Modicon Quantum

Change Configuration On The Fly User Guide

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ WARNING

UNGUARDED MACHINERY CAN CAUSE SERIOUS INJURY

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only the user can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine; therefore, only the user can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, the user should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

START-UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book

At a Glance

Document Scope

This manual provides information on the Quantum Change Configuration On The Fly (CCOTF) function.

The CCOTF function is for:
- Standalone systems
- Hot Standby systems

Validity Note

This document is valid for Unity Pro V8.0 or later.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the model number/product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of Documentation	Reference Number
Modicon Quantum Hot Standby System User Manual	35010533(English), 35010534(French), 35010535(German), 35013993(Italian), 35010536(Spanish), 35012188(Chinese).
Quantum Ethernet I/O Global System Planning Guide	S1A48959 (English), S1A48961 (French), S1A48962 (German), S1A48964 (Italian), S1A48965 (Spanish), S1A48966 (Chinese)
Quantum Ethernet I/O Ethernet Remote I/O Modules Installation and Configuration Guide	S1A48978 (English), S1A48981 (French), S1A48982 (German), S1A48983 (Italian), S1A48984 (Spanish), S1A48985 (Chinese)
Quantum Operating System, Upgrade and Update procedure	EIO000000006402 (English)

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Part I
Introduction to Quantum Change Configuration On The Fly

Overview

This part describes the Change Configuration On The Fly (CCOTF) function in Quantum systems.

What Is in This Part?

This part contains the following chapters:

Chapter 1
CCOTF Presentation

Overview

This chapter describes the Quantum CCOTF function and compatibilities.

What Is in This Chapter?

This chapter contains the following sections:

Section 1.1
CCOTF General Information

Overview

This section presents general requirements for the Quantum CCOTF function.

What Is in This Section?

This section contains the following topics:

General Requirements for Quantum CCOTF

Overview

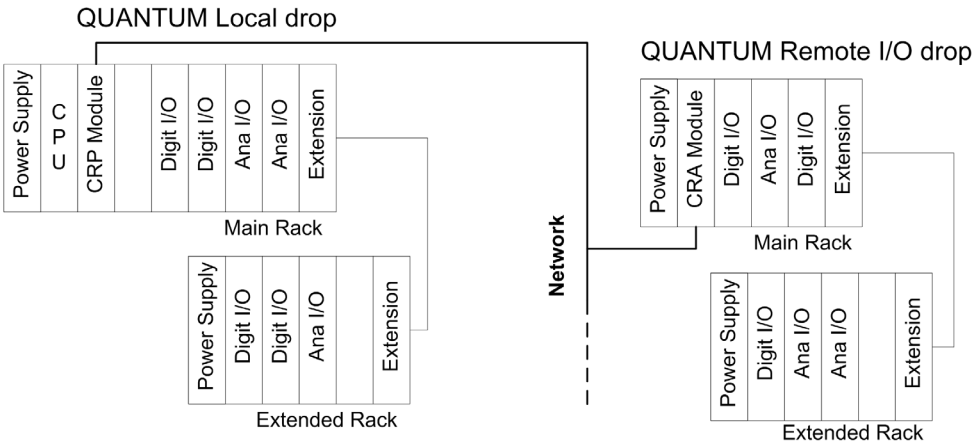
CCOTF allows modifications of a PLC I/O configuration in RUN mode.

The changes that can be made in the local drop or a S908 RIO drop are as follows:
- add a discrete or analog module in a free slot
- delete a discrete or analog module
- modify the configuration and adjustment parameters of a module

The changes that can be made in an Ethernet IO drop are as follows:
- add a Quantum or Modicon M340 EIO drop
- add a discrete or analog module in a free slot
- delete a discrete or analog module
- modify the configuration and adjustment parameters of a module

The RIO drops management in a Quantum system is based on:
- a network:
  - S908 network *(see Quantum with Unity Pro, Hardware, Reference Manual)* in an S908 Quantum system
  - Ethernet network *(see Quantum EIO, Remote I/O Modules, Installation and Configuration Guide)* in a Quantum Ethernet I/O Quantum system
- communication modules:
  - a CRP module, placed in the local drop
  - a CRA module, placed in each RIO drop

The following graphic shows an example of Quantum standalone architecture with a Quantum RIO drop:



Hardware Requirements

The CCOTF function is not available for safety Quantum PLCs.

Unity Pro Requirements

The minimum Unity software versions required to use CCOTF in a:

- Standalone system is:
  - Local drop or S908 RIO drops: Unity Pro XL, XLS 5.0 or higher
  - Quantum Ethernet IO drop: Unity Pro XL 6.0 or higher
  - Modicon M340 Ethernet IO drop: Unity Pro XL 7.0 or higher
- Hot Standby system is:
  - Local drop with S908 RIO drops: Unity Pro XL, XLS 4.1 or higher
  - Local drop with Quantum Ethernet IO drops: Unity Pro XL 6.0 or higher
  - Local drop with Modicon M340 Ethernet IO drops: Unity Pro XL 7.0 or higher

Firmware Requirements

The minimum firmware versions required to use the CCOTF function with a local or S908 RIO drop are:

Module Type	Reference	Firmware Version
Standalone CPU	140 CPU 311 10	SV2.80 or later
	140 CPU 434 12A/U	SV2.80 or later
	140 CPU 534 14A/B/U	SV2.80 or later
	140 CPU 651 50	SV2.80 or later
	140 CPU 651 50 S	SV2.80 or later
	140 CPU 651 60	SV2.80 or later
	140 CPU 652 60	SV2.80 or later
	140 CPU 658 60	SV3.20 or later
Hot Standby CPU	140 CPU 671 60	SV2.70 or later
	140 CPU 672 60	SV2.80 or later
	140 CPU 672 61	SV2.80 or later
	140 CPU 678 61	SV3.20 or later
S908 RIO module	140 CRA 93x 00	SV2.00 or later **NOTE:** Modules PV03 and later can be upgraded *(see page 50)* to allow CCOTF function.
	140 CRP 93x 00	SV2.00 or later **NOTE:** Modules PV01 and later can be upgraded to allow CCOTF function.

The minimum firmware versions required to use the CCOTF function with an Ethernet IO drop are:

Module Type	Reference	Firmware Version	CCOTF Function
Standalone CPU	140 CPU 651 50	• SV3.00 or later • SV3.10 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	Limited
	140 CPU 651 60	• SV3.00 or later • SV3.10 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	Limited
	140 CPU 652 60	• SV3.00 or later • SV3.10 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	Full
	140 CPU 658 60	• SV3.20 or later	Full
Hot Standby CPU	140 CPU 671 60	• SV3.00 or later • SV3.10 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	Limited
	140 CPU 672 60	• SV3.00 or later • SV3.10 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	Full
	140 CPU 672 61	• SV3.00 or later • SV3.10 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	Full
	140 CPU 678 61	• SV3.20 or later	Full

Module Type	Reference	Firmware Version	CCOTF Function
Ethernet IO module	140 CRP 312 00	• SV1.00 or later • SV2.00 or later (to manage add Ethernet IO drop + Modicon M340 Ethernet IO drops)	
	140 CRA 312 00	• SV1.00 or later	
	BMX CRA 312 10	• SV1.00 or later	

CCOTF function level description:

- Limited: 1 x 140 CRP 312 •• module in the system, no add drop functionality, 16 Ethernet IO drops maximum
- Full: 1 x 140 CRP 93x 00 (S908) + 1 x 140 CRP 312 •• (EIO) modules in the system, add drop functionality, 31 Ethernet IO drops maximum.

General Advice for Using CCOTF

Recommendation

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Do not manipulate a module that is supplied by a dangerous voltage. Read and understand the preventive measures that are described in the Grounding and Electromagnetic Compatibility of PLC Systems *(see Grounding and Electromagnetic Compatibility of PLC Systems, Basic Principles and Measures, User Manual)* user manual.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

RISK OF UNEXPECTED EQUIPMENT BEHAVIOR

Before doing any CCOTF modification, ensure that your system responds appropriately. Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

Take these recommendations into account before adding an Ethernet RIO drop or adding / removing a module from the local or RIO drop:

- Adding an Ethernet RIO drop in a Quantum Ethernet I/O system:
  - configure the Ethernet RIO drop in Unity Pro
  - connect the Ethernet RIO drop in the system
  - write the sequences of application program to manage the new Ethernet RIO drop
- Adding a module in the Unity Pro configuration:
  - configure the module in Unity Pro
  - plug the module in the hardware configuration
  - write the sequences of application program to manage the new module
- Removing a module from the configuration:
  - remove the sequence of application program that is related to the removed module
  - unplug the module from the hardware configuration
  - remove the module from the Unity Pro configuration

Quantum System Configuration Overview

A Quantum configuration can have:

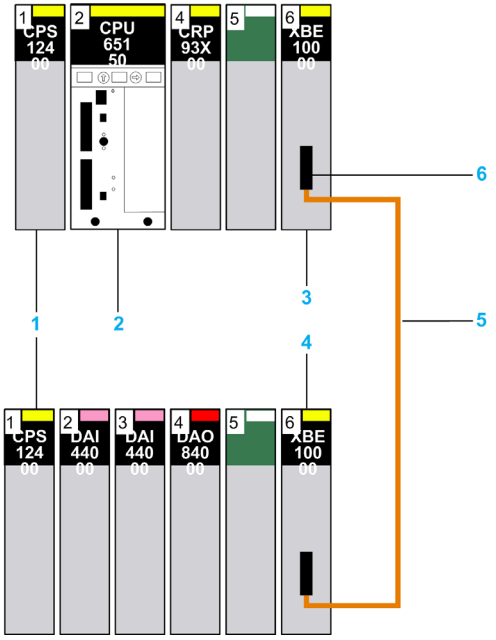
- a local drop and S908 Remote I/O drops in an S908 system
- a local drop and Ethernet Remote I/O drops in a Quantum Ethernet I/O system
- a local drop with S908 Remote I/O drops and Ethernet Remote I/O drops

The local drop and each remote I/O drop can be made of two racks (backplanes):

- The Main (Primary) rack contains the CPU and the Remote I/O drop adapter
- The Extended (Secondary) rack is linked to the main rack with two backplane expanders

CCOTF modifications can be performed on the main rack or the extended rack.

The picture below shows the elements that can be part of a Quantum drop:



1 Power Supplies (140 CPS ••• ••)
2 CPU (140 CPU ••• ••) or RIO adapter
3 First backplane Expander (140 XBE 100 00)
4 Second backplane Expander (140 XBE 100 00)
5 Backplane expander Cable (140 XCA 717 0•)
6 Cable end marked as “Primary”

Number of CCOTF Modifications

Validating a CCOTF modification requires a **Build Changes** in Unity Pro.

The number of CCOTF modifications allowed in one CCOTF transaction (a transaction is defined by the operations done between two **Build Changes**) depends on the system:

- In a local drop or S908 RIO drops, 1 modification is allowed by transaction.
- In a Quantum Ethernet RIO drop:
  - 1 add Ethernet RIO drop is allowed by transaction
  - 4 add or 4 delete modules modifications are allowed by transaction (in the same drop)
  - 1 parameter modification is allowed by transaction (in the same drop)
- In a Modicon M340 Ethernet RIO drop:
  - 1 add Ethernet RIO drop is allowed by transaction
  - 4 add or 4 delete modules modifications are allowed by transaction (in the same drop)
  - Parameters (Configuration or Adjustment) modifications are allowed on 4 channels of the same module, in the same drop, by transaction.
    A parameter modification on 1 channel causes this channel to be reset.
  - 1 Modicon M340 Ethernet RIO drop module application specific function parameter modification is allowed by transaction (BMX EHC ••• module only)

The number of modifications allowed is available in both the **Standard connected mode** as well as in the **Virtual connected mode** *(see Unity Pro, Operating Modes)*.

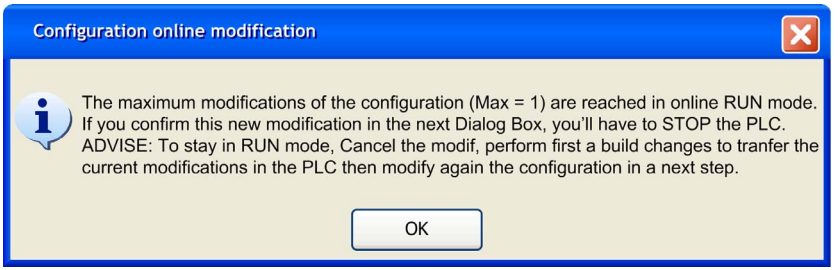
The number of CCOTF modifications allowed in a transaction respect a hierarchy:

- An add Ethernet RIO drop allows to add various module and modify the modules parameter within the same transaction.
- An add module in an Ethernet RIO drop allows to modify the added module parameters within the same transaction. 3 other modules can be added within the same transaction.
- A parameter modification performed on a Modicon M340 channel in an Ethernet RIO drop allows parameters modifications to be performed on 3 other channels on the same module, in the same drop, within the same transaction.
  No higher level CCOTF modification is allowed within the same transaction: no add or delete module nor add drop are authorized after an initial parameter modification. A **Build Changes** must be performed before performing a higher level CCOTF modification.

To perform more than one CCOTF transaction it is necessary to proceed in several steps:

- perform a **Build Changes**
- transfer the current modifications in the PLC before doing next modifications.

The picture below shows what happens if the number of allowed CCOTF modifications is exceeded in a Quantum system with S908 RIO drops:



NOTE: A CCOTF modification is valid with these two actions:

- Adding / Deleting / Modifying a module or adding an Ethernet RIO drop in the Unity Pro configuration screen is carried out.
- Performing a **Build Changes** of the modifications.

Example of a CCOTF Modification

Recommended CCOTF modification procedure:

Step	Action
1	Insert a new module in a free slot of the Unity Pro configuration screen.
2	Modify the parameters of this module.
3	Validate the parameters modification.

NOTE: These 3 actions are considered as one CCOTF modification and require one build change to be considered as a completed transaction.

NOTE: Program modifications (add, delete or modify a sequence of code) are not considered part of the CCOTF modification. Only I/O configuration modifications (if they are allowed) are counted as CCOTF modifications.

Section 1.2
CCOTF Allowed Actions and Diagnosis

Overview

This section describes CCOTF allowed actions and System Words and Bits for a Quantum local drop, S908 RIO drop and Ethernet RIO drop.

What Is in This Section?

This section contains the following topics:

Local Drop and S908 RIO Drop Allowed Actions and Diagnosis

CCOTF Allowed Actions

These actions can be done on discrete or analog modules in a Quantum local drop and a Quantum S908 RIO drop (both main or extended racks) that are in the RUN mode:

- Add a module in a drop:
  - Add a new module
  - Copy/Paste a module in the same S908 RIO drop.
    The Copy/Paste is done from and to the main or extended drop rack. The new module has the parameter values of the copied module.
- Delete a module from a drop
- Modify module parameters

NOTE: It is not possible to move a module with the CCOTF function.

Unity Pro Connection Ports

The table below indicates the possible connection points for CCOTF modifications, which depend on the physical connection link between the computer and the Quantum system:

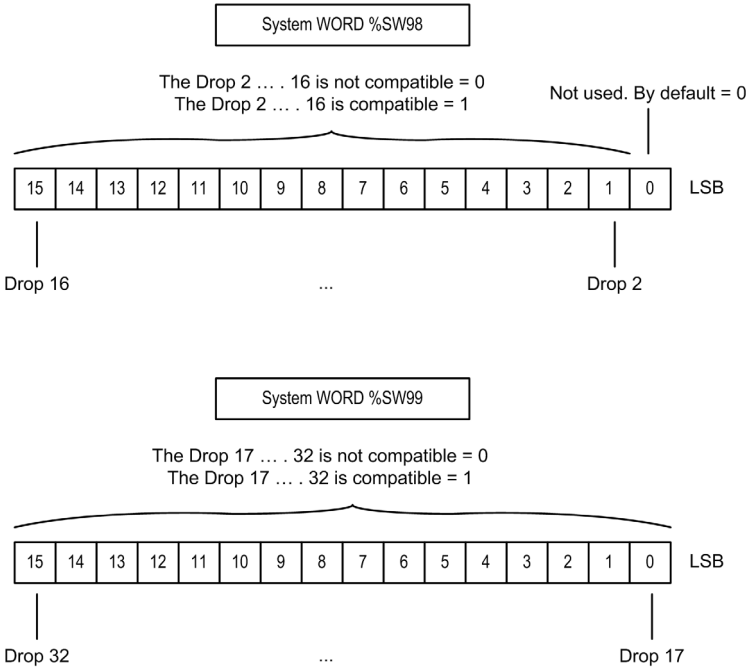
Physical link	Module available for connection
Modbus Serial	140 CPU ••• module
Modbus Plus	140 CPU ••• module
USB	140 CPU ••• module
Ethernet	140 CPU ••• module (if available)
	140 NOE ••• communication module

%SW98 and %SW99 S908 CRA Module Compatibility System Words

NOTE: All S908 RIO drops configured in the S908 RIO bus must be CCOTF compatible. This means that the corresponding bits in the system word `%SW98` and `%SW99` must be set to 1. No CCOTF modification is allowed if one of the S908 RIO drops configured in the S908 RIO bus is not CCOTF compatible.

