Module Status Display (Continued)

Module Status Display	Description
CONFIG Erase Error	Error in erasing NVS device while updating configuration log image. Cycle power to the redundancy module. If the error persists, replace the module.
CONFIG Program Error	Error in writing in NVS device while updating configuration log image. Cycle power to the redundancy module. If the error persists, replace the module.
EEPROM Write Error	Error in writing in EEPROM device while updating configuration log image. Cycle power to the redundancy module. If the error persists, replace the module.
Application Update Required	The module is running boot firmware. Download the application firmware that is obtained from the respective redundancy bundle.
ICPT	A test line on the backplane is asserted. Check if the error message goes away after removing each module, one at a time. If error persists, cycle power to the chassis, or replace the chassis.
!Cpt	All modules in the chassis do not belong to the same redundancy platform.
Untrusted Certificate Error	The 1756-RM2 and 1756-RM2XT modules use signed firmware. This error appears when either the contents of the downloaded certificate or its signature for the downloaded firmware is invalid.
Unknown[1]	Operating state is not yet determined.
Active[1]	Channel is operating normally as the active channel.
Redundant[1]	Channel is operating normally as the redundant channel.
Link Down[1]	Channel is disconnected. Several causes could be: – The cable is disconnected, broken, or damaged – The signal is attenuated – The connector is loose – The partner 1756-RM2 module is powered down or in a major fault state
No SFP[1]	No transceiver was detected. Several causes could be: – It has failed – It is loosely connected – It is not installed
SFP !Cpt[1]	Rockwell Automation does not support the transceiver.
SFP Fail[1]	The transceiver is in a failed state.

(1)   Can be present for either CH1 or CH2, but not both simultaneously.

SFP Error Message

Use only Rockwell Automation approved small form pluggable (SFP) tranceivers.

When an incompatible SFP is installed in the 1756-RM2 module, the
CH1/CH2 status indicator shows solid red and the RMCT software displays the following error
message in the status bar at the bottom of the screen: 'SFP !Cpt.'

OK Status Indicators

The OK status indicator reveals the current redundancy module state.

Table 31 - OK Status Indicator

Indicator State	Description
Off	No power is applied to the redundancy module. If necessary, apply power.
Solid red	One of these conditions exists: • The redundancy module is conducting a self-test during powerup. No action necessary. • The redundancy module has experienced a major shutdown fault. Cycle power to clear the fault. If the major fault does not clear, replace the module.
Flashing red	One of these conditions exists: • The redundancy module is updating its firmware. No action necessary. • The redundancy module has been configured improperly. Check the module configuration and correct any issues. • The redundancy module has experienced a major fault that can be cleared remotely using the RMCT.
Solid green	The redundancy module is operating normally. No action is required.
Flashing green	The redundancy module is operating normally but is not communicating with the other redundancy modules in the same chassis. If necessary, establish communication with the other redundancy module.

CH1 and CH2 Status Indicators

The CH1 and CH2 status indicators reveal the following module states.

Table 32 - CH1 and CH2 Status Indicators

Indicator State	Description
Off	One of these conditions exists: • No power • RM major fault • NVS update
Solid Green[1]	Channel is operating as the active channel.
Solid red	One of these conditions exists: • No transceiver plugged in • Faulted or failed transceiver detected • Transceiver with incorrect or vendor ID detected
Intermittent red	For 1 s, then off, indicates powerup.
Flashing red	One of these conditions exists: • Redundant channel error • No cable connection
Intermittent green[1]	On for 256 ms for each packet that is received, then off. Active operating channel. (Channel that is used for data communication between the partner 1756-RM2 modules.)
Flashing green[1]	Indicates that this channel is operating as the back-up channel and is ready to become the Active channel if the current Active channel fails.

(1)   Can be present for either CH1 or CH2, but not both simultaneously.

Redundancy Module Fault Codes and Display Messages

Redundancy modules can experience any of these faults.

Table 33 – Module Fault Codes

Fault Type	Description
Minor Recoverable	This fault type results in these conditions: • The fault does not stop redundancy operations and provides you with a recovery mechanism. • The module can clear some minor recoverable faults on its own.
Minor Nonrecoverable	This fault type results in these conditions: • The fault does not stop redundancy operations. • No recovery mechanism is available.
Major Recoverable	The fault impacts redundancy operations, although the effect is not always immediate. For example, if the fault occurred in the secondary redundancy module, the secondary chassis disqualifies and is not able to take over control if the primary redundancy module fails
Major Nonrecoverable	This fault type results in these conditions: • This is a critical fault. Redundancy operations cease. • A switchover can occur. • No recover mechanism is available. • The module can require replacement.

When the redundancy module experiences a fault, indication of that fault type is presented in these methods:

- Event log
- Module Status Display

IMPORTANT	This section describes a **subset of module fault codes** you can see in the event log or Module Status Display.
	If you see a fault code that is not included in this chapter, contact Rockwell Automation for assistance in troubleshooting that fault.

Event Log When Redundancy Module Experiences Fault

The redundancy module logs the fault type in its event log in NVS memory. You access the event log through the RMCT to troubleshoot the fault yourself or with assistance from Rockwell Automation Technical Support for troubleshooting the fault.

Module Status Display

A character string scrolls across the Module Status Display to indicate the fault type. The character string displays the fault type in either of these ways:

- Two to four-character word abbreviations
- Alpha numeric codes

This table describes the two to four-character word abbreviations.

Table 34 - Major Fault Code Messages

1st Word	2nd Word	3rd Word	4th Word	Error Description
CFG	LOG	ERR		Configuration log error. No action is required.
COMM	RSRC	ERR		Communication resource error. Reset the redundancy module.
COMM	RSRC	ERR	PRT1	Port1 Communication resource error on Backplane. Reset the redundancy module and check the chassis.
COMM	RSRC	ERR	PRT2	Port2 Communication resource error on redundancy link. Complete these tasks: 1. Reset the module. 2. Check the cable.
COMM	ERR	PRT1		Port1 Communication error, Backplane communication. Check or replace the chassis.
COMM	ERR	PRT2		Port2 Communication error on the redundancy link. Check or replace the single-mode cable.
COMM	ERR			General Communication Error. No action is required.
DUPL	RM			Duplicate redundancy module. This module is not in control. Remove this redundancy module.
EVNT	LOG	ERR		Event Log Error. No action is required.
FRMW	ERR			Firmware error. Update the firmware.
HDW	ERR			Hardware failure. Replace the module.
OS	ERR			Operating system error. Replace the module.
RM	PWR	DOWN		The redundancy module Power Down, Module detected a DC_Fail condition. Check the other modules in the chassis.
WDOG	ERR			Watchdog time out. Reset the module.
WDOG	FAIL			Watchdog task failed its status check. Replace the module.

The fault code is a four-character alphanumeric string. Valid characters are 0…9 and A through Z, except S and O. The first character is always E. Each firmware subsystem within the redundancy module is assigned a range of fault codes. Each subsystem assigns fault codes within its range. If you encounter one of these error codes, record the Exxx code and contact Rockwell Automation Technical Support.

Recovery Messages

For certain faults, the module status display provides recovery instructions. Up to four, four-character words are displayed.

Recovery Instruction Code	Description
RPLC MOD	Replace the redundancy module only.
RSET RM2	Reset the redundancy module only.
REMV MOD	Remove the redundancy module only.
SEAT MOD	Reinsert only the redundancy module into the chassis.

Convert from a Non-redundant System

When converting from a non-redundant to a redundant system, first consider the following:

- You can use only Studio 5000 Logix Designer® version 33 or later in a ControlLogix® 5580 redundant system.
- The redundant chassis pair has controller, communication module and I/O module restrictions.
- The program scan time can increase because of the additional time required for crossloading.

For more information:

- See .
- Replacement Guidelines: Logix 5000® Controllers Reference Manual, publication 1756-RM100.

Complete the tasks in this section to convert a non-redundant ControlLogix system to a redundancy system.

Update the Configuration in Programming Software

These steps provide an overview of the process that is required to update the I/O Configuration tree in the programming software.