NOTE: 800 Series I/O and Sy/Max I/O are not CCOTF compatible. When the CCOTF function is configured, neither 800 Series I/O nor Sy/Max I/O must be connected to the S908 RIO bus.

The following graphic shows the content of %SW98 and %SW99 system Status Register words *(see Unity Pro, Program Languages and Structure, Reference Manual)* used to diagnose the S908 CRA modules compatibility:



%SW100 CCOTF Modifications Counting System Word

The system word %SW100 *(see Unity Pro, Program Languages and Structure, Reference Manual)* is incremented each time a CCOTF modification is performed in the local drop or in an S908 RIO drop.

The system word value is reset to 0 on each transition from STOP to RUN mode.

%SW100 = XXYY, where:

- XX is incremented each time a CCOTF modification is done in RUN mode in an S908 RIO drop,
- YY is incremented each time a CCOTF modification is done in RUN mode in the local drop.

Status Bits

The status bit of a module is set to 0 while the module is configured but not present. The status bits are in the system words %SW180 to %SW339 *(see Unity Pro, Program Languages and Structure, Reference Manual)*. This impacts the system bits %S118 *(see Unity Pro, Program Languages and Structure, Reference Manual)* or %S119 *(see Unity Pro, Program Languages and Structure, Reference Manual)* and %S10 *(see Unity Pro, Program Languages and Structure, Reference Manual)* for local and S908 RIO drops.

On the other hand, when a parameter is changed, the module is re-started and status bit is set to 0 during several ms. This also impacts the system bits `%S118` or `%S119` and `%S10` for local and S908 RIO drops.

NOTE: When adding, deleting or modifying parameters in one module, the other modules available in the system are not impacted and their status bit remain at 1.

Ethernet RIO Drop Allowed Actions and Diagnosis

CCOTF Allowed Actions

These actions can be done in a Quantum Ethernet RIO system that is in the RUN mode:

- Add a Quantum or Modicon M340 Ethernet RIO drop
- In a Quantum Ethernet RIO drop (both main or extended racks):
  - Add a new module *(see page 31)* in a drop
  - Copy/Paste a module *(see page 31)* in the same Ethernet RIO drop.
    The Copy/Paste is done from and to the main or extended drop rack. The new module has the parameter values of the copied module.
  - Delete a module *(see page 31)* from a drop
  - Modify module *(see page 31)* parameters
- In a Modicon M340 Ethernet RIO drop (both main or extended racks):
  - Add a new module *(see page 32)* in a drop
  - Copy/Paste a module *(see page 32)* in the same Ethernet RIO drop.
    The Copy/Paste is done from and to the main or extended drop rack. The new module has the parameter values of the copied module.
  - Delete a module *(see page 32)* from a drop
  - Modify module *(see page 32)* parameters
  - Modify module application specific function parameter (BMX EHC ••• module only)

NOTE: It is not possible to move a module with the CCOTF function.

Unity Pro Connection Ports

The table below indicates the possible connection points for CCOTF modifications, which depend on the physical connection link between the computer and the Quantum system:

Physical link	Module available for connection
Modbus Serial	140 CPU ••• module
Modbus Plus	140 CPU ••• module
USB	140 CPU ••• module
Ethernet	140 CPU ••• module (if available)
	140 NOE 771 •• communication module
	140 CRA 312 00 module on a Quantum Ethernet RIO drop or BMX CRA 312 10 module on a Modicon M340 Ethernet RIO drop (service port) (1.).
	Dual ring switch located in the Ethernet RIO network main ring (1.).
	Switches located in the Ethernet RIO network sub-rings (1.).
1. **NOTE:** A configured 140 NOC 780 00 distributed I/O head module must be interlinked with the 140 CRP 312 00 remote I/O head module in the local drop.	

NOTE: Customers may use 140 NOE 771 •• modules on the local rack instead of the 140 NOC 780 00 DIO head module.

%SW66 Ethernet RIO CCOTF Status Word

The system word %SW66 *(see Unity Pro, Program Languages and Structure, Reference Manual)* holds the Ethernet RIO CCOTF function status.

`%SW66` = XXYY, where:

- XX is associated with the Ethernet RIO CCOTF status code (Succeed, Not completed, etc.).
- YY is associated with the Ethernet RIO CCOTF processing status (Idle, In progress, Completed, etc.).

%SW101 Ethernet RIO CCOTF Modifications Counting System Word

The system word %SW101 *(see Unity Pro, Program Languages and Structure, Reference Manual)* is incrementing each time an Ethernet RIO drop CCOTF modification is performed in a PLC.

The system word value is reset to 0 on cold-start, warm-start or after an application download.

`%SW101` = XXYY, where:

- XX is reserved.
- YY is incrementing each time an Ethernet I/O configuration modification is done in RUN mode.

%SW152 to %SW153 Ethernet RIO Drop Error Status System Words

The %SW152 to %SW153 Quantum system words *(see Unity Pro, Program Languages and Structure, Reference Manual)* hold the Ethernet RIO drops error status.

%SW641 to %SW702 Ethernet RIO Drop Modules Health Status System Words

The %SW641 to %SW702 Quantum system words *(see Unity Pro, Program Languages and Structure, Reference Manual)* hold the Ethernet RIO drop modules health status.

Status Bits

When adding a module, the health bit of the module is set to 0 during the time where the module is configured but not present. The health bits are in the system words %SW641 to %SW702 *(see Unity Pro, Program Languages and Structure, Reference Manual)*. This impacts the system bits%S117 *(see Unity Pro, Program Languages and Structure, Reference Manual)* and %S10 *(see Unity Pro, Program Languages and Structure, Reference Manual)* for Ethernet RIO drops.

On the other hand, when a parameter is changed, the module is re-started and status bit is set to 0 during several ms. This also impacts the system bits `%S117` and `%S10` for Ethernet RIO drops.

NOTE: When adding, deleting or modifying parameters in one module, the other modules available in the system are not impacted and their health bit remain at 1.

Impact of a CCOTF Modification on the State RAM

Overview

When a **discrete output** module is inserted in RUN in a Quantum configuration, all the output bits associated to this module in the state RAM *(see Unity Pro, Operating Modes)* are set to 0 (and all forced bits are immediately unforced).

When an **analog output** module is inserted in RUN in a Quantum configuration, all the output words associated to this module in the state RAM *(see Unity Pro, Operating Modes)* are set to 0.

When a **discrete or analog input** module is inserted in RUN in a Quantum configuration, all the input bits or words associated to this module in the state RAM *(see Unity Pro, Operating Modes)* are kept in the same state (including forced bits).

Section 1.3
CCOTF Compatible Modules

Overview

This section describes CCOTF compatible modules and bus management.

What Is in This Section?

This section contains the following topics:

Quantum Hardware Compatibility

Ethernet RIO Drop Compatibility

A compatible Quantum Ethernet RIO drop must contain a 140 CRA 312 00 Ethernet communication module.

Analog and Discrete Modules Compatibility

The table below lists the Quantum I/O modules that can be added / deleted / modified in RUN mode:

Analog Modules	Discrete Modules		
140 ACI 030 00	140 DDI 153 10	140 DAI 543 00	140 DAO 840 10
140 ACI 040 00	140 DDI 353 00	140 DAI 553 00	140 DAO 842 10
140 ACO 020 00	140 DDI 353 10	140 DAI 740 00	140 DAO 842 20
140 ACO 130 00	140 DDI 364 00	140 DAI 753 00	140 DAO 853 00
140 AII 330 00	140 DDI 673 00	140 DSI 353 00	140 DRA 840 00
140 AII 330 10	140 DDI 841 00	140 DDO 153 10	140 DRC 830 00
140 AIO 330 00	140 DDI 853 00	140 DDO 353 00	140 DVO 853 00
140 AMM 090 00	140 DAI 340 00	140 DDO 353 01	140 DDM 390 00
140 ARI 030 10	140 DAI 353 00	140 DDO 353 10	140 DDM 690 00
140 ATI 030 00	140 DAI 440 00	140 DDO 364 00	140 DAM 590 00
140 AVI 030 00	140 DAI 453 00	140 DDO 843 00	140 DII 330 00
140 AVO 020 00	140 DAI 540 00	140 DDO 885 00	140 DIO 330 00
		140 DAO 840 00	

NOTE: On a S908 network, 800 Series I/O modules and Sy/Max I/O modules are not compatible with the CCOTF function.

140 ERT 854 10 and 140 ERT 854 20 Modules

In an Ethernet RIO drop, 140 ERT 854 10 and 140 ERT 854 20 modules (expert family devices) are compatible with the CCOTF function and can be added / deleted / modified in RUN mode.

Quantum Safe Modules

Hot Swapping Quantum Safe modules (140 AII 330 00, 140 AII 330 10, 140 AIO 330 00, 140 DII 330 00 and 140 DIO 330 00) is not allowed by the intrinsic safety standards.

However, if such modules already exist in an application, the CCOTF function can be used on these modules for changing their configuration parameters.

Modicon M340 Ethernet RIO Drop Hardware Compatibility

Ethernet RIO Drop Compatibility

A compatible Modicon M340 Ethernet RIO drop must contain a BMX CRA 312 10 Ethernet communication module.

NOTE: The BMX CRA 312 00 Ethernet communication module does not manage the CCOTF function.

Analog and Discrete Modules Compatibility

The table below lists the Modicon M340 I/O modules that can be added / deleted / modified in RUN mode in a Quantum Ethernet I/O system:

Analog Modules	Discrete Modules		
BMX AMI 0410	BMX DAI 0805	BMX DDI 1602	BMX DDM 16022
BMX AMI 0800	BMX DAI 1602	BMX DDI 1603	BMX DDM 16025
BMX AMI 0810	BMX DAI 1603	BMX DDI 1604	BMX DDM 3202 K
BMX ART 0414[1]	BMX DAI 1604	BMX DDI 3202 K	BMX DRA 0804
BMX ART 0814	BMX DAO 1605	BMX DDI 6402 K	BMX DRA 0805
BMX AMO 0210		BMX DDO 1602	BMX DRA 1605
BMX AMO 0410		BMX DDO 1612	
BMX AMO 0802		BMX DDO 3202 K	
BMX AMM 0600		BMX DDO 6402 K	

NOTE: [1]Firmware V2.1 equal or higher must be installed

Expert and Communication Modules Compatibility

The table below lists Modicon M340 modules compatibility:

Module	CCOTF Action Compatibility
BMX EHC 0200	• Modify configuration and adjustment parameters • Modify application specific function
BMX EHC 0800	

CCOTF Bus Management Compatibility

Bus and Drop Compatibility

The modifications can be done only in the Quantum local drop, Quantum RIO drops connected to the S908 network or Quantum RIO drops connected to the Ethernet network in a Quantum Ethernet I/O system.

It is not possible to do any change on the DIO Bus in RUN.

The **online modification in RUN** option must be validated in the Unity Pro CPU configuration screen *(see page 45)* to allow CCOTF modifications.

If 800 Series I/O and Sy/Max I/O are connected to the S908 RIO network, an error is displayed by Unity Pro during the build process.

This table describes the bus and drop compatibility with the CCOTF function:

Type of Drop			**Modifications Authorized in RUN mode**
LOCAL Drop	Main RACK		Yes
	Extended RACK		Yes
S908 RIO Drop	Sy/Max drop		No
	800 Series drop		No
	Quantum drop	Main RACK	Yes
		Extended RACK	Yes **NOTE:** It is not possible to add an extended rack with the CCOTF function.
Ethernet RIO Drop	Quantum drop	Main RACK	Yes
		Extended RACK	Yes **NOTE:** It is not possible to add an extended rack with the CCOTF function.
	Modicon M340 drop	Main RACK	Yes
		Extended RACK	Yes **NOTE:** It is not possible to add an extended rack with the CCOTF function.
DIO Bus			No

Chapter 2
System Upgrade to Use CCOTF

Overview

This chapter describes how to replace your hardware or upgrade your firmware to take advantage of the CCOTF function for Quantum system.

It is necessary for the Quantum system to be stopped during the upgrade procedure.

The system upgrade can be done with:
- a temporary STOP (few minutes required) for changing the hardware modules
- a complete STOP for upgrading the CPU, Copro and CRP/CRA firmware

NOTE: To download the CPU, Copro, CRA and CRP firmware, please access to Schneider Electric web site www.schneider-electric.com.

⚠ WARNING

SYSTEM NO LONGER ACTIVE

Before stopping the system, always positively confirm that there is no critical operation in progress.

The system is no longer active.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
Standalone System Upgrade

Overview

This section describes how to replace your hardware or upgrade modules firmware to take advantage of the CCOTF function for a Quantum standalone system.

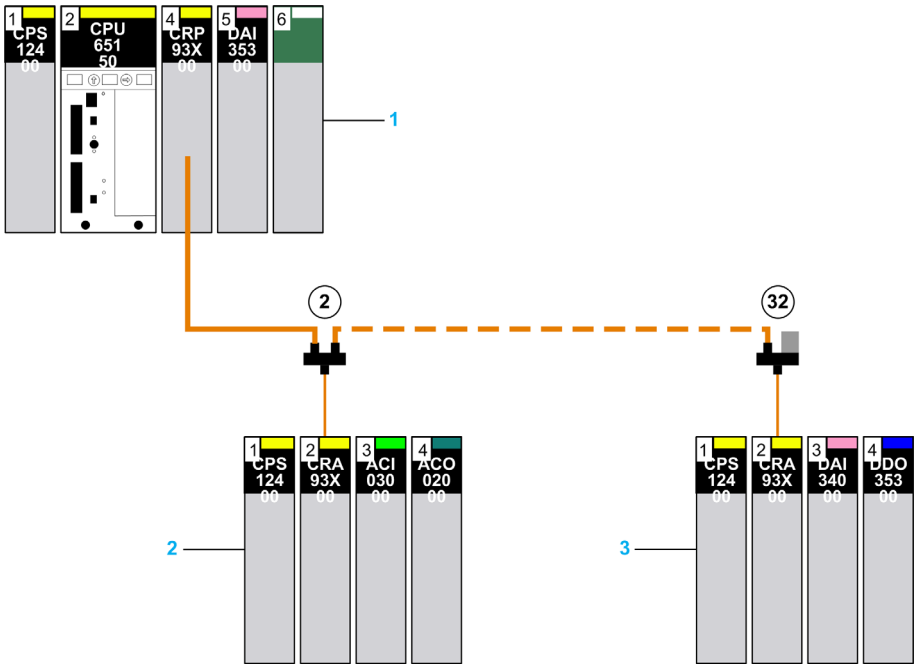
What Is in This Section?

This section contains the following topics:

Principle

General

The picture below shows an example of a Quantum standalone configuration to be upgraded to be CCOTF compatible:



1 PLC
2 Drop number 2
3 Drop number 32

In order to make a Quantum configuration CCOTF compatible, there are several steps to follow:

Step	Action
1	Replace the hardware *(see page 39)* or upgrade the firmware *(see page 50)* for the CPU and S908 CRP (in a Quantum system with S908 RIO drops).
2	Modify the application.
3	(In a Quantum system with S908 RIO drops, replace the hardware *(see page 41)* or upgrade the firmware *(see page 51)* for all the S908 CRA modules connected to the RIO bus.

Quantum Ethernet RIO Communication Modules

To benefit from the latest CCOTF function actions, Quantum CPU and Ethernet RIO communication module (140 CRP 312 00) need to be updated to the latest version *(see page 16)*:

Step	Action
1	Replace the hardware *(see page 39)* or upgrade the firmware *(see page 50)* for the CPU and Quantum Ethernet CRP (in a Quantum system with Ethernet RIO drops).
2	Modify the application.

Modicon M340 Ethernet RIO communication module (BMX CRA 312 10) is CCOTF compatible.

Replacing Standalone Hardware Modules

Replacing PLC Procedure

This procedure describes how to replace the modules in a standalone local drop to be CCOTF compatible:

Step	Action
1	Upload the application program running on the Quantum CPU to Unity Pro.
2	Export the application in the XEF format on the Unity Pro workstation.
3	If not yet installed, upgrade to Unity Pro XL V5.0 (or higher version).

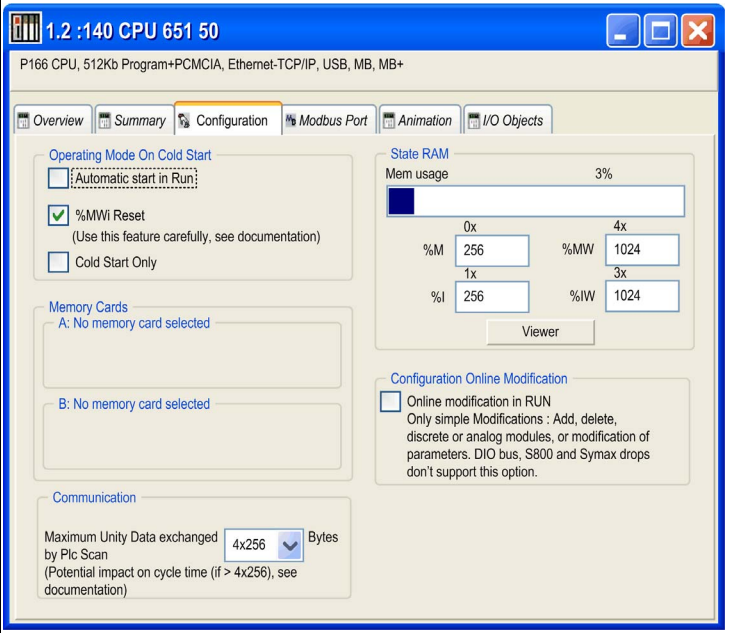
⚠ WARNING

LOSS OF COMMUNICATION

Before changing the mode of PLC to STOP, always confirm that there is no critical operation in progress. The system is no longer active.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
4	Stop the PLC and power it off.
5	If using a PCMCIA card, remove it then remove its batteries to empty the card.
6	In a Quantum system with: ● S908 RIO drops, disconnect the S908 RIO cables from the S908 CRP module (140 CRP 93* 00). ● Ethernet RIO drops, disconnect the Ethernet cables from the Quantum Ethernet CRP module (140 CRP 312 00).
7	Replace hardware or upgrade *(see page 50)* the CPU firmware with a compatible version: ● V2.80 (or higher firmware version) for a local drop with S908 RIO drops ● V3.10 (or higher firmware version) for a local drop with Ethernet RIO drops
8	In a Quantum system with: ● S908 RIO drops, replace hardware or upgrade *(see page 50)* the S908 CRP firmware with a compatible version V2.00 (or higher firmware version). ● Ethernet RIO drops, replace hardware or upgrade *(see page 50)* the Quantum Ethernet CRP firmware with a compatible version V2.00 (or higher firmware version).
9	Power on the PLC.

Step	Action
10	If using a PCMCIA card, insert the batteries in the PCMCIA card and then insert the PCMCIA card in the CPU. **NOTE:** The CPU must be in the **No Conf** state.
11	Import the XEF file of the application into Unity Pro.
12	In the Local Bus editor replace the current version of the CPU with the new firmware CPU version.
13	Click on the **Online modification in Run** check box in the CPU configuration screen to enable the new function. The dialog below shows the check box in the Configuration tab: 
14	Rebuild the application using **Rebuild all**. The CPU is in STOP mode.
15	Download the application to the CPU while the CPU is in the STOP mode. At the end of the application download, all the application data in the PLC have their initial values.
16	In a Quantum system with: ● S908 RIO drops, reconnect the S908 RIO cable to the S908 CRP module. ● Ethernet RIO drops, reconnect the Ethernet cables to the Quantum Ethernet CRP module.

⚠ WARNING

LOSS OF DATA

At the end of the application download, all the application data in the PLC have their initial values. Before changing the mode of the PLC to RUN, always confirm that the application can restart with initial values.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
17	Connect Unity Pro to the PLC and put the PLC in the RUN mode.

Replacing the S908 CRA Modules in a Quantum System with S908 RIO Drops

Replacing S908 CRA modules in the S908 RIO drops can only be done after the local drop of the PLC has been updated to be CCOTF compatible with upgraded CPU and S908 CRP modules.

The following table represents the procedure to replace an S908 CRA (140 CRA 93* 00):

Step	Action
1	Make sure that a powered off RIO drop is supported by the application.
2	Power off the S908 RIO drop.
3	Disconnect the S908 RIO cable from the S908 CRA module.
4	Replace hardware or upgrade *(see page 50)* the S908 CRA firmware with a compatible version V2.00 (or higher firmware version).
5	Reconnect the S908 RIO cable on the S908 CRA module.
6	Power on the S908 RIO drop.

Repeat steps 2 through 7 for all S908 RIO drops.

NOTE: To allow CCOTF modifications, all S908 RIO drops configured on the RIO bus must be CCOTF compatible *(see page 24)*.

Section 2.2
Hot Standby System Upgrade

Overview

This section describes how to replace your hardware or upgrade modules firmware to take advantage of the CCOTF function for Quantum Hot Standby system.

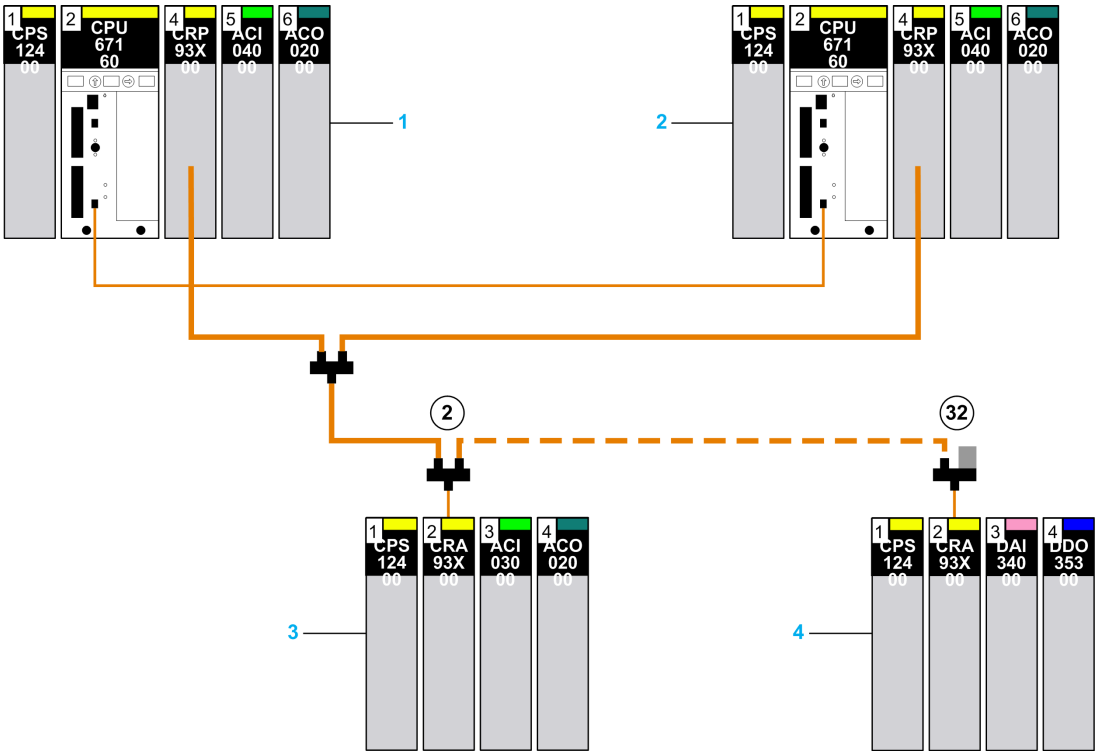
What Is in This Section?

This section contains the following topics:

Principle

General

The picture below shows an example of a Quantum Hot Standby configuration to be upgraded to be CCOTF compatible:



1 Primary PLC (PLC A)
2 Standby PLC (PLC B)
3 Drop number 2
4 Drop number 32

In order to make a Quantum Hot Standby configuration CCOTF compatible, there are several steps to follow:

Step	Action
1	Replace the hardware *(see page 45)* or upgrade the firmware *(see page 50)* for the CPU and S908 CRP (in a Quantum system with S908 RIO drops) in Standby PLC B.
2	Replace the hardware *(see page 48)* or upgrade the firmware *(see page 50)* for the CPU and S908 CRP (in a Quantum system with S908 RIO drops) in Primary PLC A.
3	Modify the application in both PLCs.
4	In a Quantum system with S908 RIO drops, replace the hardware *(see page 49)* or upgrade the firmware *(see page 51)* for all the S908 CRA modules connected to the RIO bus.

Quantum Ethernet RIO Communication Modules

To benefit from the latest CCOTF function actions, Quantum CPU and Ethernet RIO communication module (140 CRP 312 00) need to be updated to the latest version *(see page 16)*:

Step	Action
1	Replace the hardware *(see page 45)* or upgrade the firmware *(see page 50)* for the CPU and Quantum Ethernet CRP (in a Quantum system with Ethernet RIO drops) in Standby PLC B.
2	Replace the hardware *(see page 48)* or upgrade the firmware *(see page 50)* for the CPU Quantum Ethernet CRP (in a Quantum system with Ethernet RIO drops) in Primary PLC A.
3	Modify the application.

Modicon M340 Ethernet RIO communication module (BMX CRA 312 10) is CCOTF compatible.

Replacing Hot Standby Hardware Modules

Overview

The modules must be replaced in the following order:

- Standby PLC *(see page 45)* (PLC B in this example)
- Primary PLC *(see page 48)* (PLC A in this example)
- S098 CRA modules *(see page 49)* in the S908 RIO drops (in a Quantum system with S908 RIO drops)

Replacing PLC B Procedure

The procedure below describes how to replace the modules in the Standby PLC:

Step	Action
1	Make sure that the application program running on the Quantum Hot Standby CPUs has been exported in the XEF format and is available on the computer. If not, upload the application program from one of the two PLCs to Unity Pro.
2	Export the application in the XEF format on the Unity Pro workstation.
3	If not yet installed, install Unity Pro XL or XLS V4.1 (or higher software version).

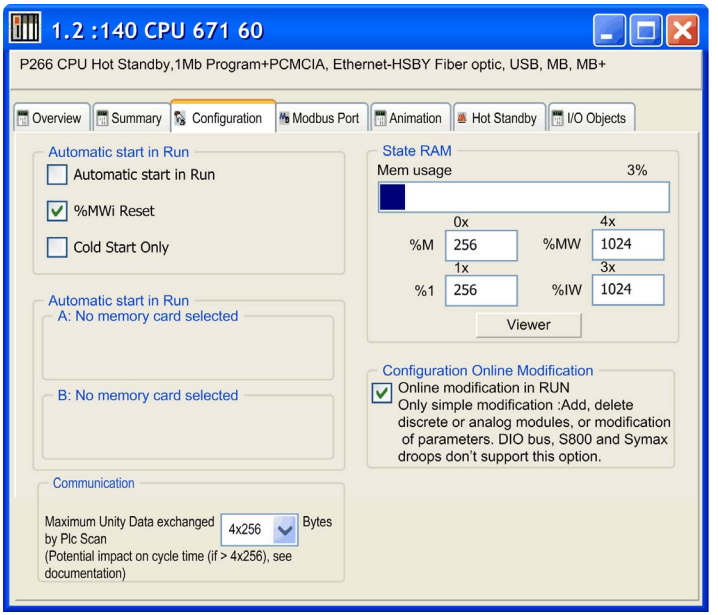
⚠ WARNING

SYSTEM NO LONGER ACTIVE NOR REDUNDANT

Before stopping the system, always positively confirm that there is no critical operation in progress. The system is no longer active nor redundant.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
4	Stop the Standby PLC (PLC B) and power it off. **NOTE:** At this point, the system is no longer operating redundantly.
5	If using a PCMCIA card, remove it then remove its batteries to empty the card.
6	Disconnect the fiber optic sync link cable on CPU B.
7	In a Quantum system with: ● S908 RIO drops, disconnect the S908 RIO cables from the S908 CRP B module (140 CRP 93* 00). ● Ethernet RIO drops, disconnect the Ethernet cables from the Quantum Ethernet CRP B module (140 CRP 312 00).

Step	Action
8	Replace hardware or upgrade *(see page 50)* the CPU B firmware with a compatible version: ● V2.70 (or higher firmware version) for local drop with S908 RIO drops ● V3.10 (or higher firmware version) for local drop with Ethernet RIO drops
9	In a Quantum system with: ● S908 RIO drops, replace hardware or upgrade *(see page 50)* the S908 CRP B firmware with a compatible version V2.00 (or higher firmware version). ● Ethernet RIO drops, replace hardware or upgrade *(see page 50)* the Quantum Ethernet CRP B firmware with a compatible version V2.00 (or higher firmware version).
10	Power on PLC B.
11	When using a PCMCIA card, insert the batteries in the PCMCIA card and then insert the PCMCIA card in CPU B. **NOTE:** The CPU must be in a **No Conf** state.
12	Import the XEF file of the application.
13	In the Local Bus editor replace the current version of the CPU with the new firmware CPU version.
14	Click on the **online modification in Run** check box in the CPU configuration screen to enable the new function. The dialog box below shows the check box in the Configuration Tab: 

Step	Action
15	Rebuild the application using **Rebuild all** and download into CPU B. The CPU is in STOP mode.
16	In a Quantum system with: ● S908 RIO drops, reconnect the S908 RIO cable to the S908 CRP B module. ● Ethernet RIO drops, reconnect the Ethernet cables to the Quantum Ethernet CRP B module.
17	Connect the fiber optic sync link cable onto the CPU B.
18	Connect Unity Pro to PLC A.

⚠ WARNING

LOSS OF COMMUNICATION

Before changing the mode of PLC A to STOP, always confirm that there is no critical operation in progress. The system is no longer active nor redundant.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
19	Stop PLC A. **NOTE:** The system is no longer active nor redundant.
20	Connect Unity Pro to PLC B.

⚠ WARNING

UNEXPECTED APPLICATION BEHAVIOR - LOSS OF DATA

At the end of the application download, all the application data in the PLC B have their initial value. Before changing the mode of PLC B to RUN, always confirm that the application can restart with initial values.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
21	Put the PLC B in RUN mode.
22	Ensure that PLC B becomes the Primary.

Changing PLC A Procedure

This procedure follows **Changing PLC B Procedure** and describes how to replace the PLC A:

Step	Action
1	Power off PLC A that is in STOP mode. **NOTE:** At this point, the system is no longer operating redundantly.
2	If using a PCMCIA card, remove it then remove its batteries to empty the card.
3	Disconnect the fiber optic sync link cable on CPU A.
4	In a Quantum system with: ● S908 RIO drops, disconnect the S908 RIO cables from the S908 CRP A module (140 CRP 93* 00). ● Ethernet RIO drops, disconnect the Ethernet cables from the Quantum Ethernet CRP A module (140 CRP 312 00).
5	Replace hardware or upgrade *(see page 50)* the CPU A firmware with a compatible version: ● V2.70 (or higher firmware version) for local drop with S908 RIO drops ● V3.10 (or higher firmware version) for local drop with Ethernet RIO drops
6	In a Quantum system with: ● S908 RIO drops, replace hardware or upgrade *(see page 50)* the S908 CRP A firmware with a compatible version V2.00 (or higher firmware version). ● Ethernet RIO drops, replace hardware or upgrade *(see page 50)* the Quantum Ethernet CRP A firmware with a compatible version V2.00 (or higher firmware version).
7	Power on PLC A.
8	When using a PCMCIA card, insert the batteries in the PCMCIA card and then insert the PCMCIA card in CPU A. **NOTE:** The CPU must be in a **No Conf** state.
9	In a Quantum system with: ● S908 RIO drops, reconnect the S908 RIO cable to the S908 CRP A module. ● Ethernet RIO drops, reconnect the Ethernet cables to the Quantum Ethernet CRP A module.
10	Connect the fiber optic sync link cable onto the CPU A.
11	An automatic transfer from Primary to Standby is done.
12	Make sure PLC A runs as Standby.