7. I/O modules are not permitted in a redundant chassis. If you have I/O in the chassis with the controller, add a ControlLogix EtherNet/IP™ communication module to the appropriate network.

| IMPORTANT | The 1756-EN3TR EtherNet/IP communication modules are not supported in a redundant chassis. |
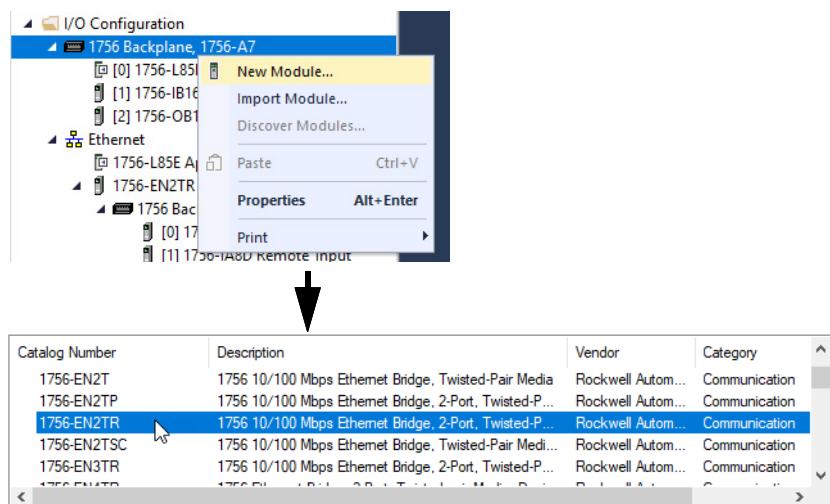
8. Since the I/O now has to reside in a separate chassis, add another EtherNet/IO adapter under the adapter you just created.

    You can now move the I/O modules to the new chassis in the I/O Configuration tree.

The I/O can be placed in this chassis.
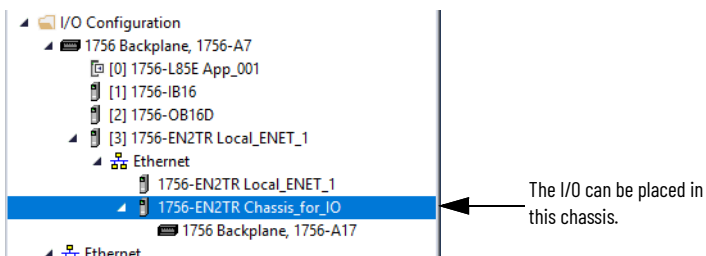
9. Copy the I/O modules and paste them into the chassis of the newly added communication module.

Paste I/O into the new EtherNet/IP® chassis.
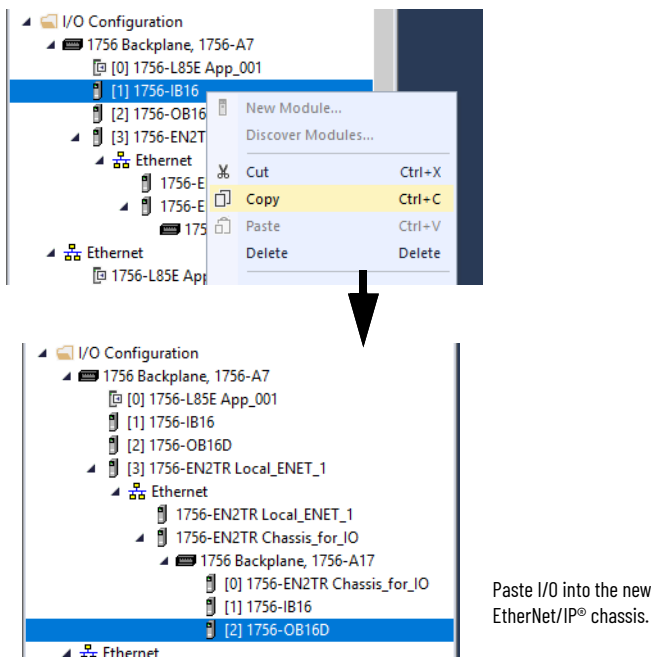
10. Delete the I/O modules from the controller chassis configuration.
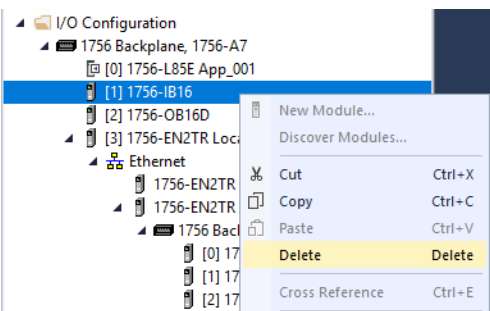
11. Since the font Ethernet port of the controller is disabled once you enable the controller for redundacy, you must first move any remote communications from the front port to an EtherNet/IP module in the local chassis.

12. Continue by completing the procedures to Replace Local I/O Tags and to Replace Aliases to Local I/O Tags.

Replace Local I/O Tags

If you have moved I/O modules out of the local controller chassis and into the remote I/O chassis, complete these steps to find and replace the local I/O tags in your program.

1. Open the routine where the local I/O tags must be updated.

2. Press CTRL+H to open the Replace in Routines dialog box.
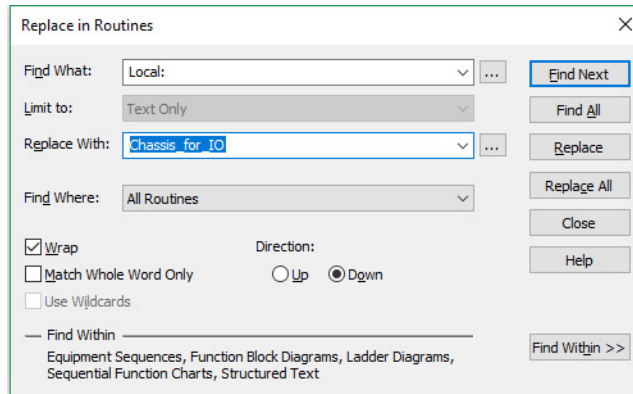
3. From the Find What pull-down menu, choose Local:.

4. From the Replace With pull-down menu, choose the name of the communication module where the remote I/O was placed.

5. From the Find Where pull-down menu, choose All Routines.

6. Click Find Within >>.

7. Select Ladder Diagrams.

8. Check Instruction Operands.
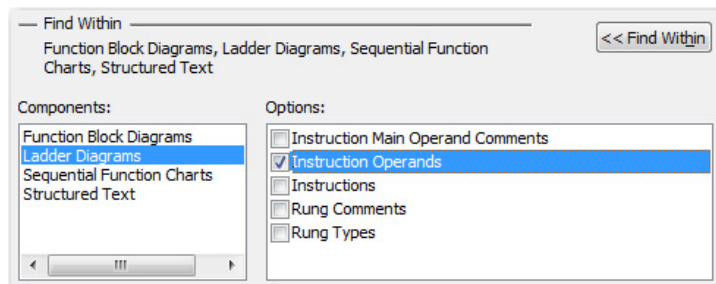
9. Click Replace All.

   The find/replace is completed and the results are indicated in the Search Results tab.

Replace Aliases to Local I/O Tags

If your program uses alias tags for the I/O modules that you are moving, complete these steps to replace alias tags.

1. In the programming software, open the Controller Tags.
2. Press CTRL+H to open the Replace Tags dialog box.
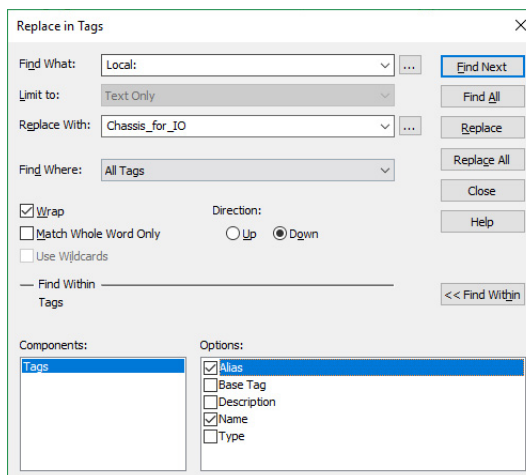
3. From the Find What pull-down menu, choose Local:.
4. From the Replace With pull-down menu, choose the name of the communication module where the remote I/O was placed.
5. From the Find Where pull-down menu, choose All Tags.
6. Click Find Within >>.
7. Select Alias and click Replace All.