Replacing the S908 CRA Modules in a Quantum System with S908 RIO Drops

Replacing S908 CRA modules in the S908 RIO drops must only be done after the local drop of the Primary PLC *(see page 48)* and the Standby PLC *(see page 45)* have been updated with upgraded CPUs and S908 CRP modules.

To replace the S908 CRA module, follow the procedure described in the CCOTF with a standalone system dedicated chapter. *(see page 41)*

Section 2.3
Firmware Upgrade

Upgrading the Firmware

CPU/Copro Compatibility

The Copro (co-processor) in the 140 CPU ••• module is a processor dedicated to:

- embedded Ethernet link management in high-end standalone CPUs in a standalone system
- Hot Standby fiber optic link management in a Hot Standby system

The Copro firmware version depends on the Quantum CPU firmware version.

The table below shows the CPU and Copro firmware required to be CCOTF compatible:

System	Quantum CPU Firmware Version	Copro Firmware Version
Standalone	V2.80	V2.80 to V2.89
	V3.00	V3.00 to V3.09
	V3.10	V3.00 to V3.09
Hot Standby	V2.70	V2.70 to V2.79
	V2.80	V2.80 to V2.89
	V3.00	V3.00 to V3.09
	V3.10	V3.10

CPU Firmware Upgrade

The CPU firmware download is done through Modbus or Modbus Plus, using the Unity Pro OS Loader tool *(see Unity Pro, OSLoader, User Manual)*.

The procedure to follow is described in the Quantum Operating System Upgrade and Update procedure guide *(see page 10)*.

Copro Firmware Upgrade

The Copro firmware download is done through Modbus or Modbus Plus, using the Unity Pro OS Loader tool *(see Unity Pro, OSLoader, User Manual)*.

The procedure to follow is described in the Quantum Operating System Upgrade and Update procedure guide *(see page 10)*.

S908 CRP Firmware Upgrade

The S908 CRP firmware download is done through Modbus or Modbus Plus, using the Unity Pro OS Loader tool *(see Unity Pro, OSLoader, User Manual)*.

The procedure to follow is described in the Quantum Operating System Upgrade and Update procedure guide *(see page 10)*.

S908 CRA Firmware Upgrade

The S908 CRA firmware download is done through Modbus or Modbus Plus, using the Unity Pro OS Loader tool *(see Unity Pro, OSLoader, User Manual)*.

The procedure to follow is described in the Quantum Operating System Upgrade and Update procedure guide *(see page 10)*.

Quantum Ethernet CRP Firmware Upgrade

The Quantum Ethernet CRP firmware download is done through Ethernet, using the Unity Pro OS Loader tool *(see Unity Pro, OSLoader, User Manual)*.

The procedure to follow is described in the Quantum Operating System Upgrade and Update procedure guide *(see page 10)*.

Chapter 3
Quantum CCOTF Performance

Key Performance

Cycle Time Impact

The table below describes the cycle time, which depends on the modification done:

Modification	Maximum Time impact
Inserting a new module	30% of the Mast Task cycle time
Deleting a module	30% of the Mast Task cycle time
Modifying parameters of an existing module	30% of the Mast Task cycle time

NOTE: The percentage varies depending on the cycle time. For cycle time lower than 80 ms, the max time impact could be higher.

NOTE: A CCOTF modification only impacts the module concerned.

Time to Complete a CCOTF Modification in a RIO drop

To understand how a CCOTF modification is performed, the following points have to be considered:

- A CCOTF modification is managed at the Mast task frequency.
- When a CCOTF modification is done in a RIO drop, several specific requests are sent to the CPU in order to modify the CPU memory area containing the I/O drop configuration. This modification is performed when the **Build Changes** button is selected in Unity Pro.
- Memory areas containing all the I/O drop configurations are contiguous in the CPU memory, if the CCOTF modification is related to the first RIO drop, all the other memory areas related to the other RIO drops have to be shifted in the CPU memory.
  If the CCOTF modification is related to the last RIO drop, only the area of this drop is modified.
  An important consequence of this point is that a CCOTF modification in the last RIO drop will require less Mast task cycles than a CCOTF modification in the first RIO drop.
- Inserting a new module is completed when the status bit of this module is set to 1.

NOTE: The worst case possible is to add a new module in the first RIO drop. The time needed by the system to complete a CCOTF modification is lower than 4 seconds.

Part II
Using CCOTF with a Standalone System

Overview

This part describes using CCOTF with a Quantum standalone system.

What Is in This Part?

This part contains the following chapters:

Chapter 4
Add Ethernet RIO Drop

Overview

This chapter describes the procedure to add a Quantum Ethernet RIO drop or a Modicon M340 Ethernet RIO drop in a Quantum standalone system.

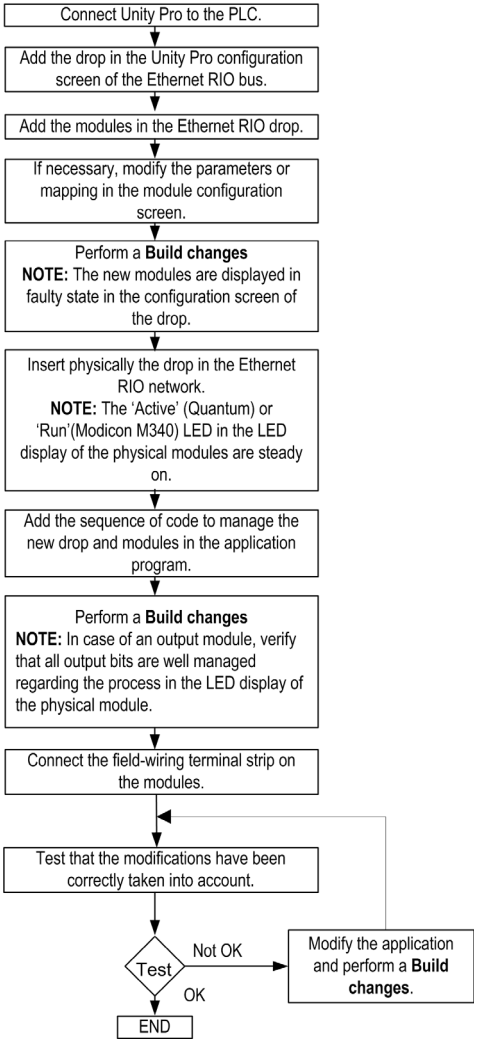
What Is in This Chapter?

This chapter contains the following topics:

Add an Ethernet RIO Drop in a Standalone System while in the Standard Connected Mode

Addition

The following flow-chart describes the action to be done when adding a Ethernet RIO drop while in the Standard Connected Mode:



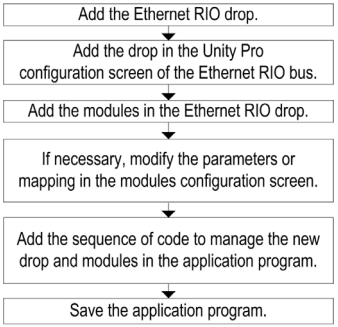
NOTE: 1 Ethernet RIO drop contains 1 or 2 racks (linked with a backplane expander cable).

Add an Ethernet RIO Drop in a Standalone System while in the Virtual Connected Mode

Addition in Offline Mode

In this mode, it is possible to modify the I/O configuration when the application is offline. The application that is downloaded onto the PLCs has to be generated with the **Virtual connected mode** check box enabled in the **Project settings** →**General** →**Build settings**.

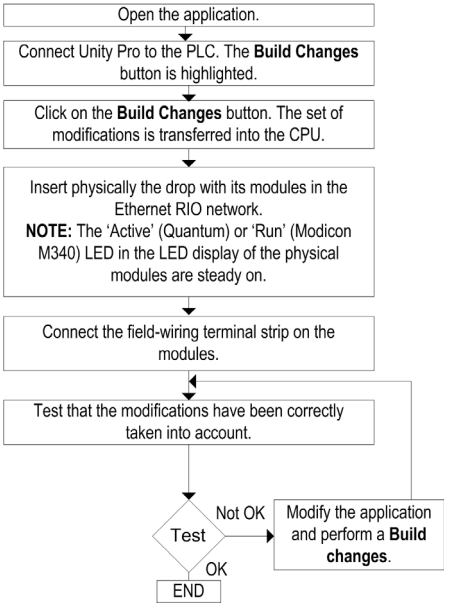
The following flow-chart describes the action to be done when adding an Ethernet RIO drop while in the **OFFLINE** Virtual Connected Mode:



NOTE: 1 Ethernet RIO drop contains 1 or 2 racks (linked with a backplane expander cable).

Addition when Connected to the Quantum Ethernet RIO System

The following flow-chart describes the action to be done when adding an Ethernet RIO drop while in the **CONNECTED** Virtual Connected Mode:



Chapter 5
Add/Delete Modules

Overview

This chapter describes the procedures to add or delete modules in a local, S908 RIO or Ethernet RIO drop of a Quantum standalone system.

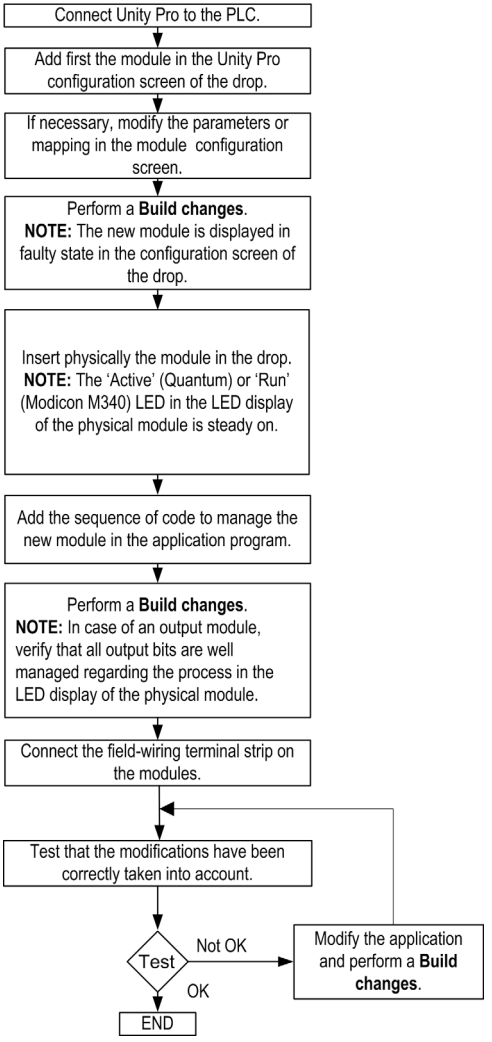
What Is in This Chapter?

This chapter contains the following topics:

Add/Delete a Module in a Standalone System while in the Standard Connected Mode

Addition

The following flow-chart describes the action to be done when adding a module while in the Standard Connected Mode:

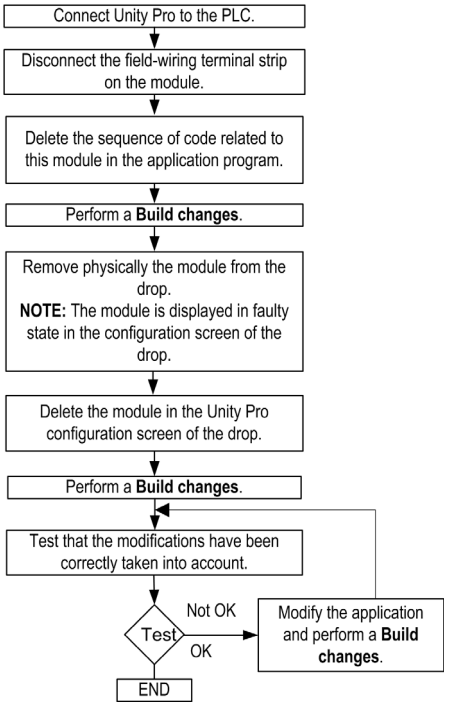


NOTE: One Ethernet RIO drop can have up to 4 modules added in one CCOTF transaction.

Deletion

⚠ WARNING
POSSIBLE UNEXPECTED EQUIPMENT BEHAVIOR Remove the field wiring terminal strip on the module before deleting a module. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

The following flow-chart describes the action to be done when deleting a module while in the Standard Connected Mode:



NOTE: One Ethernet RIO drop can have up to 4 modules deleted in one CCOTF transaction.

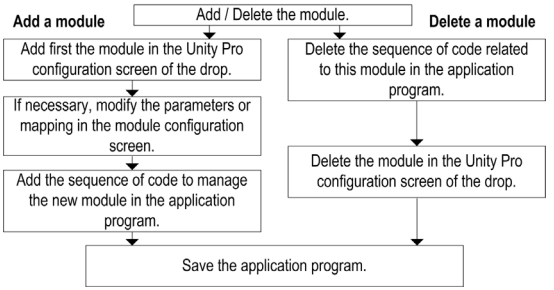
NOTE: A Modicon M340 discrete module with time stamped channels in a Modicon M340 Ethernet RIO drop can not be deleted.

Add/Delete a Module in a Standalone System while in the Virtual Connected Mode

Addition/Deletion in Offline Mode

In this mode, it is possible to modify the I/O configuration when the application is offline. The application that is downloaded onto the PLCs has to be generated with the **Virtual connected mode** check box enabled in the **Project settings** →**General** →**Build settings**.

The following flow-chart describes the action to be done when adding or deleting a module while in the **OFFLINE** Virtual Connected Mode:



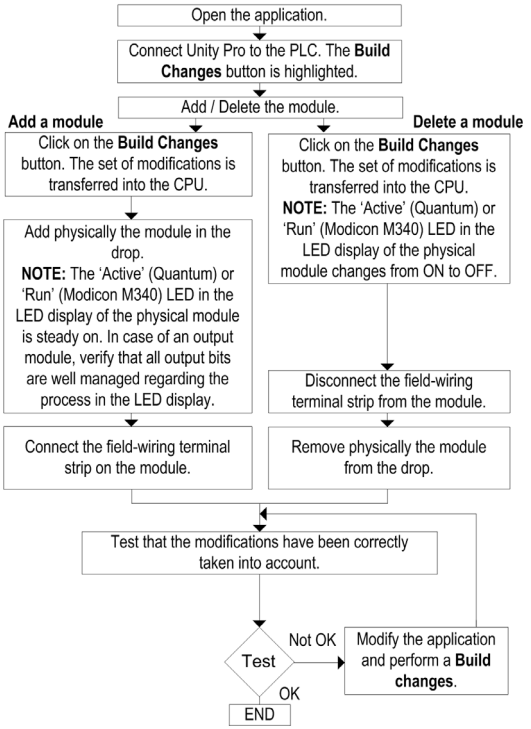
NOTE: One Ethernet RIO drop can have up to 4 modules added/deleted in one CCOTF transaction.

NOTE: A Modicon M340 discrete module with time stamped channels in a Modicon M340 Ethernet RIO drop can not be deleted.

Addition/Deletion when Connected to the Quantum System

⚠ WARNING
POSSIBLE UNEXPECTED EQUIPMENT BEHAVIOR
Remove the field wiring terminal strip on the module before deleting a module.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when adding or deleting a module while in the **CONNECTED** Virtual Connected Mode:



Chapter 6
Modify Module Parameters

Overview

This chapter describes the procedures to modify module parameters in a local, S908 RIO or Ethernet RIO drop of a Quantum standalone system.

What Is in This Chapter?

This chapter contains the following topics:

General

Parameter Types

There are two kinds of parameters to take into account:

Configuration parameters linked to the application memory mapping or the CPU operating system

Example: input/output starting and ending addresses, mapping, task, etc.