   The Search Results tab indicates the changed tags.

Remove Other Modules from the Controller Chassis

If modules other than those modules listed in Table 1 on page 15 are in the controller chassis, you must remove them. You can use these modules in ControlLogix redundancy systems. Not all components are compatible with all redundancy system revisions. To make sure of component compatibility, see the release notes specific to your redundancy system revision in the PCDC at: http://www.rockwellautomation.com/global/support/pcdc.page.

Add an Identical Chassis

After you have configured your primary chassis with the modules that are listed in Table 1 on page 15, add an identical chassis that contains the same modules with the same module-placement.

Upgrade to Redundancy Firmware

Once you have made the appropriate changes to your system configuration and program, and have added the identical chassis, upgrade your system firmware.

For information about how to upgrade the redundant system firmware, see Configure Redundant Firmware on page 24.

Update the Controller Revision and Download the Project

After you upgrade the firmware, use programming software to access the controller properties and update the controller major revision to match the redundancy firmware major revision you are using.
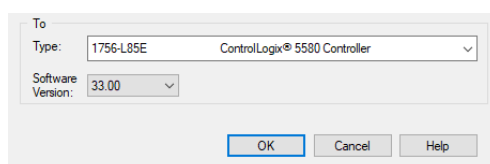
Once you have updated the controller firmware revision and saved the changes, download the updated program to the controller.

Redundancy Object Attributes

Table of Redundancy Object Attributes

Use this table of redundancy object attributes as a reference when programming to obtain the status of your redundancy system.

For this information	Get this attribute	Data Type	GSV/SSV	Description	
Redundancy status of the entire chassis.	ChassisRedundancyState	INT	GSV	**If**	**Then**
				16#2	Primary with synchronized secondary
				16#3	Primary with disqualified secondary
				16#4	Primary with no secondary
				16#10	Primary locked for update
Redundancy state of the partner chassis.	PartnerChassis RedundancyState	INT	GSV	**If**	**Then**
				16#8	Synchronized secondary
				16#9	Disqualified secondary with primary
				16#E	No partner
				16#12	Secondary locked for update
Redundancy status of the controller.	ModuleRedundancy State	INT	GSV	**If**	**Then**
				16#2	Primary with synchronized secondary
				16#3	Primary with disqualified secondary
				16#4	Primary with no secondary
				16#6	Primary with synchronizing secondary
				16#F	Primary locking for update.
				16#10	Primary locked for update
Redundancy state of the partner.	PartnerModule RedundancyState	INT	GSV	**If**	**Then**
				16#7	Synchronizing secondary
				16#8	Synchronized secondary
				16#9	Disqualified secondary with primary
				16#E	No partner
				16#11	Secondary locking for update
				16#12	Secondary locked for update
Results of the compatibility checks with the partner controller.	CompatibilityResults	INT	GSV	**If**	**Then**
				0	Undetermined
				1	No compatible partner
				2	Fully compatible partner
Status of the synchronization (qualification) process.	Qualification InProgress	INT	GSV	**If**	**Then**
				-1	Synchronization (qualification) is not in progress.
				0	Unsupported
				1...99	For modules that can measure their completion percentage, the percent of synchronization (qualification) that is complete.
				50	For modules that cannot measure their completion percentage, synchronization (qualification) is in progress.
				100	Synchronization (qualification) is complete.

For this information	Get this attribute	Data Type	GSV/SSV	Description	
Keyswitch settings of the controller and its partner match or do not match.	KeyswitchAlarm	DINT	GSV	**If**	**Then**
				0	• The keyswitches match OR • No partner is present.
				1	Keyswitches do not match
Position of the keyswitch of the partner.	PartnerKeyswitch	DINT	GSV	**If**	**Then the keyswitch is in**
				0	Unknown
				1	RUN
				2	PROG
				3	REM
Status of the minor faults of the partner (if the ModuleRedundancyState indicates that a partner is present).	PartnerMinorFaults	DINT	GSV	**This bit**	**Means this minor fault**
				1	Power-up fault
				3	I/O fault
				4	Problem with an instruction (program)
				6	Periodic task overlap (watchdog)
				10	Issue with the energy storage module
Mode of the partner.	PartnerMode	DINT	GSV	**If**	**Then**
				16#0	Power up
				16#1	Program
				16#2	Run
				16#3	Test
				16#4	Faulted
				16#5	Run-to-program
				16#6	Test-to-program
				16#7	Program-to-run
				16#8	Test-to-run
				16#9	Run-to-test
				16#A	Program-to-test
				16#B	Into faulted
				16#C	Faulted-to-program
In a pair of redundant chassis, identification of a specific chassis without regard to the state of the chassis.	PhysicalChassisID	INT	GSV	**If**	**Then**
				0	Unknown
				1	Chassis A
				2	Chassis B
Slot number of the redundancy module (1756-RM2) in this chassis.	SRMSlotNumber	INT	GSV		
• Size of the last crossload. • Size of the last crossload if you had a secondary chassis.	LastDataTransfer Size	DINT	GSV	This attribute gives the size of data that was or would have been crossloaded in the last scan in the number of DINTs (4-byte words). The secondary chassis does not have to be connected or online. If you do not have a secondary chassis, the number of DINTs that would have been crossloaded are indicated.	
• Size of the biggest crossload. • Size of the biggest crossload if you had a secondary chassis.	MaxDataTransfer Size	DINT	GSV SSV	This attribute gives the biggest size of the LastDataTransfer Size attribute in DINTs (4-byte words). The secondary chassis does not have to be connected or online. If you do not have a secondary chassis, the largest number of DINTs that would have been crossloaded are indicated. If you must reset this value, use an SSV instruction with a Source value of 0.	

Appendix **C**

Redundancy System Checklists

Chassis Configuration Checklist

✓	Requirement
	Chassis that is used for the redundant pair are the same size, for example, both are 1756-A7, 7-slot chassis.
	Use only one controller in each chassis.
	Only these modules are used in the redundant chassis pair: • Up to one ControlLogix® controllers, catalog numbers 1756-L81E, 1756-L81E-NSE, 1756-L81EK, 1756-L81EXT, 1756-L81EP, 1756-L82E, 1756-L82E-NSE, 1756-L82EK, 1756-L82EXT, 1756-L83E, 1756-L83E-NSE, 1756-L83EK, 1756-L83EXT, 1756-L83EP, 1756-L84E, 1756-L84E-NSE, 1756-L84EK, 1756-L84EXT, 1756-L85E, 1756-L85E-NSE, 1756-L85EK, 1756-L85EXT, 1756-L85EP • Up to seven EtherNet/IP™ communication modules, catalog numbers 1756-EN2F, 1756-EN2T, 1756-EN2TP, 1756-EN2TR, 1756-EN2TXT, 1756-EN4TR, 1756-EN4TRK, 1756-EN4TRXT. • One Redundancy module, catalog numbers 1756-RM2, 1756-RM2XT
	Each chassis of the pair is composed of identical modules that are of identical redundancy firmware revisions and catalog numbers.
	Partner modules are placed in same slots of both chassis of the redundant pair.
	I/O modules are **not** placed in the redundant chassis.

Remote I/O Checklist

✓	Requirement
	I/O is **not** placed in redundant chassis.
	I/O is connected to the redundant chassis by using EtherNet/IP connections to the same EtherNet/IP network as the redundant controller chassis, without bridging. If in the I/O tree of the redundancy controller, all I/O and consumed tag connections must be multicast connections. The I/O tree of the redundancy controller can contain produced unicast tags that remote devices consume.

Redundancy Module Checklist

✓	Requirement
	One redundancy module is placed in the same slot of each redundant chassis.
	A fiber-optic cable connects the redundancy modules in the redundant chassis pair. The following are catalog numbers of fiber-optic cable you can order from Rockwell Automation: • 1756-RMC1 (1 m, 3.28 ft) • 1756-RMC3 (3 m, 9.84 ft) • 1756-RMC10 (10 m, 32.81 ft) If necessary, you can make your own fiber-optic cable that is up to 10 km (32,808.40 ft) for the 1756-RM2 module.