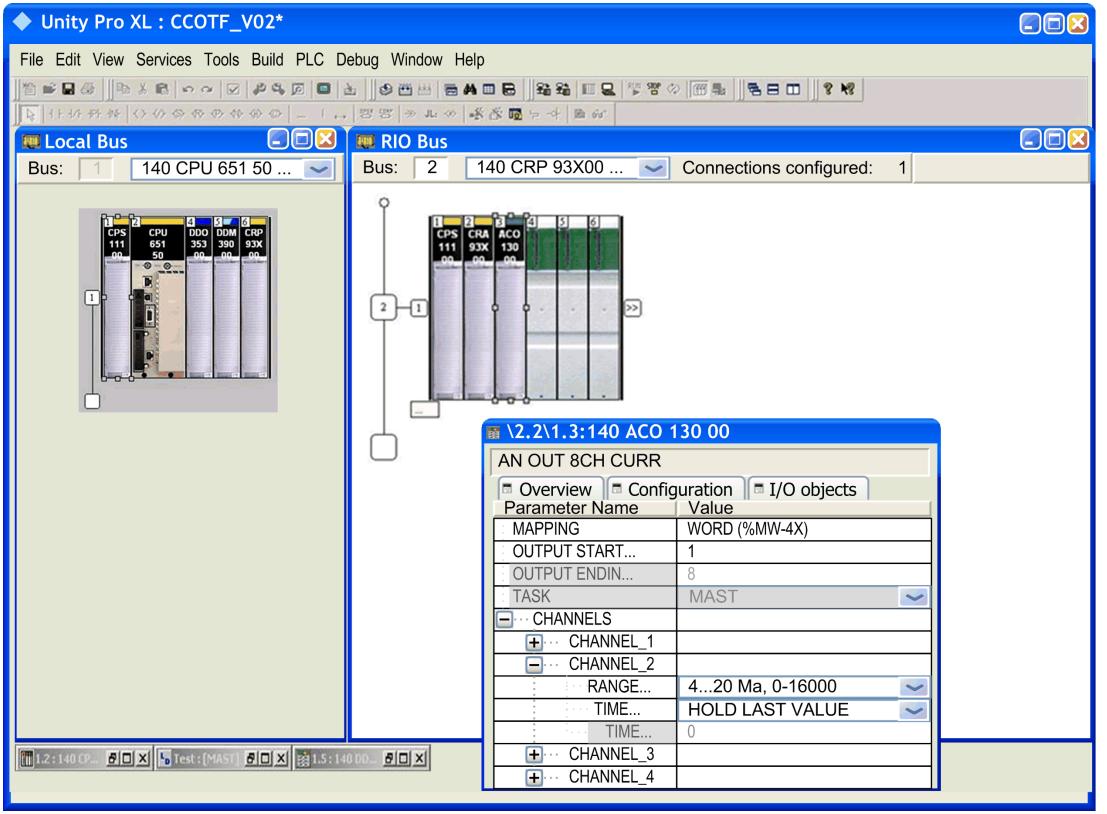
Adjustment parameters that impact module behavior

Example: input/output type, timeout value, filter selection, dual mode, output shut down state, automatic restart, fail state, fallback value, data format, channels, input/output range, etc. *(see Unity Pro, Program Languages and Structure, Reference Manual)*

NOTE: In a pre-existing module only the **adjustment parameters** can be modified.

In a newly inserted module all parameters can be modified before the **Build changes**.

This dialog box shows the **configuration parameters** screen:



Modicon M340 Ethernet RIO Drop Modules

Modicon M340 modules parameter modification causes a channel reset on the following modules type:

- analog I/O modules: modified channel reset
- BMX EHC 0200 and BMX EHC 0800 modules: modified channel reset
- discrete I/O modules: group of channels containing the modified channel reset

BMX EHC 0200 and BMX EHC 0800 modules use specific parameters with the following type: **Application Specific Function** (Example: frequency mode, event counting mode, one shot counter mode, modulo loop...). The application specific functions can be modified with the CCOTF function.

Modify Module Parameters in a Standalone System while in the Standard Connected Mode

Parameter Modifications

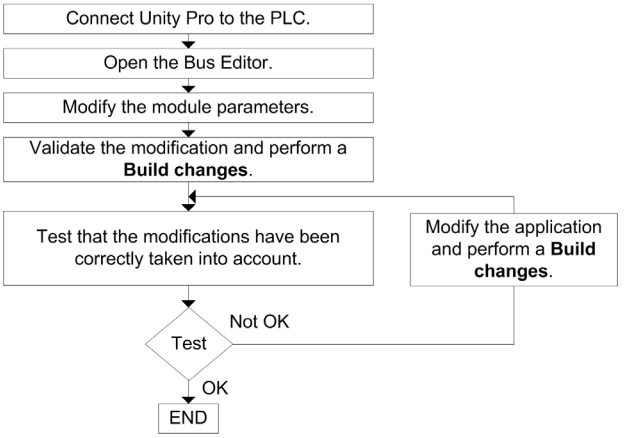
⚠ WARNING

RISK OF UNEXPECTED EQUIPMENT BEHAVIOR

Before doing any CCOTF modification, ensure that your system responds appropriately. Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when modifying module parameters *(see page 68)* while in the Standard Connected Mode:



Modify Module Parameters in a Standalone System while in the Virtual Connected Mode

Parameter Modifications in Offline Mode

It is possible to modify the I/O configuration and the application offline. The application that is downloaded in the PLCs has to be generated with the **Virtual Connected Mode** check box enabled in the **Project settings** dialog box.

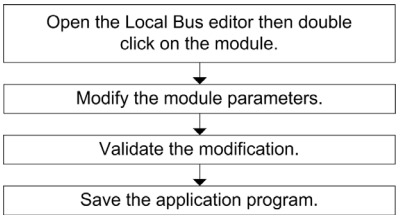
⚠ WARNING

RISK OF UNEXPECTED EQUIPMENT BEHAVIOR

Before doing any CCOTF modification, ensure that your system responds appropriately. Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

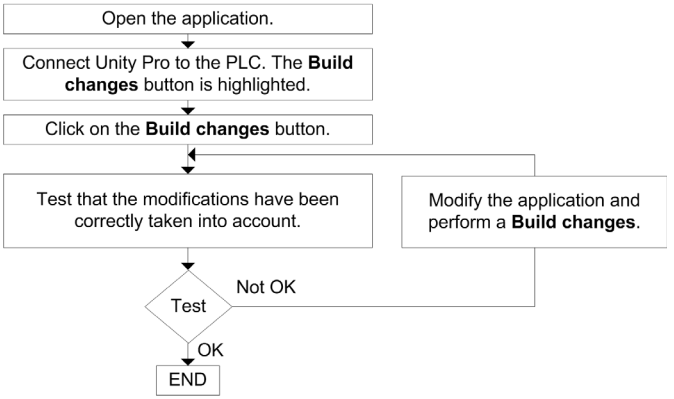
Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when modifying module parameters *(see page 68)* from a standalone drop while in the **OFFLINE** Virtual Connected mode:



Parameter Modifications when Connected to the Quantum System

The following flow-chart describes the action to be done when modifying module parameters from a standalone drop while in the **CONNECTED** Virtual Connected Mode:



Chapter 7
CCOTF Troubleshooting

General Troubleshooting List

Overview

If a CCOTF modification can not be performed on Quantum Standalone system, check the following potential problems and their solutions in the table below:

Potential Problem	Solution
The CPU does not have operating system version 02.80 or higher.	Replace the CPU module with a CCOTF compatible CPU or upgrade the operating system.
The S908 CRP module does not have firmware version 02.00 or higher.	Replace the S908 CRP module with a CCOTF compatible S908 CRP or upgrade the firmware.
The S908 CRA modules in all Quantum RIO drops connected to the RIO link do not have firmware version 02.00 or higher.	Replace the S908 CRA module with a CCOTF compatible S908 CRA or upgrade the firmware.
Unity Pro 5.0 or higher version is not installed.	Install Unity 5.0 or higher version.
The processor type is not replaced in the Unity Pro configuration tab.	Replace the non CCOTF processor by the CCOTF corresponding processor in the Unity Pro configuration table.
The **Online modification in RUN** check box is not selected.	Check **Online modification in RUN** in the CPU configuration tab *(see page 39)*.
PLC has an application that is not CCOTF compatible.	The application must be rebuilt (`Build -> Rebuild All` menu in Unity Pro) and downloaded in both PLCs after changing the processor and checking the **Online Modification in RUN** check box.
At least one Quantum S908 RIO drop is not compatible with the CCOTF function.	Check that all Quantum S908 RIO drops that are configured in the application have their corresponding bits at 1 in `%SW98` and `%SW99` (except drops not powered on).
A Quantum S908 RIO drop that has been upgraded has its corresponding bit at 0 in %SW98 or %SW99.	Power off then power on the S908 RIO drop.
A new CCOTF modification is not allowed.	Wait until previous CCOTF modification is completed.

Potential Problem	Solution
The Ethernet CRP is not ready.	Try to make the CCOTF modification again.
The Ethernet CRA connection is not always available.	Check the Ethernet connections of all the communication modules involved in the Ethernet RIO daisy chain ring.
Ethernet RIO drop connection is lost during the CCOTF modification.	The drop is automatically re-configured with the new configuration when the connection with the Ethernet CRP is established.

NOTE: A Quantum S908 RIO Drop that does not contain any I/O modules has its corresponding bit at 0 in %SW98 or %SW99. In consequence, an empty Quantum S908 RIO drop blocks CCOTF modifications.

Part III
Using CCOTF with a Hot Standby System

Overview

This part describes using CCOTF with a Quantum Hot Standby System.

What Is in This Part?

This part contains the following chapters:

Chapter 8
Introduction to CCOTF with a Hot Standby System

Hot Standby CCOTF Actions

Overview

CCOTF function allows modifications when the PLC is in RUN *(see page 15)* mode.

NOTE: Local I/O can be used but they are not part of the redundant system in a Quantum Hot Standby *(see Modicon Quantum, Hot Standby System, User Manual)* system environment.

NOTE: The CCOTF modification can only be done if the module is compatible *(see page 31)*.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Always transfer the application to the Standby PLC after modifying the configuration in the Primary PLC.The application in both PLCs must be the same.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

S908 RIO Drop Specifics

The application transfer from Primary to Standby PLC after one CCOTF transaction is recommended. However, transferring the application after more than one CCOTF transaction will not generate an S908 RIO drop reset if a Switchover occurs.

Two system Status Register Words: %SW98 and %SW99 allow to manage the S908 CRA compatibility *(see page 24)*.

A CCOTF modification can only be performed on the Primary PLC with the other PLC in Standby state.

NOTE: In an S908 system, Unity Pro can be connected to the Primary or the Standby PLC. Connection to the Primary is preferred.

Ethernet RIO Specifics

If a Switchover occurs after a CCOTF transaction and before the application transfer, the Ethernet RIO drop gets the configuration from the new Primary (configuration preceding the CCOTF modification). The output values of the modified drop depend on the Primary application, no glitch or bump will appear on the outputs.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Make sure that your system responds appropriately if the drop takes back its previous configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The application must be transferred from Primary to Standby PLC after one CCOTF transaction. Transferring the application after more than one CCOTF transaction can lead to the Ethernet RIO drop reset if a Switchover occurs.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Ensure that your application program does not operate a Switchover before starting any CCOTF modification.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

A CCOTF modification can only be performed on the Primary PLC with the other PLC in Standby state.

NOTE: In an Ethernet RIO system, Unity Pro can only be connected to the Primary PLC.

Application Program Mismatch Bit %SW60.3

Before doing any CCOTF modification, make sure that the system word %SW60.3 *(see Modicon Quantum, Hot Standby System, User Manual)* is set to 1.

The logic mismatch command behavior depends on the Quantum system:

- In a local or S908 RIO drop, if system bit %SW60.3 is not set to 1, the Standby PLC goes to the OFFLINE state after the first CCOTF modification and no other CCOTF modifications are allowed.
- In an Ethernet RIO drop, is system bit %SW60.3 is not set to 1, CCOTF modifications are not allowed

Number of CCOTF Modifications Allowed

Validating a CCOTF modification requires a Build Changes in Unity Pro.

The number of CCOTF modifications allowed *(see page 21)* in one CCOTF transaction depends on the system.

Chapter 9
Add Ethernet RIO Drop

Overview

This chapter describes the procedure to add a Quantum Ethernet RIO drop or a Modicon M340 Ethernet RIO drop in a Quantum Hot Standby system.

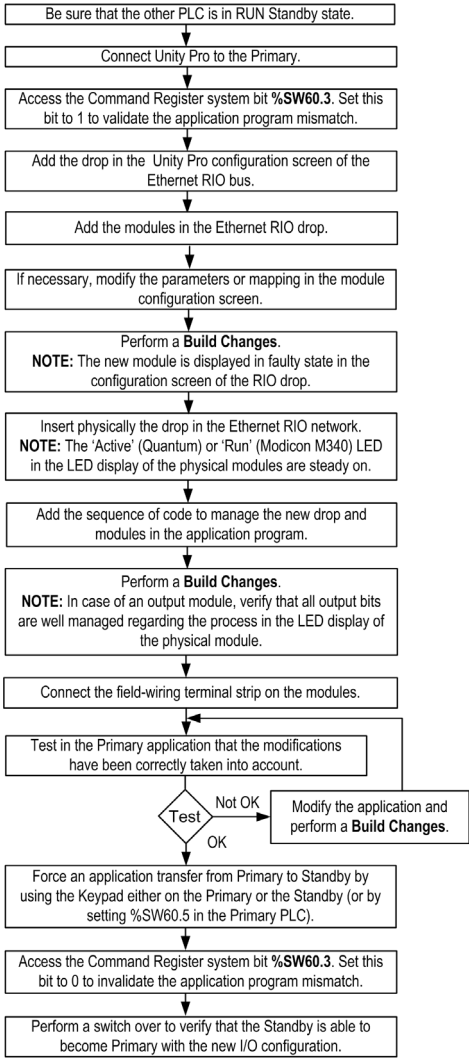
What Is in This Chapter?

This chapter contains the following topics:

Add an Ethernet RIO Drop in a Hot Standby System while in the Standard Connected Mode

Addition

The following flow-chart describes the action to be done when adding an Ethernet RIO drop while in the Standard Connected Mode:



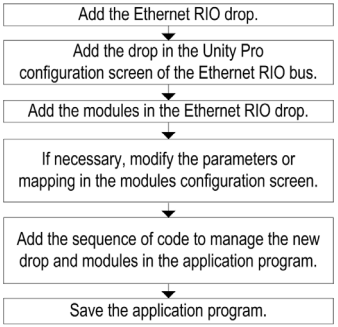
NOTE: 1 Ethernet RIO drop contains 1 or 2 racks (linked with a backplane expander cable).

Add an Ethernet RIO Drop in a Hot Standby System while in the Virtual Connected Mode

Addition in Offline Mode

In this mode, it is possible to modify the I/O configuration while the application is offline. The application that is downloaded onto the PLCs has to be generated with the **Virtual connected mode** check box enabled in the **Project settings** →**General** →**Build settings**.

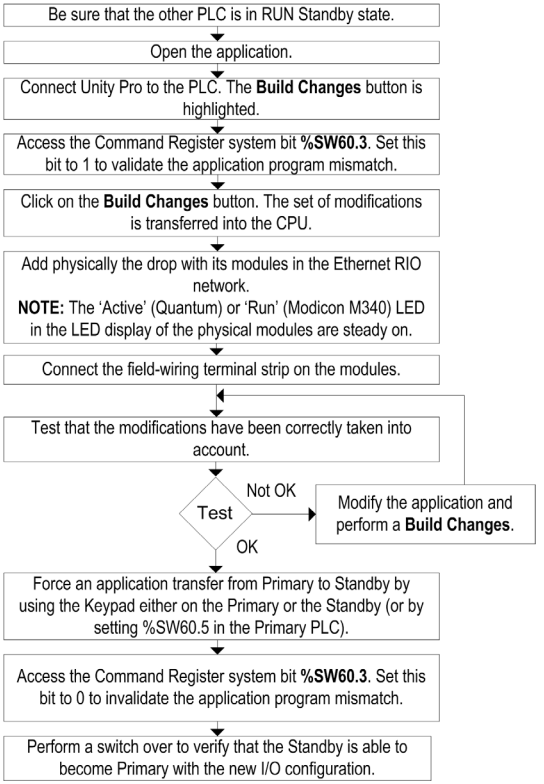
The following flow-chart describes the action to be done when adding an Ethernet RIO drop in a Hot Standby system while in the **OFFLINE** Virtual Connected Mode:



NOTE: 1 Ethernet RIO drop contains 1 or 2 racks (linked with a backplane expander cable).

Addition when Connected to the Quantum System

The following flow-chart describes the action to be done when adding an Ethernet RIO drop in a Hot Standby system while in the **CONNECTED** Virtual Connected Mode:



Chapter 10
Add/Delete Modules

Overview

This chapter describes adding and deleting modules in a Quantum Hot Standby system.

What Is in This Chapter?

This chapter contains the following sections:

Section 10.1
Add/Delete Modules in the Local Drop

Overview

This section describes adding and deleting modules in the local drop with a Quantum Hot Standby system.

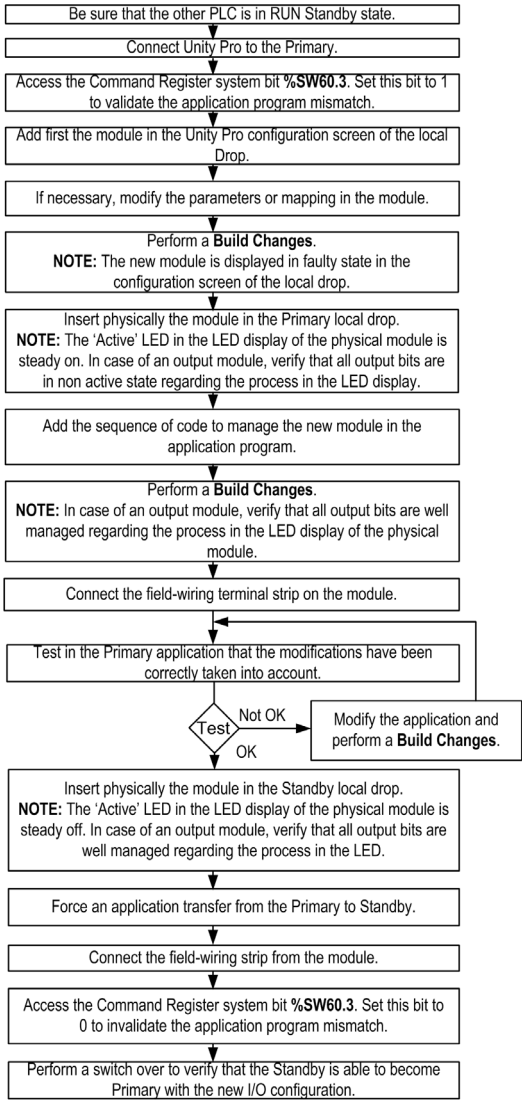
What Is in This Section?

This section contains the following topics:

Add/Delete a Module in a Hot Standby Local Drop while in the Standard Connected Mode

Addition

The following flow-chart describes the action to be done when adding a module in the local drop while in the Standard Connected Mode:



Deletion

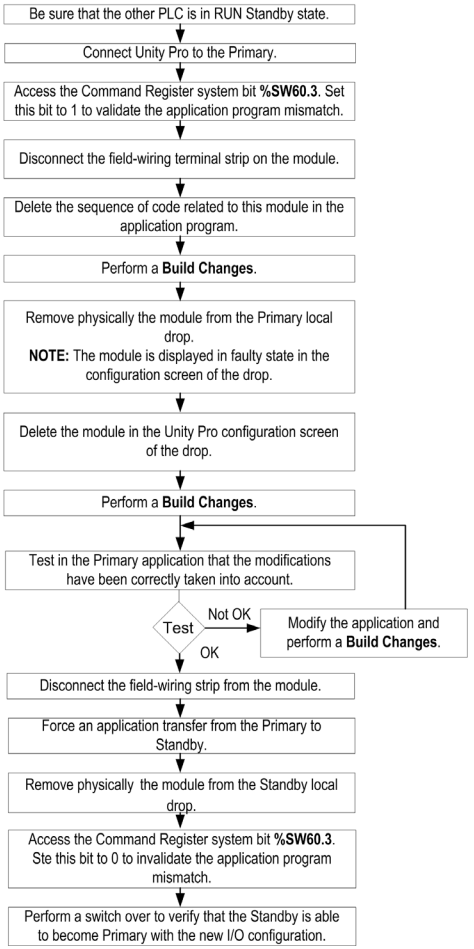
⚠ WARNING

POSSIBLE UNEXPECTED EQUIPMENT BEHAVIOR

Remove the field wiring terminal strip on the module before deleting a module.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when deleting a module from the local drop while in the Standard Connected Mode:

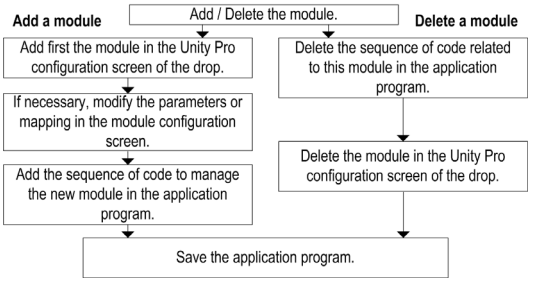


Add/Delete a Module in a Hot Standby Local Drop while in the Virtual Connected Mode

Addition/Deletion in Offline Mode

In this mode, it is possible to modify the I/O configuration when the application is offline. The application that is downloaded onto the PLCs has to be generated with the **Virtual connected mode** check box enabled in the **Project settings** →**General** →**Build settings**.

The following flow-chart describes the action to be done when adding or deleting a module in the local drop while in the **OFFLINE** Virtual Connected Mode:



Addition/Deletion when Connected to the Quantum System

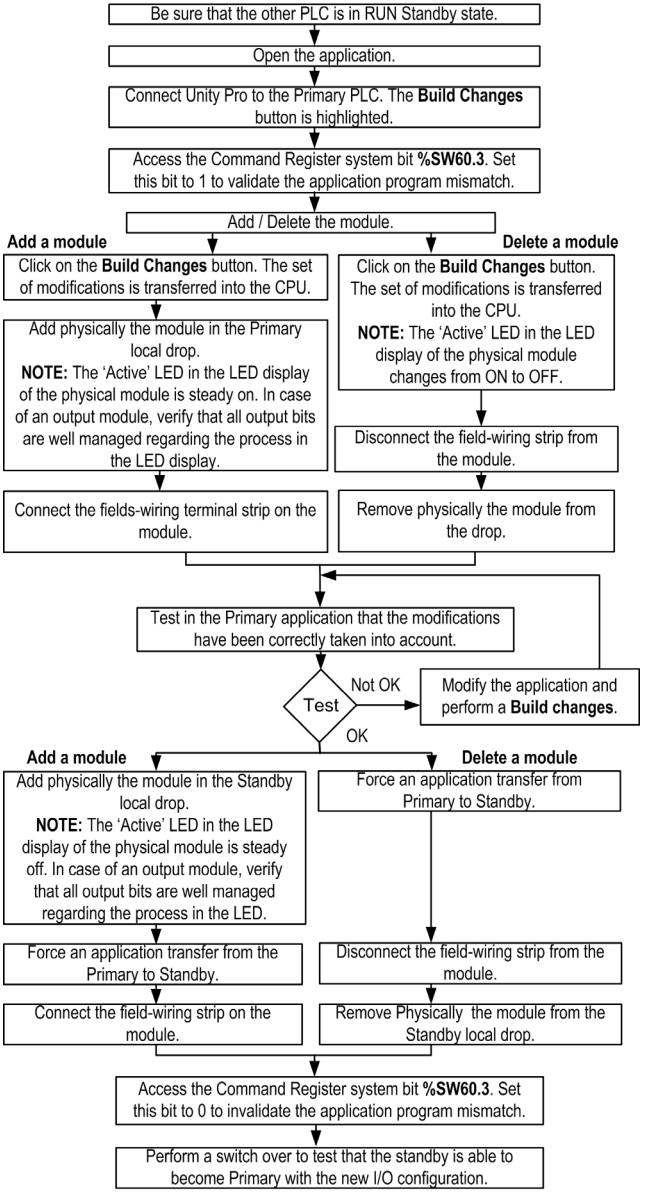
⚠ WARNING

POSSIBLE UNEXPECTED EQUIPMENT BEHAVIOR

Remove the field wiring terminal strip on the module before deleting a module.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when adding or deleting a module in the local drop while in the **CONNECTED** Virtual Connected Mode:



Section 10.2
Add/Delete Modules in an S908 or Ethernet RIO Drop

Overview

This section describes adding and deleting modules in an S908 RIO drop or Quantum Ethernet RIO drop with a Quantum Hot Standby system.

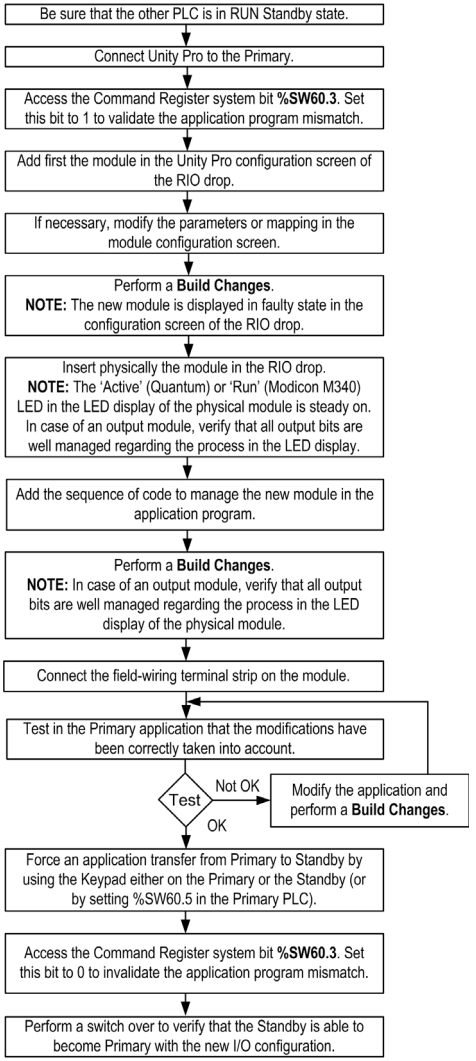
What Is in This Section?

This section contains the following topics:

Add/Delete a Module in a Hot Standby S908 RIO Drop or Quantum Ethernet RIO Drop while in the Standard Connected Mode

Addition

The following flow-chart describes the action to be done when adding a module in a RIO drop while in the Standard Connected Mode:



NOTE: One Ethernet RIO drop can have up to 4 modules added in one CCOTF transaction.

Deletion

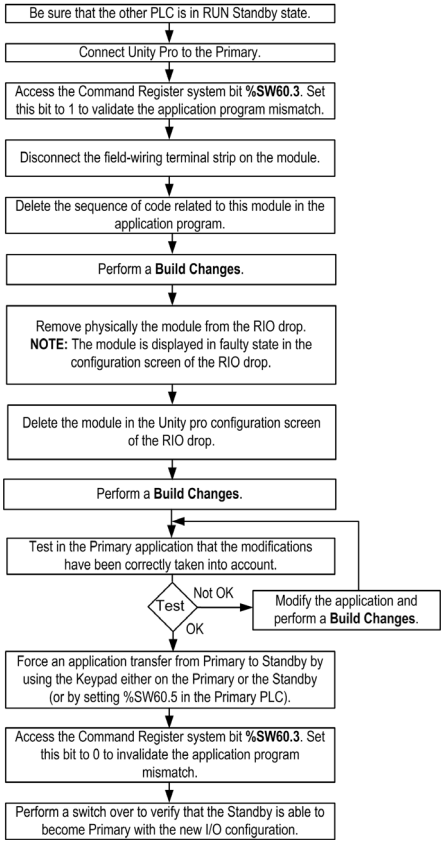
⚠ WARNING

POSSIBLE UNEXPECTED EQUIPMENT BEHAVIOR

Remove the field wiring terminal strip on the module before deleting a module.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when deleting a module from a RIO drop while in the Standard Connected Mode:



NOTE: One Ethernet RIO drop can have up to 4 modules deleted in one CCOTF transaction.

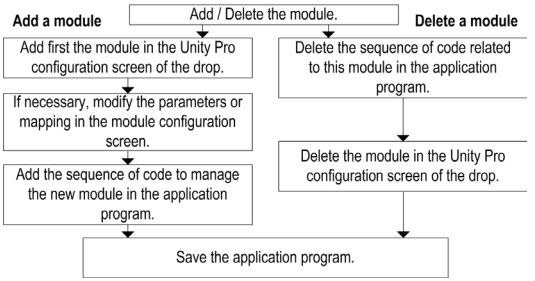
NOTE: A Modicon M340 discrete module with time stamped channels in a Modicon M340 Ethernet RIO drop can not be deleted.

Add/Delete a Module in a Hot Standby S908 RIO Drop or Quantum Ethernet RIO Drop while in the Virtual Connected Mode

Addition/Deletion in Offline Mode

In this mode, it is possible to modify the I/O configuration while the application is offline. The application that is downloaded onto the PLCs has to be generated with the **Virtual connected mode** check box enabled in the **Project settings** →**General** →**Build settings**.

The following flow-chart describes the action to be done when adding or deleting a module in a Hot Standby system while in the **OFFLINE** Virtual Connected Mode:



NOTE: One Ethernet RIO drop can have up to 4 modules added/deleted in one CCOTF transaction.

NOTE: A Modicon M340 discrete module with time stamped channels in a Modicon M340 Ethernet RIO drop can not be deleted.

Addition/Deletion when Connected to the Quantum System

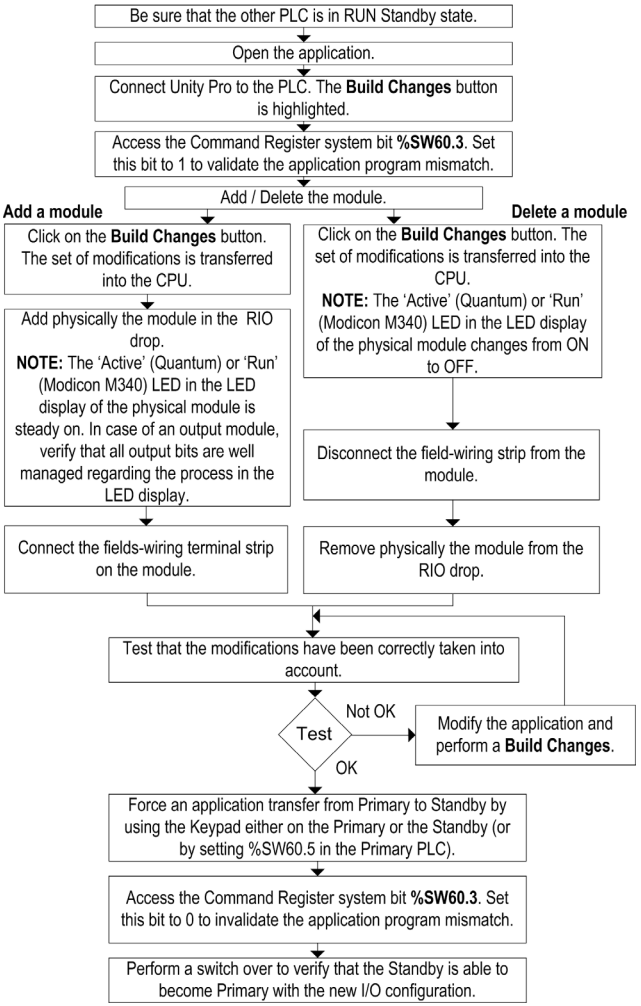
⚠ WARNING

POSSIBLE UNEXPECTED EQUIPMENT BEHAVIOR

Remove the field wiring terminal strip on the module before deleting a module.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when adding or deleting a module in a Hot Standby system while in the **CONNECTED** Virtual Connected Mode:



Chapter 11
Modify Module Parameters

Overview

This chapter describes the procedures to modify module parameters in a local, S908 RIO or Ethernet RIO drop of a Quantum Hot Standby system.

Various types of parameters can be modified *(see page 68)* and Modicon M340 Ethernet RIO drop modules may have specific parameters and behavior *(see page 69)*.

What Is in This Chapter?