ControlLogix Controller Checklist

✓	Requirement
	Identical ControlLogix controllers are placed in the same slot of both chassis of the redundant pair.
	Partnered controllers are identical in firmware revision.

EtherNet/IP Module Checklist

✓	Requirement
EtherNet/IP Module	
	Identical EtherNet/IP communication modules are placed in the same slot of both chassis of the redundant chassis pair.
	EtherNet/IP communication modules are one of these catalog numbers: • 1756-EN2F, 1756-EN2T, 1756-EN2TP, 1756-EN2TR, 1756-EN2TXT, 1756-EN4TR, 1756-EN4TRK, 1756-EN4TRXT
EtherNet/IP Network	
	Redundancy systems support unicast produced tags. Unicast consumed tags are **not supported** in redundancy systems.
	USB ports of communication modules in the redundant chassis are **not** used while the system is running (online).
	IP addresses of devices on the EtherNet/IP network are static and IP address swapping is enabled.[1]
	The partner EtherNet/IP communication modules must be able to communicate to each other over the Ethernet network.
EtherNet/IP HMI	
	Data server communication recovery time is the time during a switchover from primary to secondary, when tag data from the controller is unavailable for reading or writing. See Data Server Communication Recovery Time Reduction During a Switchover on page 19.
	• PanelView™ Standard terminal • None (the use of the PanelView Standard terminal in a redundant system requires the same considerations as a non-redundant system). • PanelView Plus terminal, VersaView® industrial computer that runs a Windows CE operating system • FactoryTalk® Linx software, version 3.0 or later, is used. • FactoryTalk View SE software with FactoryTalk Linx software • FactoryTalk Linx software, version 3.0 or later is used. • IP address swapping is used.[1] • HMI and both redundant chassis are on the same subnet.

(1)   Other IP address configurations are permitted, but require additional considerations. For more information, see IP Address Swapping on page 29.

Project and Programming Checklist

Also see the <u>ControlLogix Controller Checklist</u> on <u>page 135</u>.

✓	Requirement
	The Redundancy Module Date and Time has been set by using the RMCT (this in not required, but strongly recommended).
	One project is created by using programming software and is downloaded to the primary controller.[1]
	Enable redundancy on the Redundancy tab of the Controller Properties dialog box. This is the only setting within Controller Properties dialog box required for redundancy to function. The configurable settings on other tabs within Controller Properties dialog box are optional, and not required for redundancy to function.
	Time synchronization is not required for redundancy to function. If your application requires Time synchronization, then: • Enable Time synchronization on the Date/Time tab of the Controller Properties dialog box. • Select Time Sync and Motion on the Module Definition dialog box for the Ethernet module that is located in the local chassis.
	Task configuration is either: • One continuous task within the project. **or** • Multiple periodic tasks with only one task at the highest priority. Also, multiple tasks are structured at all different priorities and periods so that the fewest possible separate tasks are used.
	The redundant controller program does **not** contain: • Event tasks. • Inhibited tasks.
	Programming specific to critical I/O that must be bumpless is placed in the highest-priority user task according to your task configuration. **If you use this task structure** / **Then programming specific to bumpless I/O is in** One continuous task / The continuous task. One continuous task and one or more periodic tasks / The highest-priority periodic task where only that one task is at the highest priority. Multiple periodic tasks / The highest-priority periodic task where only that one task is at the highest priority.
	To calculate watchdog time for ControlLogix 5580 controllers, see <u>Minimum Value for the Watchdog Time on page 63</u>.
	Scan time is minimized by using these techniques when possible: • Unused tags are eliminated. • Arrays and user-defined data types are used instead of individual tags. • Redundancy data is synchronized at strategic points by using the Synchronize Data after Execution setting in the Program Properties dialog box. • Programming is written as compactly and efficiently as possible. • Programs are executed only when necessary. • Data is grouped according to frequency of use.
	For produced/consumed data, the communication module in the remote chassis that holds the consuming controller uses the Comm Format: None.
	Critical messages from a remote chassis to redundant chassis use cached connections.
	Active tags on scan per controller are less than 10,000 tags/second.
	Perform measurements of potential alarm bursts during system commissioning and make changes in the commissioned project if measured scan times are not acceptable

(1) The project that is loaded on the primary controller is automatically crossloaded to the secondary controller when synchronization occurs.

Notes:

Online Firmware Update Considerations

Overview

This appendix provides instructions for updating firmware in a powered-up and running ControlLogix® 5580 redundancy system. This update is known as **Redundancy System Update** (RSU).

You can access release notes for each redundancy firmware revision from the Rockwell Automation [Product Compatibility and Download Center](#) (PCDC).

RSU Requirements

Redundancy System Update (RSU) restrictions only matter when attempting to upgrade the redundancy system while running. If the system is being modified offline and downloaded then the system can go directly to the firmware of interest.

There are a few general guidelines to follow when attempting to utilize the RSU feature:

- RSU can only update redundancy bundles to other redundancy bundles.
- RSU can only be used to go up one major revision at a time. This may require going through the RSU process multiple times depending on the jump being made with the update
- RSU can only be used to update modules to newer firmware bundles.
- RSU **cannot** move a redundancy system to an older bundle.
- RSU **cannot** be used to upgrade a redundancy system to a new family of processor Example: If you're using a 1756-L7x controller you cannot use RSU to upgrade to a 1756-L8x controller.
- The firmware of every module in the system needs to be either at the same revision or higher in the bundle being updated to. See the Knowledgebase Technote *ControlLogix: Redundancy Firmware Bundle Revision History*.
- You must use this process if you are upgrading a redundancy system to revision 33.011_kit2 or later.
- A replacement ControlLogix 5580 controller must have memory equal to or greater than the memory in the original ControlLogix 5580 controller.

If the lock for update fails when attempting to use RSU, see the Knowledgebase Technote *Lock for Update Fails*.

Redundancy System Update Migration Paths

General Rules:

- Going to a later minor revision and/or kit is acceptable.
- Going to the next major revision is acceptable.
- Going through more than one major revision requires you to perform the RSU process multiple times.

Redundancy System Update Migration Path Limitations

From Firmware Revision	Firmware Revision Updates Not Allowed	Firmware Revision Updates Conditionally Not Allowed[1]
33.011_kit1	–	–
33.011_kit2	–	–
33.012_kit1	–	–
33.015_kit1	–	–
33.015_kit2	–	34.011_kit1
34.011_kit1	–	–
34.011_kit2	–	35.011_kit1
35.011_kit1	–	–
35.011_kit2	–	–
35.011_kit3	–	–
36.011_kit1	–	–

(1)   Depending on the modules used in the local rack, you may not be able to update the system with RSU. See Knowledgebase Technote *ControlLogix: Redundancy Firmware Bundle Revision History* to see which modules are at an older firmware in the newer redundancy bundle.

Before You Begin

Before you update products in a ControlLogix® redundancy system, you must first:

- Download and install the compatible versions of the Studio 5000 Logix Designer® application, communication software, and ControlFLASH Plus™ software.
- Understand the <u>Redundant Chassis Requirements on page 22</u>.
- <u>Install the Firmware Bundle on page 22</u>.
- <u>Install the Redundancy Module Configuration Tool on page 23</u>.

Verify Your Redundancy Module Configuration Tool (RMCT) Version

IMPORTANT	• The RMCT launches at the version that is compatible with the 1756-RM2 or 1756-RM2XT redundancy module firmware that is installed. You must update your RMCT version and the redundancy module firmware revision so it is compatible with the new RMCT version. If you do not perform this update, the About dialog box will not reflect the new RMCT version. • You must uninstall any existing version of the Redundancy Module Configuration Tool (RMCT) before you install the RMCT, version 8.06.03 or later. If you do not uninstall the previous version, you can have difficulty if you try to uninstall version 8.06.03 or later at another time.

Complete these steps to check or verify the version of the RMCT you have installed.

1. Launch the communication software.
2. Click the RSWho icon.

If Module Configuration is not available in the list of options, a compatible version of the RMCT has not been installed.