This chapter contains the following topics:

Modify Module Parameters in a Hot Standby Drop while in the Standard Connected Mode

Parameter Modifications

⚠ WARNING

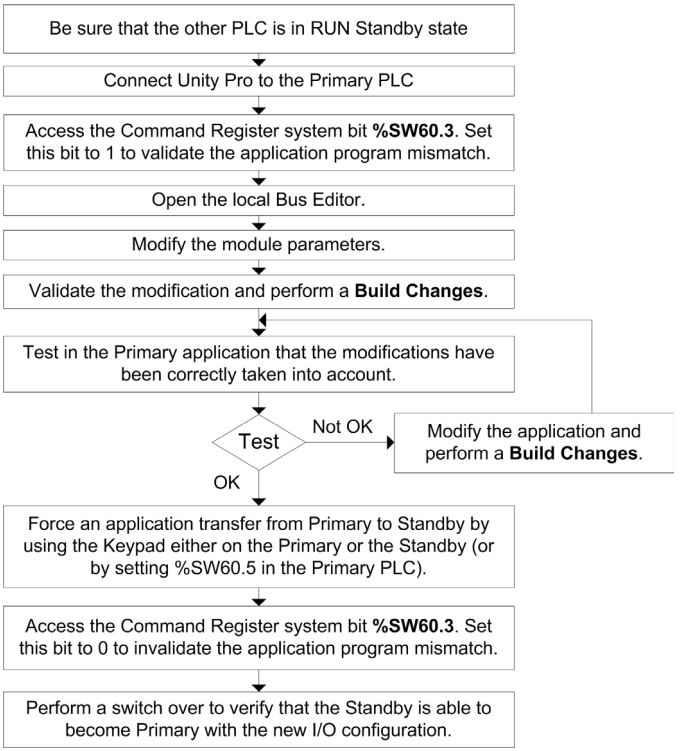
RISK OF UNEXPECTED EQUIPMENT BEHAVIOR

Before doing any CCOTF modification, ensure that your system responds appropriately. Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

The following flow-chart describes the action to be done when modifying module parameters while in the Standard Connected Mode:



Modify Module Parameters in a Hot Standby Drop while in the Virtual Connected Mode

Parameter Modifications in Offline Mode

It is possible to modify the I/O configuration and the application offline. The application that is downloaded in the PLCs has to be generated with the **Virtual Connected Mode** check box enabled in the **Project settings** dialog box.

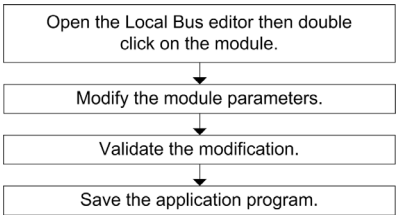
⚠ WARNING

RISK OF UNEXPECTED EQUIPMENT BEHAVIOR

Before doing any CCOTF modification, ensure that your system responds appropriately. Modifications made when the **on line modification in RUN** check box is selected can have an immediate impact on the process.

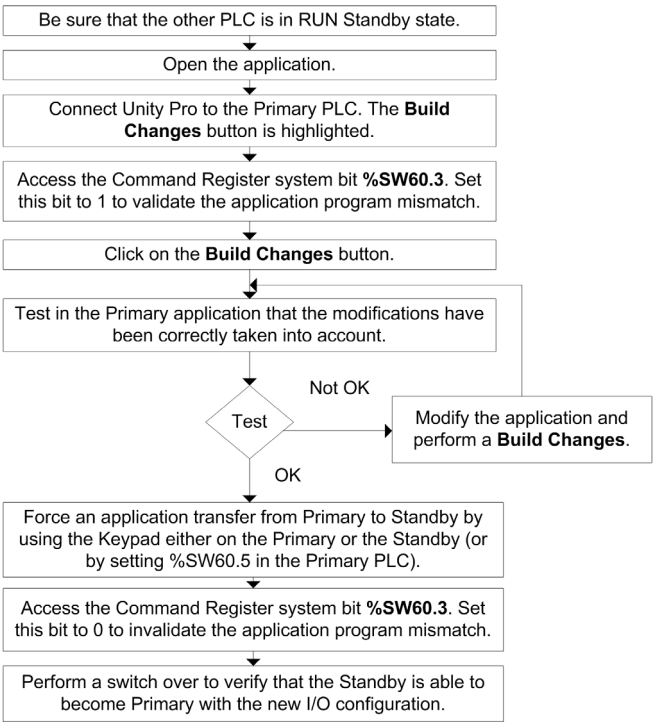
Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following flow-chart describes the action to be done when modifying module parameters while in the **OFFLINE** Virtual Connected Mode:



Parameter Modifications while Connected to the Quantum System

The following flow-chart describes the action to be done when modifying module parameters while in the **CONNECTED** Virtual Connected Mode:



Chapter 12
CCOTF Troubleshooting

Troubleshooting List

Overview

If a CCOTF modification cannot be performed in the Quantum Hot Standby system, check the following potential problems and their solutions in the table below:

Problem	Solution
The system is running as a Standalone system, without redundancy.	Verify that one PLC is in RUN Primary state and the other is in RUN Standby state.
Unity Pro 4.1 or higher version is not installed.	Install Unity 4.1 or higher version.
At least one of the two PLCs has an application that is not CCOTF compatible.	The application must be rebuilt (`Build -> Rebuild All` menu in Unity Pro) and downloaded in both PLCs after changing the processor and checking the **Online Modification in RUN** check box.
CCOTF modification is not allowed.	The system must be running in a Hot Standby configuration (one PLC is in RUN Primary state and the other in RUN Standby state).
CCOTF modification is not allowed in an Ethernet RIO drop.	Verify that Unity Pro is connected to the Primary PLC.
	Verify that the **application program mismatch** bit %SW60.3 is set to 1. *(see page 78)*
A new modification generating more than one mismatch in an Ethernet RIO drop is done.	Transfer the application from Primary to Standby before doing the new modification (Unity Pro proposes an application transfer when trying the new modification). If no application transfer is performed and a Switchover occurs, glitches or bumps may appear on the output *(see page 77)*.

If the potential problem is not described above, refer to the CCOTF general Troubleshooting list *(see page 73)*.

Glossary

0-9

%I

According to the IEC standard, `%I` indicates a discrete input-type language object.

%IW

According to the IEC standard, `%IW` indicates an analog input-type language object.

%M

According to the IEC standard, `%M` indicates a memory bit-type language object.

%MW

According to the IEC standard, `%MW` indicates a memory word-type language object.

%Q

According to the IEC standard, `%Q` indicates a discrete output-type language object.

%QW

According to the IEC standard, `%QW` indicates an analog output-type language object.

A

adapter

The target of real-time I/O data connection requests from scanners. It cannot send or receive real-time I/O data unless it is configured to do so by a scanner, and it does not store or originate the data communications parameters necessary to establish the connection. An adapter accepts explicit message requests (connected and unconnected) from other devices.

advanced mode

A selection in Unity Pro that displays expert-level configuration properties that help define Ethernet connections. To maintain system performance, confirm that advanced mode properties are configured only by persons with a solid understanding of communication protocols.

architecture

A framework for the specification of a network, constructed on the following:

- physical components and their functional organization and configuration
- operational principles and procedures
- data formats used in its operation

ARP

(*address resolution protocol*) A request and reply protocol used for resolution of network layer addresses into link layer addresses, a function in multiple-access networks.

array

A table containing elements of a single type.

The syntax is as follows: `array [<limits>] OF <Type>`

Example:

`array [1..2] OF BOOL` is a one-dimensional table with two elements of type `BOOL`.

`array [1..10, 1..20] OF INT` is a two-dimensional table with 10x20 elements of type `INT`.

ART

(*application response time*) The time a PLC application takes to react to a given input. ART is measured from the time a physical signal in the PLC turns on and triggers a write command until the remote output turns on to signify that the data has been received.

B

BOOL

(*boolean type*) The basic data type in computing. A `BOOL` variable can have either of the following two values: 0 (`FALSE`) or 1 (`TRUE`).

A bit extracted from a word is of type `BOOL`, for example: `%MW10.4`.

BOOTP

(*bootstrap protocol*) A UDP network protocol that can be used by a network client to automatically obtain an IP address from a server. The client identifies itself to the server using its MAC address. The server, which maintains a pre-configured table of client device MAC addresses and associated IP addresses, sends the client its defined IP address. The BOOTP service utilizes UDP ports 67 and 68.

broadcast

A message sent to devices in the subnet.

C

CCOTF

(*change configuration on the fly*) A feature of Unity Pro that allows a PLC hardware change in the system configuration while the PLC is operating and not impacting other active drop operations.

CIP™

(*common industrial protocol*) A comprehensive suite of messages and services for the collection of manufacturing automation applications — control, safety, synchronization, motion, configuration and information. CIP allows users to integrate these manufacturing applications with enterprise-level Ethernet networks and the internet. CIP is the core protocol of EtherNet/IP.

class 1 connection

A CIP transport connection used for I/O data transmission via implicit messaging between EtherNet/IP devices.

class 3 connection
A CIP transport connection used for explicit messaging between EtherNet/IP devices.

connected messaging
Using a CIP connection for communication that establishes a relationship between 2 or more application objects on different nodes. The connection establishes a virtual circuit in advance for a particular purpose, such as frequent explicit messages or real-time I/O data transfers.

connection
A virtual circuit between 2 or more network devices, created prior to the transmission of data. After a connection is established, a series of data is transmitted over the same communication path, without the need to include routing information — including source and destination address — with each piece of data.

connection originator
The EtherNet/IP network node that initiates a connection request for I/O data transfer or explicit messaging.

connectionless
Communication between 2 network devices, where data is sent without prior arrangement between the devices. Each piece of transmitted data includes routing information — including source and destination address.

ConneXium Network Manager
A diagnostic software program that lets you visualize your entire network on a single screen, allowing you to monitor, edit, and troubleshoot your industrial Ethernet network.

ConneXium Network Manager uses Modbus/TCP commands to read binary and word registers from PLCs and I/O devices, and generates alarms based upon register changes, user defined monitors, or limit values.

control network
An Ethernet-based network containing PLCs, SCADA systems, an NTP server, PCs, AMS, switches, etc. Two kinds of topologies are supported:
- flat — Devices in this network belong to the same subnet.
- 2 levels — The network is split into an operation network and an inter-controller network. These 2 networks can be physically independent, but are generally linked by a routing device.

copper cables
Twisted pair cables

D

DDT
(*derived data type*) A set of elements with the same type (`array`) or with different types (structure).

determinism

For a defined application and architecture, the ability to predict that the delay between an event (change of an input value) and the corresponding change of an output state is a finite time *t*, smaller than the time required for your process to run correctly.

device network

An Ethernet-based network within a remote I/O network that contains both remote I/O and distributed I/O devices. Devices connected on this network follow specific rules to allow remote I/O determinism.

DFB

(*derived function block*) Function blocks that can be defined by the user in ST, IL, LD or FBD language.

Using these DFB types in an application makes it possible to:

- simplify the design and entry of the program
- make the program easier to read
- make it easier to debug
- reduce the amount of code generated

DHCP

(*dynamic host configuration protocol*) An extension of the BOOTP communications protocol that provides for the automatic assignment of IP addressing settings—including IP address, subnet mask, gateway IP address, and DNS server names. DHCP does not require the maintenance of a table identifying each network device. The client identifies itself to the DHCP server using either its MAC address, or a uniquely assigned device identifier. The DHCP service utilizes UDP ports 67 and 68.

distributed I/O cloud

A group of distributed I/O devices connected either to a non-ring port on a DRS or to a distributed I/O communications module in the local rack. Distributed I/O clouds are single-point connections to the Quantum EIO network and are not required to support RSTP.

distributed I/O device

Any Ethernet device (Schneider Electric device, PC, servers, or third-party devices) that supports I/O exchange with a PLC or other Ethernet communication service.

distributed I/O network

A network containing distributed I/O devices that integrates a unique standalone PLC or a unique Hot Standby system. I/O scanning may be performed by a communication module interlinked with a remote I/O head module on the local rack of an Ethernet remote I/O system. Distributed I/O network traffic is delivered after remote I/O traffic, which takes priority in an Ethernet remote I/O network.

DNS

(*domain name server/service*) A service that translates an alpha-numeric domain name into an IP address, the unique identifier of a device on the network.

domain name

An alpha-numeric string that identifies a device on the internet, and which appears as the primary component of a web site's uniform resource locator (URL). For example, the domain name *schneider-electric.com* is the primary component of the URL *www.schneider-electric.com*.

Each domain name is assigned as part of the domain name system, and is associated with an IP address.

Also called a host name.

DRS

(*dual-ring switch*) A ConneXium extended managed switch with one of several possible predefined configurations downloaded to it so that it can participate in a Quantum EIO network. A DRS provides 2 RSTP-enabled ring connections, one for the main ring and one for a sub-ring. It also manages QoS, which provides a predictable level of performance for both remote I/O and distributed I/O traffic on the same I/O network.

DRSs require a firmware version 6.0 or later.

DT

(*date and time*) A data type encoded in BCD in a 64-bit format that contains the following information:

- the year encoded in a 16-bit field
- the month encoded in an 8-bit field
- the day encoded in an 8-bit field
- the time encoded in an 8-bit field
- the minutes encoded in an 8-bit field
- the seconds encoded in an 8-bit field

NOTE: The 8 least significant bits are not used.

The `DT` type is entered as follows:

`DT#``<Year>`**`-`**`<Month>`**`-`**`<Day>`**`-`**`<Hour>`**`:`**`<Minutes>`**`:`**`<Seconds>`

This table shows the upper/lower limits of each field:

Field	Limits	Comment
Year	[1990,2099]	Year
Month	[01,12]	The leading 0 is displayed; it can be omitted during data entry.
Day	[01,31]	For months 01/03/05/07/08/10/12
	[01,30]	For months 04/06/09/11
	[01,29]	For month 02 (leap years)
	[01,28]	For month 02 (non-leap years)
Hour	[00,23]	The leading 0 is displayed; it can be omitted during data entry.
Minute	[00,59]	The leading 0 is displayed; it can be omitted during data entry.
Second	[00,59]	The leading 0 is displayed; it can be omitted during data entry.

DTM

(*device type manager*) A device driver running on the host PC. It provides a unified structure for accessing device parameters, configuring and operating the devices, and troubleshooting the network. DTMs can range from a simple graphical user interface (GUI) for setting device parameters to a highly sophisticated application capable of performing complex real-time calculations for diagnosis and maintenance purposes. In the context of a DTM, a device can be a communications module or a remote device on the network.

See *FDT*.

E

EDS

(*electronic data sheet*) Simple text files that describe the configuration capabilities of a device. EDS files are generated and maintained by the manufacturer of the device.

EF

(*elementary function*) A block used in a program to perform a predefined logical function.

A function does not have any information on the internal state. Several calls to the same function using the same input parameters will return the same output values. You will find information on the graphic form of the function call in the [*functional block (instance)*]. Unlike a call to a function block, function calls include only an output which is not named and whose name is identical to that of the function. In FBD, each call is indicated by a unique [number] via the graphic block. This number is managed automatically and cannot be modified.

Position and configure these functions in your program in order to execute your application.

You can also develop other functions using the SDKC development kit.

EFB

(*elementary function block*) A block used in a program to perform a predefined logical function.

EFBs have states and internal parameters. Even if the inputs are identical, the output values may differ. For example, a counter has an output indicating that the preselection value has been reached. This output is set to 1 when the current value is equal to the preselection value.

EN

(*enable*) An optional block input. When enabled, an `ENO` output is set automatically.

If `EN` = 0, the block is not enabled; its internal program is not executed, and `ENO` is set to 0.

If `EN` = 1, the block's internal program is run and `ENO` is set to 1. If a runtime error is detected, `ENO` is set to 0.

If the `EN` input is not connected, it is set automatically to 1.

ENO

error notification The output associated with the optional input EN.

If ENO is set to 0 (either because EN = 0 or if a runtime error is detected):

- The status of the function block outputs remains the same as it was during the previous scanning cycle that executed correctly.
- The output(s) of the function, as well as the procedures, are set to 0.