3. Right-click your redundancy module and choose Module Configuration.
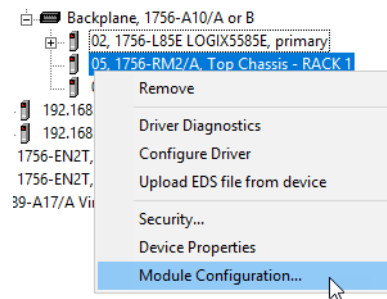
The Module Configuration dialog box opens.

4. Right-click the title bar and choose About.
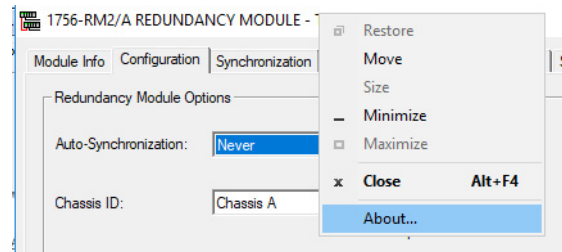
The About dialog box opens and indicates the RMCT version.
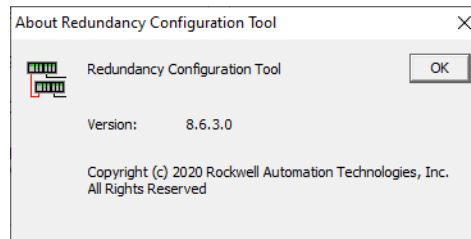
Prepare the Controller Project for the Update

Use this section to upgrade to a major controller firmware revision, upgrade to a controller with more memory, and/or to upgrade a communication module.

To prepare the controller project and controllers for the update, complete these steps.

1. Start the Logix Designer application, and select your redundancy project.
2. Go online with the primary controller.
3. To make sure that your offline project has the latest updates, or in case you do not have an offline file, upload the project from the primary controller.
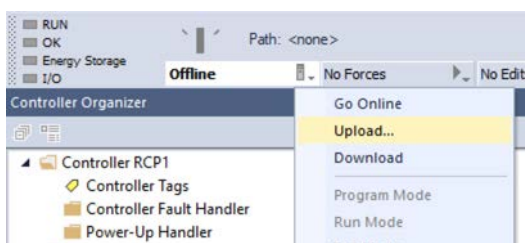
4. Verify that the watchdog time is set to a value that corresponds with the requirements of the redundancy system revision and your application.
5. Cancel or assemble any pending test edits.
6. Remove all sequential function chart (SFC) forces from the project.
7. Verify that no changes are required for the following:
   - I/O forces
   - I/O configuration

IMPORTANT	After this step, changes to I/O cannot be made until after the redundancy system revision update is complete and both chassis are synchronized.

8. Save the project.
9. Go offline.
10. Click Controller Properties.
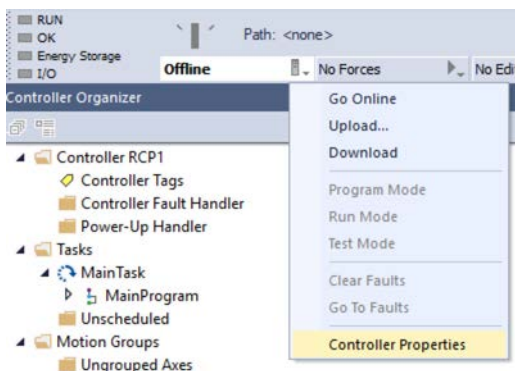
11. Click Change Controller.
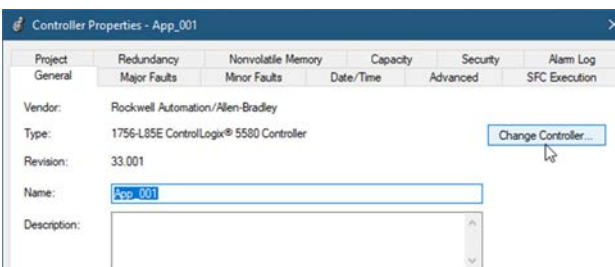
12. Specify the controller catalog number and controller revision that you are upgrading to.
13. If you install a new controller while upgrading the secondary chassis firmware, specify the new controller catalog number.
14. Click OK.

    The Logix Designer application converts the project to the later revision.

15. If applicable, access the Module Properties for each communication module in the chassis and specify the module firmware revision that you are upgrading to.
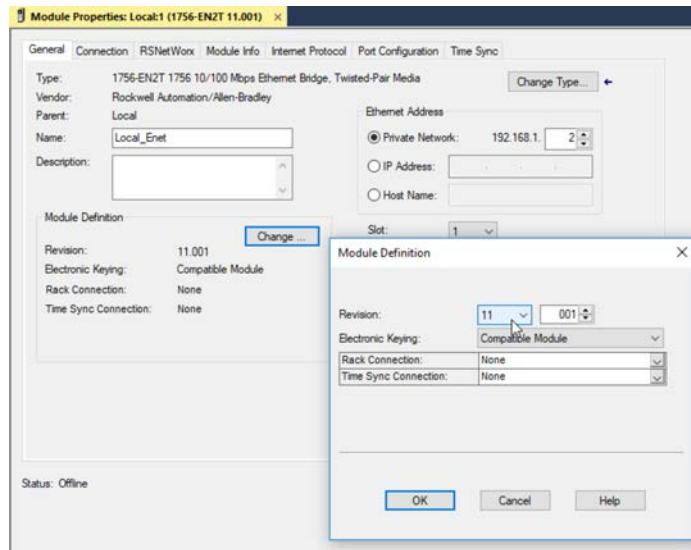
> If you are unable to specify the new revision, you must change the Electronic Keying parameter to Compatible Module. You must also select the highest available firmware revision.

16. Save the project.

17. Continue with .

Update the Redundancy System Firmware

You can update redundancy firmware to another revision while your process continues to run.

Before You Begin

Consider these points before you begin upgrading your redundancy system to a new revision:

- During the update procedures, you cannot use the programming software to change the mode of the controller. Instead, use the keyswitch on the front of the controller.

- Remember the following when completing the tasks described in the rest of this section:

  - Do not change the project other than with changes that are identified in these tasks.

  - Verify that no one else is also changing the project.

  - Do not use a FactoryTalk® Batch Server to change equipment phase-states when upgrading your redundancy system.

Complete the steps in this table to update your redundancy system from one redundancy system revision to another redundancy revision while your process continues to run.

Task	Page
Prepare the Redundant Chassis for the Firmware Update	144
Update the Redundancy Module Firmware in the Primary Chassis	145
Update Redundancy Module Firmware and Other Module Firmware in the Secondary Chassis	145
Lock the System and Initiate a Switchover to Update	146
Update the New Secondary Chassis Firmware	148
Synchronize the Redundant Chassis	148

> ⚠️ **WARNING:** While you complete the processes to update the redundancy system firmware, you will not have a redundant system. The controller runs the machinery without a backup until the update is completed.

Prepare the Redundant Chassis for the Firmware Update

Complete these steps to prepare both the primary and secondary redundant chassis for redundancy firmware updates.

1. Set the keyswitch of the primary and secondary controllers to REM.

   If the redundant controllers in both chassis of the redundant chassis pair are not in Remote RUN (REM) mode, the redundancy firmware update cannot be completed.

2. Open the communication software and browse to the redundancy module.

3. To open the RMCT, right-click the redundancy module and choose Module Configuration.
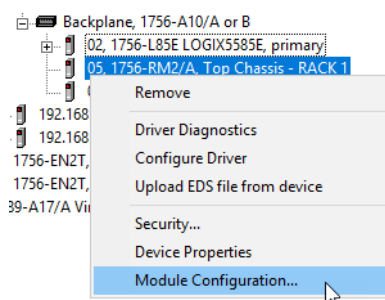
4. Click the Configuration tab in the RMCT.

5. From the Auto-Synchronization pull-down menu, choose Never.
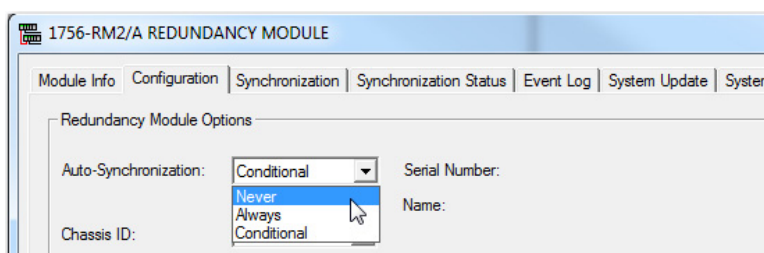
6. Click Apply, and then click Yes.

7. Click the Synchronization tab.
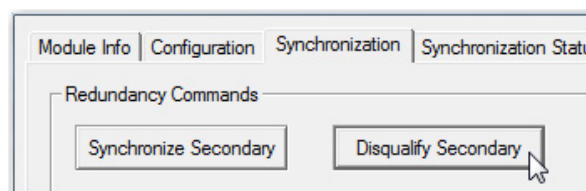
8. Click Disqualify Secondary.

9. On the RMCT Confirmation dialog, click Yes.
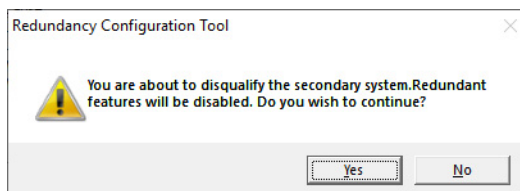
The secondary chassis is disqualified as indicated by the RMCT at the bottom-left of the RMCT and on the status display of the redundancy module.

Status in RMCT ⟶

Chassis A: Disqualified Secondary with Primary
Auto-Synchronization State: Never

10. Click OK, and close the RMCT.

    If you close the RMCT, it helps prevent a timeout from occurring when the firmware of the redundancy module is updated.

11. Continue with <u>Update the Redundancy Module Firmware in the Primary Chassis on page 145</u>.

Update the Redundancy Module Firmware in the Primary Chassis

Make sure that the primary chassis is powered on. If you have to power on the chassis, wait at least 45 seconds after powerup before you begin the update. During this time, the redundancy module conducts internal power-up sequence operations and is not ready for an update.

Use ControlFLASH Plus software to upgrade the firmware of each module in each chassis. For information on how to use ControlFLASH Plus software, see the ControlFLASH Plus Quick Start Guide, publication <u>CFP-QS001.</u>

Complete these steps to update the redundancy module firmware in the primary chassis.

1. Launch ControlFLASH Plus software.
2. Upgrade the 1756-RM2 redundancy module.
3. Once the firmware upgrade is complete, verify that the redundancy module status displays PRIM, which indicates a successful upgrade.
4. Close ControlFLASH Plus software.

Update Redundancy Module Firmware and Other Module Firmware in the Secondary Chassis

Make sure that the secondary chassis is powered on. If you have to power on the chassis, wait at least 45 seconds before you begin the secondary update. During this time, the redundancy module conducts internal power-up sequence operations and is not ready for an update.

Complete these steps to update the firmware in the secondary chassis.

1. If you want to replace your module hardware, remove the module from the secondary chassis and replace it with the new module. See <u>Module Replacement Considerations on page 151</u>.

| **IMPORTANT**	When replacing communications modules, make sure that rotary switches and Port Configuration for Ethernet modules match the existing modules.
	If you replace EtherNet/IP modules as part of this redundancy update, make sure that you have read through and are familiar with the <u>Module Replacement Considerations on page 151</u>.

1. Launch ControlFLASH Plus software.
2. Upgrade the 1756-RM2 redundancy module.
3. Update the rest of modules in the secondary chassis.
4. Close ControlFLASH Plus software.

5. Download the project to the secondary controller.

IMPORTANT   When you download a project that has I/O forces enabled, the application prompts you to enable or disable forces after the download completes.

   After the locked switchover, the forces are whatever you selected (enabled or disabled).

---
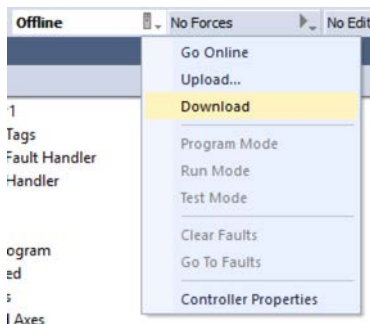
6. After the download is complete, go offline.

You are now ready to lock the system and initiate a locked switchover to update the primary chassis. Continue with .

Lock the System and Initiate a Switchover to Update

Once you have downloaded the controller project, complete these steps to lock the system and initiate a switchover.

IMPORTANT   Remain offline with your controller while completing these steps.

- Once you have locked the system, do not abort the system lock. Aborting the system lock during this procedure clears the project from the secondary controller.
- Do not disconnect any communication cables while completing these steps.
- Completing a locked switchover causes SFC instructions to be reset to their initial state. This action can cause the SFC instructions to execute twice.

---

1. In the communication software, right-click the redundancy module in the primary chassis and choose Module Configuration to open the RMCT.
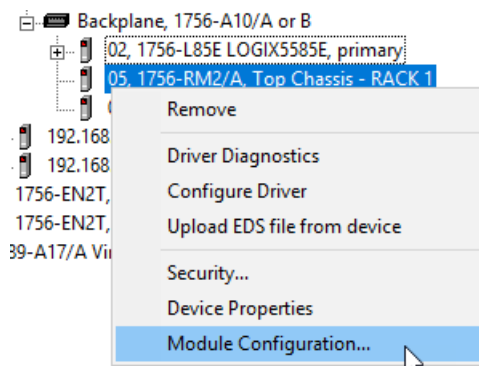
2. Click the System Update tab.
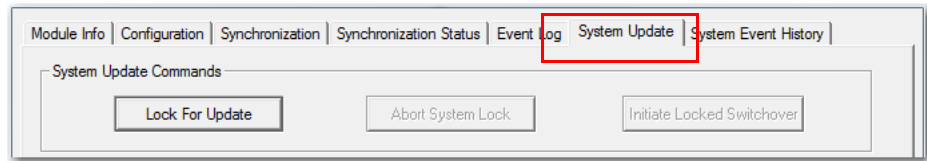
3. Click Lock For Update, and then click Yes at the Redundancy Configuration Tool dialog box.
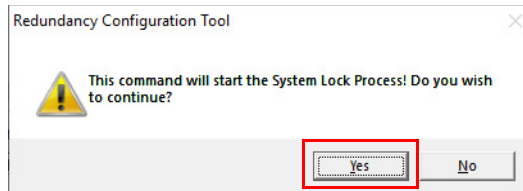
4. Wait for the system to lock.

   The System Update Lock Attempts log indicates when the system lock is complete.

IMPORTANT   For errors associated with Lock For Update, see Knowledgebase Technote *Lock for Update Fails*.

---

5. Click Initiate Locked Switchover, and then click Yes at the Redundancy Configuration Tool dialog box.
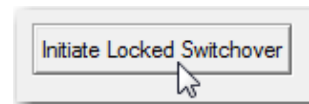
   Your secondary chassis assumes control and becomes the primary chassis. When the switchover is complete, the Locked Switchover Attempts log indicates success.

   The text in chassis status row indicates the switchover state in combination with the log.

   Once your locked switchover is complete, update the firmware revisions for modules in the new secondary chassis.

IMPORTANT   After the locked switchover, the new secondary controllers no longer contain a user application and their configuration settings are reset to the factory-default settings.

   The new secondary controllers use the default settings, and the components in the secondary chassis are updated and the system is synchronized.

---

6. On the RMCT, click OK.

Update the New Secondary Chassis Firmware

To update the firmware of all modules in the new secondary chassis, complete these steps.

1. If you are replacing and upgrading your module hardware, remove the module from the secondary chassis and replace it with the new module.

| **IMPORTANT** | When replacing communications modules, make sure that the rotary switches and port configuration for Ethernet modules match the existing modules. |
| | If you replace EtherNet/IP communication modules as part of this redundancy update, make sure that you have read through, and are familiar with, the Module Replacement Considerations on page 151. |

---

2. Launch ControlFLASH Plus software.
3. Upgrade each communication module in the new secondary chassis, including controllers, if applicable.
4. Close ControlFLASH Plus software.