Ethernet

A 10 Mb/s, 100 Mb/s, or 1 Gb/s, CSMA/CD, frame-based LAN that can run over copper twisted pair or fiber optic cable, or wireless. The IEEE standard 802.3 defines the rules for configuring a wired Ethernet network; the IEEE standard 802.11 defines the rules for configuring a wireless Ethernet network. Common forms include 10BASE-T, 100BASE-TX, and 1000BASE-T, which can utilize category 5e copper twisted pair cables and RJ45 modular connectors.

EtherNet/IP™

A network communication protocol for industrial automation applications that combines the standard internet transmission protocols of TCP/IP and UDP with the application layer common industrial protocol (CIP) to support both high speed data exchange and industrial control. EtherNet/IP employs electronic data sheets (EDS) to classify each network device and its functionality.

explicit messaging

TCP/IP-based messaging for Modbus TCP and EtherNet/IP. It is used for point-to-point, client/server messages that include both data—typically unscheduled information between a client and a server—and routing information. In EtherNet/IP, explicit messaging is considered class 3 type messaging, and can be connection-based or connectionless.

explicit messaging client

(*explicit messaging client class*) The device class defined by the ODVA for EtherNet/IP nodes that only support explicit messaging as a client. HMI and SCADA systems are common examples of this device class.

extended distributed I/O network

An Ethernet-based network containing distributed I/O devices located on an existing distributed I/O network that participate in an Ethernet remote I/O network through use of an *extended port* on a control network head module.

F

FBD

(*function block diagram*) A graphical programming language that works like a flowchart. By adding simple logical blocks (AND, OR, etc.), each function or function block in the program is represented in this graphical format. For each block, the inputs are on the left and the outputs on the right. Block outputs can be linked to inputs of other blocks in order to create complex expressions.

FDR

(*faulty device replacement*) A service that uses configuration software to replace an inoperable device.

FDT

(*field device tool*) The technology that harmonizes communication between field devices and the system host.

fiber converter module

Module installed on Modicon X80 racks and Ethernet remote I/O drops to:

- extend the total length of the Quantum EIO network — when you have Ethernet remote I/O drops in separate areas of a factory that are more than 100 m apart
- improve noise immunity
- resolve possible grounding issues — when using different grounding methods is required between 2 buildings

FTP

(*file transfer protocol*) A protocol that copies a file from one host to another over a TCP/IP-based network, such as the internet. FTP uses a client-server architecture as well as separate control and data connections between the client and server.

full duplex

The ability of 2 networked devices to independently and simultaneously communicate with each other in both directions.

G

gateway

A device that interconnects 2 different networks — sometimes with different network protocols. When used to connect networks based on different protocols, a gateway converts a datagram from one protocol stack into the other. When used to connect 2 IP-based networks, a gateway (also called a router) has 2 separate IP addresses – one on each network.

global data

Global data provides the automatic exchange of data variables for the coordination of PLC applications.

H

harsh environment

Resistance to hydrocarbons, industrial oils, detergents and solder chips. Relative humidity up to 100%, saline atmosphere, significant temperature variations, operating temperature between -10° C and + 70° C, or in mobile installations.

high-capacity daisy chain loop

Often referred to as HCDCL, a high-capacity daisy chain loop uses DRSs to extend the distance between remote I/O drops or connect sub-rings (containing remote I/O drops or distributed I/O devices) and/or distributed I/O clouds to the Ethernet remote I/O network.

HMI

(*human machine interface*) An HMI is a device that displays process data to a human operator, who in turn uses the HMI to control the process.

An HMI is typically connected to a SCADA system to provide diagnostics and management data — such as scheduled maintenance procedures and detailed schematics for a particular machine or sensor.

Hot Standby

A high-availability Quantum control system with a second (standby) PLC that maintains up-to-date system status. If the primary PLC becomes inoperable, the standby PLC takes control of the system.

HTTP

(*hypertext transfer protocol*) A networking protocol for distributed and collaborative information systems. HTTP is the basis of data communication for the web.

I

I/O scanning

Continuously polling the I/O modules to collect data and status, event, and diagnostics information. This process monitors inputs and controls outputs.

IEC

(*international electrotechnical commission*) The agency that prepares and publishes international standards for electrical, electronic, and related technologies.

IEC 61131-3

International standard: programmable logic controllers

Part 3: programming languages

IGMP

(internet group management protocol) This internet standard for multicasting allows a host to subscribe to a particular multicast group.

IL

(*instruction list*) A series of basic instructions similar to assembly language used to program processors. Each instruction is made up of an instruction code and an operand.

implicit messaging

UDP/IP-based class 1 connected messaging for EtherNet/IP. Implicit messaging maintains an open connection for the scheduled transfer of control data between a producer and consumer. Because an open connection is maintained, each message contains primarily data — without the overhead of object information — and a connection identifier.

independent distributed I/O network
An Ethernet-based network containing distributed I/O devices located on an existing distributed I/O network that participate in the control network only of an Ethernet remote I/O network.

INT
(*integer*) (encoded in 16 bits) The upper/lower limits are as follows: -(2 to the power of 15) to (2 to the power of 15) - 1.

Example:

```
-32768, 32767, 2#1111110001001001, 16#9FA4.
```

inter-controller network
An Ethernet-based network that is part of the control network, and provides data exchange between controllers and engineering tools (programming, asset management system (AMS)).

interlink port
An Ethernet port on Ethernet remote I/O head modules allowing direct connection of distributed I/O modules to the remote I/O network and transparency between a control network and the Ethernet remote I/O network.

IP address
The 32-bit identifier — consisting of both a network address and a host address — assigned to a device connected to a TCP/IP network.

isolated distributed I/O network
An Ethernet-based network containing distributed I/O devices that do not participate in an Ethernet remote I/O network.

J

jitter
Jitter is the time variation in the delivery of an Ethernet packet, caused by packet queuing along its network travel path. Jitter can be reduced to predictable amounts by applying packet handling policies—e.g. quality of service (QoS)—that grant priority to the packets of a specified type (e.g. remote I/O data packets) over other packet types.

L

LD
(*ladder diagram*) A programming language that represents instructions to be executed as graphical diagrams very similar to electrical diagrams (contacts, coils, etc.).

legacy (S908) remote I/O
A Quantum remote I/O system using coaxial cabling and terminators.

literal value of an integer

A value used to enter integer values in the decimal system. Values may be preceded by the "+" and "-" signs. Underscore signs (_) separating numbers are not significant.

Example:

```
-12, 0, 123_456, +986
```

local rack

A Quantum rack containing the controller, a power supply, and an Ethernet remote I/O head module. A local rack consists of 1 or 2 racks — the main rack (containing the remote I/O head module) and an optional extended rack. A Quantum Ethernet remote I/O network requires 1 local rack on the main ring.

local slave

A functionality offered by Schneider Electric EtherNet/IP communication modules that allows a scanner to take the role of an adapter. The local slave enables the module to publish data via implicit messaging connections. Local slave is typically used in peer-to-peer exchanges between PLCs.

M

MAST

A master processor task that is run through its programming software. The MAST task has 2 sections:

- IN: Inputs are copied to the IN section before execution of the MAST task.
- OUT: Outputs are copied to the OUT section after execution of the MAST task.

MIB

(*management information base*) A virtual database used for managing the objects in a communications network. See SNMP.

Modbus

An application-layer messaging protocol. Modbus provides client and server communications between devices connected on different types of buses or networks. Modbus offers many services specified by function codes.

Modbus/TCP

(*Modbus over TCP protocol*) A Modbus variant used for communications over TCP/IP networks.

multicast

A special form of broadcast where copies of the packet are delivered to only a specified subset of network destinations. Implicit messaging typically uses multicast format for communications in an EtherNet/IP network.

N

network

There are 2 meanings:

- In a ladder diagram:
  A set of interconnected graphic elements. The scope of a network is local, concerning the organizational unit (section) of the program containing the network.
- With expert communication modules:
  A set of stations that intercommunicate. The term *network* is also used to define a group interconnected graphic elements. This group then makes up part of a program that may comprise a group of networks.

NIM

(*network interface module*) A NIM resides in the first position on an STB island (leftmost on the physical setup). The NIM provides the interface between the I/O modules and the fieldbus master. It is the only module on the island that is fieldbus-dependent — a different NIM is available for each fieldbus.

NTP

(*network time protocol*) Protocol for synchronizing computer system clocks. The protocol uses a jitter buffer to resist the effects of variable latency.

O

O->T

(*originator to target*) See *originator* and *target*.

operation network

An Ethernet-based network containing operator tools (SCADA, client PC, printers, batch tools, EMS, etc.). PLCs are connected directly or through routing of the inter-controller network. This network is part of the control network.

originator

In EtherNet/IP, a device is considered the originator when it initiates a CIP connection for implicit or explicit messaging communications or when it initiates a message request for un-connected explicit messaging.

OS Loader

Firmware upgrade tool for Quantum hardware.

P

PLC

programmable logic controller. The PLC is the brain of an industrial manufacturing process. It automates a process as opposed to relay control systems. PLCs are computers suited to survive the harsh conditions of the industrial environment.

port 502

Port 502 of the TCP/IP stack is the well-known port that is reserved for Modbus communications.

port mirroring

In this mode, data traffic that is related to the source port on a network switch is copied to another destination port. This allows a connected management tool to monitor and analyze the traffic.

NOTE: In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Unity Pro, etc.) through the SERVICE port on the 140 CRP 312 00 head module and the 140 CRA 312 00 and BMX CRA 312 •0 adapter modules.

Q

QoS

(*quality of service*) The practice of assigning different priorities to traffic types for the purpose of regulating data flow on the network. In an industrial network, QoS is used to provide a predictable level of network performance.

Quantum Ethernet I/O device

These devices in Quantum Ethernet I/O systems provide automatic network recovery and deterministic remote I/O performance. The time it takes to resolve a remote I/O logic scan can be calculated, and the system can recover quickly from a communication disruption. Quantum Ethernet I/O devices include:

- local rack (with an Ethernet remote I/O head module)
- remote I/O drop (with an Ethernet adapter module)
- DRS pre-configured switch

R

rack optimized connection

Data from multiple I/O modules consolidated in a single data packet to be presented to the scanner in an implicit message in an EtherNet/IP network.

remote I/O drop

One of the 3 types of remote I/O devices in an Ethernet remote I/O network. A remote I/O drop is a Quantum rack of I/O modules that are connected to an Ethernet remote I/O network and managed by an Ethernet remote adapter module. A drop can be a single rack or a rack with an extension rack.

remote I/O main ring

The main ring of an Ethernet remote I/O network. The ring contains remote I/O devices and a local rack (containing a controller, a power supply module, and an Ethernet remote I/O head module).

remote I/O network

An Ethernet-based network that contains 1 standalone PLC or one Hot Standby system and remote I/O devices. There are 3 types of remote I/O devices: a local rack, a remote I/O drop, and a ConneXium extended dual-ring switch (DRS). Distributed I/O devices may also participate in a remote I/O network via connection to DRSs.

RPI

(requested packet interval) The time period between cyclic data transmissions requested by the scanner. EtherNet/IP devices publish data at the rate specified by the RPI assigned to them by the scanner, and they receive message requests from the scanner at each RPI.

RSTP

(*rapid spanning tree protocol*) A protocol that allows a network design to include spare (redundant) links to provide automatic backup paths if an active link stops working, without the need for loops or manual enabling/disabling of backup links.

S

S908 legacy remote I/O

A Quantum remote I/O system using coaxial cabling and terminators.

SCADA

(*supervisory control and data acquisition*) SCADA systems are computer systems that control and monitor industrial, infrastructure, or facility-based processes (examples: transmitting electricity, transporting gas and oil in pipelines, and water distribution).

scanner

The originator of I/O connection requests for implicit messaging in EtherNet/IP, and message requests for Modbus TCP.

scanner class device

An EtherNet/IP node capable of originating exchanges of I/O with other nodes in the network.

service port

A dedicated Ethernet port on the Quantum Ethernet remote I/O modules. The port may support 3 major functions (depending on the module type):

- port mirroring — for diagnostic use
- access — for connecting HMI/Unity Pro/ConneXium Network Manager to the PLC
- extended — to extend the device network to another subnet
- disabled — disables the port, no traffic is forwarded in this mode

SFC

(*sequential function chart*) An IEC programming language that graphically represents, in a structured manner, the operation of a sequential PLC. This graphical description of the PLC's sequential behavior and of the various resulting situations is created using simple graphic symbols.

simple daisy chain loop

A daisy chain loop that contains remote I/O devices only (no switches or distributed I/O devices). This topology consists of a local rack (containing a remote I/O head module), and 1 or more remote I/O drops (each drop containing a remote I/O adapter module).

SMTP

(*simple mail transfer protocol*) An email notification service that allows controller-based projects to report alarms or events. The controller monitors the system and can automatically create an email message alert with data, alarms, and/or events. Mail recipients can be either local or remote.

SNMP

(*simple network management protocol*) Protocol used in network management systems to monitor network-attached devices for events. The protocol is part of the internet protocol suite (IP) as defined by the internet engineering task force (IETF), which consists of network management guidelines, including an application layer protocol, a database schema, and a set of data objects.

SNTP

(*simple network time protocol*) See *NTP*.

SOE

(*sequence of events*) The process of determining the order of events in an industrial system and correlating those events to a real-time clock.

ST

(*structured text*) A structured, developed language similar to computer programming languages. It can be used to organize a series of instructions.

sub-ring

An Ethernet-based network with a loop attached to the main ring, via a DRS. A sub-ring may contain either remote I/O or distributed I/O devices.

subnet mask

The 32-bit value used to hide (or mask) the network portion of the IP address and thereby reveal the host address of a device on a network using the IP protocol.

switch

A multi-port device used to segment the network and limit the likelihood of collisions. Packets are filtered or forwarded based upon their source and destination addresses. Switches are capable of full-duplex operation and provide full network bandwidth to each port. A switch can have different input/output speeds (for example, 10, 100 or 1000 Mb/s). Switches are considered OSI layer 2 (data link layer) devices.

T

T->O

(*target to originator*) See *target* and *originator*.

target

In EtherNet/IP, a device that is the recipient of a connection request for implicit or explicit messaging communications, or when it is the recipient of a message request for un-connected explicit messaging.

TCP

(*transmission control protocol*) A key protocol of the internet protocol suite that supports connection-oriented communications, by establishing the connection necessary to transmit an ordered sequence of data over the same communication path.

TCP/IP

Also known as *internet protocol suite*, TCP/IP is a collection of protocols used to conduct transactions on a network. The suite takes its name from 2 commonly used protocols: transmission control protocol and internet protocol. TCP/IP is a connection-oriented protocol that is used by Modbus TCP and EtherNet/IP for explicit messaging.

TOD

(*time of day*) The `TOD` type, encoded in BCD in a 32-bit format, contains the following information:

- the hour encoded in an 8-bit field
- the minutes encoded in an 8-bit field
- the seconds encoded in an 8-bit field

NOTE: The 8 least significant bits are not used.

The TOD type is entered as follows: **`TOD#`**`<Hour>:<Minutes>:<Seconds>`

This table shows the upper/lower limits of each field:

Field	Limits	Comment
Hour	[00,23]	The leading 0 is displayed; it can be omitted during data entry.
Minute	[00,59]	The leading 0 is displayed; it can be omitted during data entry.
Second	[00,59]	The leading 0 is displayed; it can be omitted during data entry.

Example: `TOD#23:59:45`.

TR

(*transparent ready*) Web-enabled power distribution equipment, including medium- and low-voltage switch gear, switchboards, panel boards, motor control centers, and unit substations. Transparent Ready equipment allows you to access metering and equipment status from any PC on the network, using a standard web browser.

trap

An event directed by an SNMP agent that indicates one of the following:

- a change has occurred in the status of an agent
- an unauthorized SNMP manager device has attempted to get data from, or change data on, an SNMP agent

U

UDP

(*user datagram protocol*) A transport layer protocol that supports connectionless communications. Applications running on networked nodes can use UDP to send datagrams to one another. UDP does not always deliver datagrams as reliable or ordered as those delivered by TCP. However, by avoiding the overhead required for TCP, UDP is faster. UDP may be the preferred protocol for time-sensitive applications, where dropped datagrams are preferable to delayed datagrams. UDP is the primary transport for implicit messaging in EtherNet/IP.

V

variable

Memory entity of type `BOOL`, `WORD`, `DWORD`, etc., whose contents can be modified by the program currently running.

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