Once you replace and/or update the firmware for each of the modules in the new secondary chassis, continue with Synchronize the Redundant Chassis on page 148.

Synchronize the Redundant Chassis

To synchronize the redundant chassis after firmware in both chassis have been updated to the same revision, complete these steps.

1. In the communication software, right-click the 1756-RM2 or 1756-RM2XT module in the primary chassis and choose Module Configuration to open the RMCT.
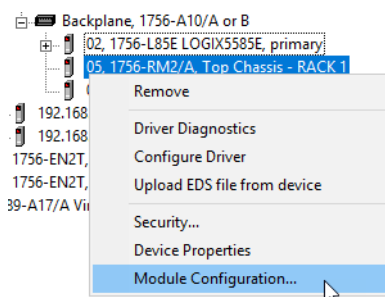
2. On the Synchronization tab, click Synchronize Secondary.
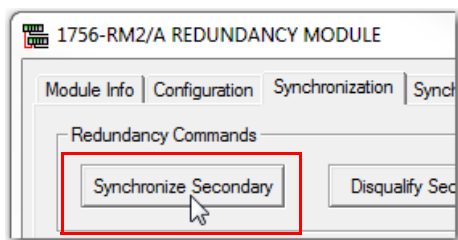
3. On the RMCT Confirmation dialog, click Yes.
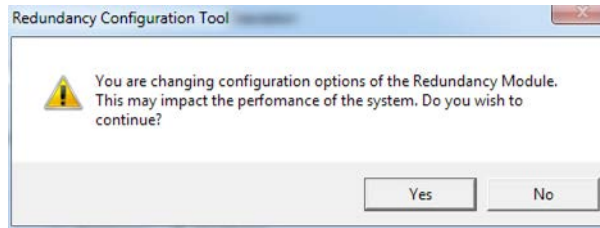
Wait for synchronization to complete.

Steps 4...8 are only applicable if the Ethernet switches are set between 2...254.

4. Initiate a switchover.
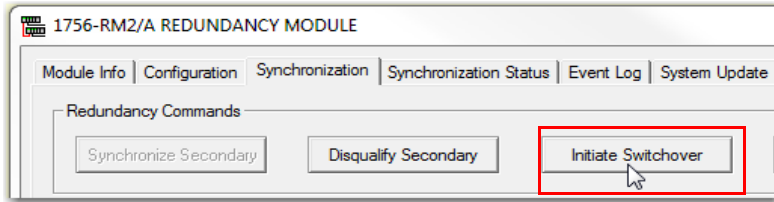
5. In the new secondary, set the rotary switches back to the original configuration.

6. Repeat this process for all Ethernet modules that need the rotary switches set back to 2...254.

7. From the Auto-Synchronization pull-down menu, choose the option that suits your application.
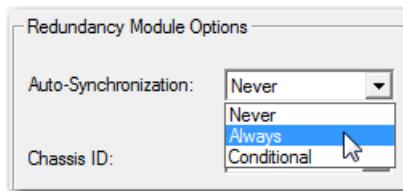
8. If Conditional configuration is applied above, manually synchronize the chassis.
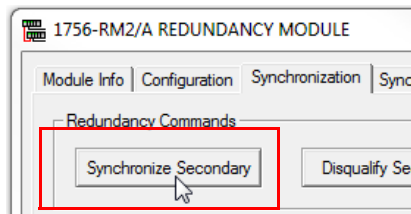
9. Set the redundancy module date and time according to your preference.

10. Click OK.

11. Close the RMCT.

EDS Files

If you see modules that are displayed in the communication software with yellow question marks, the EDS files for the modules are not registered. You can right-click on the module and proceed with the "Upload EDS files from device" wizard to upload the EDS file. If this option is not available or as an alternative, follow this link to obtain the EDS files for modules in your system: Electronic Data Sheets (EDS).

1. Download the required EDS file.

2. Choose Start > Programs > Rockwell Software® > EDS Hardware Installation Tool.

   The tool then prompts you to Add or Remove EDS files.

Your redundant system firmware update is now complete.

Notes:

Module Replacement Considerations

Before You Begin

When replacing modules in ControlLogix® redundancy systems, there are considerations for these situations:

- Replace a module in the secondary chassis.
- Replace an EtherNet/IP™ communication module.
- Replace a 1756-RM2 or 1756-RM2XT module with a new 1756-RM2 or 1756-RM2XT module.

In a redundant system, modules can be replaced, and firmware can be updated using either of the following methods:

- **Method 1:** Modules are replaced and firmware is updated while the redundancy system is powered up and the controllers are left in RUN mode. In this case, this appendix applies.
- **Method 2:** If you power down the redundancy system or take controllers out of RUN mode to replace modules, then this method is similar to a new installation and this appendix does not apply. Instead, see <u>Configure the Redundancy Modules on page 37</u>.

Replace a Module in the Secondary Chassis That Has the Same Catalog Number and Firmware Revision

These steps are used when performing a direct module replacement. For example, use these steps when replacing a communication module in the secondary chassis with a module that has the same:

- Catalog number
- Series
- Firmware (after updating the firmware, if necessary)

| IMPORTANT | When you replace communication modules, make sure that the rotary switches and port configuration for EtherNet/IP modules match the existing modules. |

---

1. Using the Redundancy Module Configuration Tool (RMCT):
   a. Set Auto-Synchronization to Never.
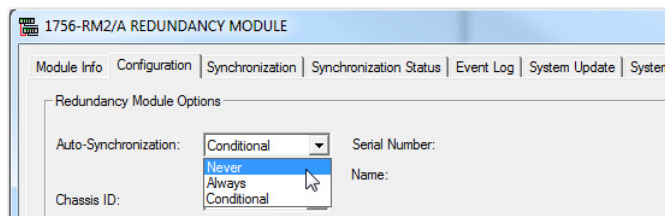
   b. Disqualify the redundant chassis pair (if not already disqualified).
2. Remove the module from the secondary chassis and replace it with the new module.
3. If applicable, update the module firmware by using ControlFLASH Plus™ software.

4. In the RMCT, from the Auto-Synchronization pull-down menu, choose your preferred method.
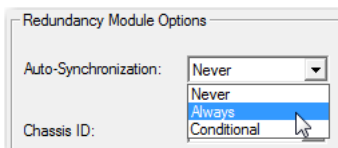
5. If necessary, manually synchronize the chassis.
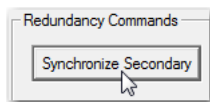
Replace an EtherNet/IP Module with a New Series

This section describes how to replace EtherNet/IP communication modules in a redundancy system without the need for a controller update.

You can replace the EtherNet/IP modules by using the following methods:

- Synchronization and Switchover for EtherNet/IP Modules

  Use this method if Electronic Keying is not set to Exact match.
- Online Firmware Update Considerations

  Use this method if Electronic Keying is set to Exact Match. You must configure the new modules to use Exact Match.

IMPORTANT	Consider the following:
	• Before replacing modules, make sure that you have the correct firmware for all new modules.
	• When you replace modules, you must do so in pairs or the system cannot synchronize after a switchover.
	• Partnered pairs of EtherNet/IP modules must use the same values for the following parameters for IP address swapping to work: IP addresses, Network mask, Gateway address

---

Synchronization and Switchover for EtherNet/IP Modules

Complete these steps to replace EtherNet/IP modules with new series modules.

1. Make sure the existing module and replacement module use the same IP, Network Mask, and Gateway addresses.
2. Make sure that the RMCT is at a version compatible with your redundancy bundle.
3. Make sure that the redundancy module firmware is at the firmware revision for the specified bundle for only 1756-RM2 and 1756-RM2XT modules.
4. Go online with the primary controller.
5. For each module, verify that the Electronic Keying is set to Compatible Module or Disable Keying.
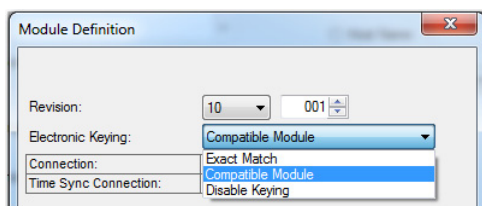
6. In the communication software, start the RMCT for the redundancy module in either chassis.
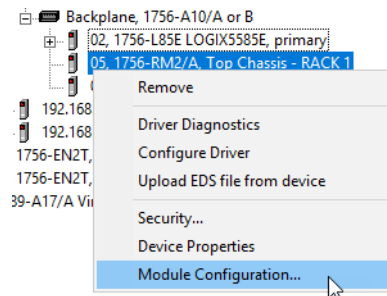
7. On the Configuration tab, from the Auto-Synchronization pull-down menu, choose Never.
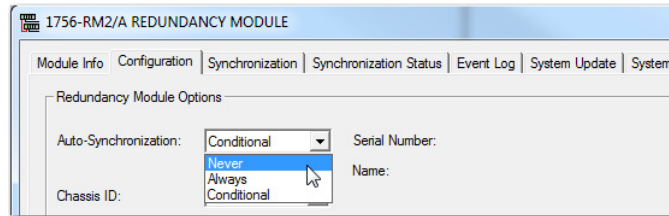
8. Click Apply.

9. On the Synchronization tab, click Disqualify Secondary.
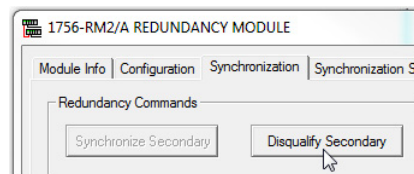
10. Make a note of the Port Configuration of the secondary Ethernet module.
    - IP address
    - Network Mask
    - Gateway address
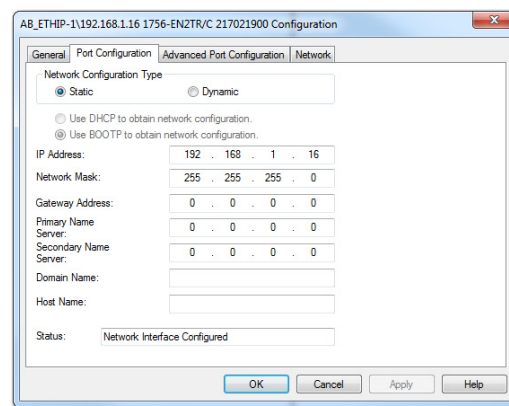
11. Disconnect the Ethernet cables from the secondary Ethernet module.

12. Turn off power to the secondary chassis.

13. Remove the EtherNet/IP module from the secondary chassis.

14. Set the switches on the new EtherNet/IP module to 888, insert the module in the secondary chassis, and apply power to the chassis.

    a. After the reset is complete, turn power off to the secondary chassis, remove the module from the secondary chassis.

    b. Set the switches to the same settings as on the module that was removed.

    c. Reinsert the module into the secondary chassis, reattach the cable, and apply power to the secondary chassis.

    d. To support bridging across the backplane (or via the USB port), configure the Port Configuration of the secondary module to match the Port Configuration of the primary module.

15. If you have not already done so, update the firmware of the new EtherNet/IP module.

16. After the update completes, connect the Ethernet cable to the secondary Ethernet module, and wait for communication to resume on the network.

17. Repeat steps <u>10</u>…<u>15</u> for all EtherNet/IP modules in the secondary chassis.

Complete these steps to verify module compatibility and synchronization.

1. At the Synchronization status tab, verify that the Synchronization Status tab indicates that the modules are fully compatible.
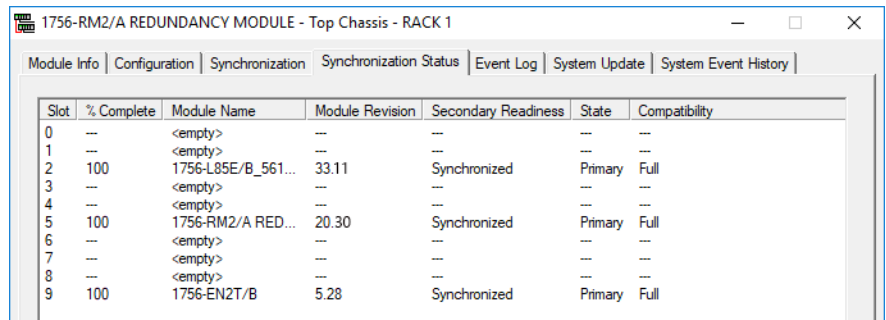
2. On the Synchronization tab, synchronize the secondary chassis.
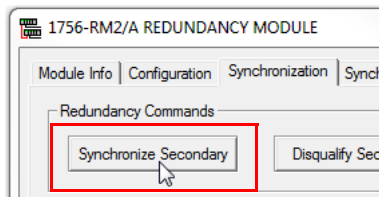
    Wait for synchronization to complete.

3. Initiate a switchover.
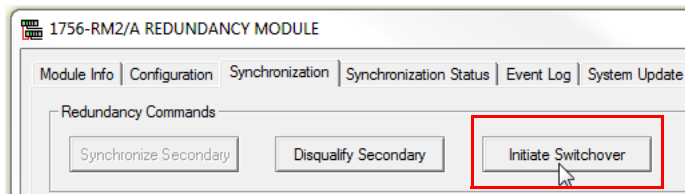
4. Disconnect the Ethernet cables from the secondary Ethernet module.

5. Turn off power to the secondary chassis.

6. Remove the module from the secondary chassis.

7. Set the switches on the new EtherNet/IP module to 888 and insert it in the secondary chassis.

   a. After the reset is complete, remove the module from the secondary chassis.

   b. Set the switches to the same settings as on the module that was removed.

   c. Reinsert the module into the secondary chassis, reattach the cable, and apply power to the secondary chassis.

   d. To support bridging across the backplane (or via the USB port), configure the Port Configuration of the secondary module to match the Port Configuration of the primary module.

   e. If you have not already done so, update the firmware of the new EtherNet/IP module.

8. Repeat the steps [4](#)...[7](#) for all EtherNet/IP modules in secondary chassis.

9. On the Configuration tab, from the Auto-Synchronization pull-down menu, choose Always.
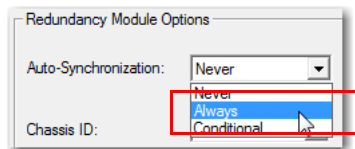
10. Click Apply, Yes, and OK.

11. Verify that the secondary chassis has qualified.

Replace a 1756-RM2 Module with a 1756-RM2 Module

You can replace 1756-RM2 modules with 1756-RM2 modules without initiating a switchover.

1. Install the compatible version of the RMCT software.

   You must shut down the communication software to install the RMCT software, and then restart the communication software after the installation is complete.

2. On the RMCT Configuration tab, from the Auto-Synchronization pull-down menu, choose Never.

3. Disqualify the redundant chassis pair (if not already disqualified) by using the RMCT.

4. Unplug the fiber cable or cables from both of the redundancy modules.

5. Close any open RMCT sessions that are connected to the current redundancy modules that are being replaced.

6. Remove the redundancy module pair (in any order) from the redundant chassis.

7. Insert the 1756-RM2 redundancy module pair (in any order) in the redundant chassis into the same slots as the previous redundancy modules.

8. If not already installed, use the communication software to upload the EDS file for the 1756-RM2 module. If needed, obtain the EDS file for the 1756-RM2 module.

   Follow the procedure that is described in [EDS Files on page 149](#)

9. Update the primary and secondary 1756-RM2 modules to the appropriate firmware revision (in any order).

10. Reconnect the fiber cable on either CH1 or CH2 of the 1756-RM2 redundancy module.

11. Optional: Connect a second fiber cable on the remaining channel for fiber redundancy.

12. Wait for at least 45 seconds after connecting the fiber cables.

13. Launch the RMCT again for the newly installed 1756-RM2 modules.

14. On the RMCT Configuration tab, from the Auto Synchronization pull-down menu, choose your original setting.

15. Synchronize the system again (if it is not already qualified) by using the RMCT.

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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UNITED KINGDOM: Rockwell Automation Ltd., Pitfield, Kiln Farm, Milton Keynes, MK11 3DR, United Kingdom, Tel: (44)(1908) 838-800, Fax: (44)(1908) 261-917