Modicon Quantum Hot Standby with Unity User Manual

UNY USE 107 10 V20E

September 2004

33002507 01

a brand of Schneider Electric

Telemecanique

Table of Contents

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 or Warning 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, serious injury, or equipment damage.

⚠ WARNING

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

⚠ CAUTION

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

PLEASE NOTE

Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About the Book

At a Glance

Document Scope

This guide describes the Modicon Quantum Hot Standby with Unity system consisting of the Unity Pro software, the Modicon Quantum Hot Standby with Unity 140 CPU 671 60, power supplies, and remote I/O (RIO).
This guide describes how to build a Modicon Quantum Hot Standby with Unity system. Users of legacy Quantum Hot Standby systems should note that significant differences exist between Unity and legacy systems, and where important, this guide identifies those differences.

Note: Software Requirements
Required to use a Quantum Modicon Hot Standby with Unity system:
- Unity Pro 2.0 or higher
- CRA firmware: Release 1.25 or higher
- CRP firmware: Release 1.14 or higher

Note: Who should use this document?
Anyone who uses a Hot Standby system or needs fault-tolerant availability through redundancy in an automation system.
You should have knowledge of programmable logic controllers (PLCs). Familiarity with automation controls is expected.
You should possess a working knowledge of the Unity Pro software. Familiarity with Concept, ProWORX, or Modsoft will help.

Note: Terminology
This guide uses the following terminology.
- application program = a project or logic program
- controller = a Unity Programmable Logic Controller (PLC), module, which contains both
  1. a CPU
  2. a Copro
- CPU = (Central Processing Unit) a microprocessor in the controller, which processes the application program
- copro = a microprocessor in the controller, which communicates between two controllers
- modify = to edit or to change an application program
- module = any unit either a controller, NOE, RIO, CRP, CRA, DDI, AVO
- scan = program cycle

Because Modicon Quantum Hot Standby with Unity systems deliver fault-tolerant availability through redundancy, use a Modicon Quantum Hot Standby with Unity system when downtime cannot be tolerated. Redundancy means that two backplanes are configured identically. A Modicon Quantum Hot Standby with Unity system must have identical configurations:
- identical 140 CPU 671 60s which contain both a CPU and a Copro
- identical versions of the EXEC
- identical power supplies
- identical RIO Heads
- identical cabling and cabling systems
- identical I/O drops
- identical sequential placement on the backplane

Validity Note

The data and illustrations found in this book are not binding. We reserve the right to modify our products in line with our policy of continuous product development. The information in this document is subject to change without notice and should not be construed as a commitment by Schneider Electric.

Related Documents

Title of Documentation	Reference Number
Quantum with Unity Pro Hardware Reference Manual	Electronic Documentation CD: UNYUSE909CDM
Quantum with Unity Pro Discrete and Analog I/O Reference Manual	Electronic Documentation CD: UNYUSE909CDM
Quantum with Unity Pro Experts and Communication Reference Manual	Electronic Documentation CD: UNYUSE909CDM
Quantum Automation Series Hardware Reference Manual	840USE10000
Modbus Plus Network I/O Servicing Guide, Version 2.0	840USE10400
Remote I/O Cable System Planning and Installation Guide, Version 3.0	890USE10100
Modbus Plus Network Planning and Installation Guide, Version 4.0	890USE10000

Product Related Warnings

Schneider Electric assumes no responsibility for any errors that may appear in this document. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.
No part of this document may be reproduced in any form or by any means, electronic or mechanical, including photocopying, without express written permission of Schneider Electric.
All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to ensure compliance with documented system data, only the manufacturer should perform repairs to components.
When controllers are used for applications with technical safety requirements, please follow the relevant instructions.
Failure to use Schneider Electric software or approved software with our hardware products may result in improper operating results.
Failure to observe this product related warning can result in injury or equipment damage.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techpub@schneider-electric.com

Introducing the Modicon Quantum Hot Standby with Unity System

I

At a Glance

Purpose

This part introduces the Modicon Quantum Hot Standby with Unity system. The content describes the hardware available, the compatibility of Modicon Quantum Hot Standby with Unity system with legacy systems, and using IEC logic and Unity.

What's in this Part?

This part contains the following chapters:

Modicon Quantum Hot Standby with Unity Overview

1

Introduction

Overview

In this chapter you will find a brief overview of the Modicon Quantum Hot Standby with Unity system, the module, and the indicators.

What's in this Chapter?

This chapter contains the following topics:

Overview of the Modicon Quantum Hot Standby with Unity System

Purpose of a Hot Standby System

Use a Modicon Quantum Hot Standby with Unity system when downtime cannot be tolerated. Hot standby systems deliver high availability through redundancy. A hot standby system consists of two identical configurations.

- Modicon Quantum 140 CPU 671 60
- Modicon Quantum Power Supply Module
- Modicon Quantum RIO Head
- Modicon Optional Modules (NOE, NOM)

One of the 140 CPU 67160's acts as the Primary controller, and the other acts as the Standby controller. The Primary controller runs the application program and operates the remote I/O.

Identical Configurations

Two backplanes are configured with identical hardware and software.
One of the programmable logic controllers (PLCs) functions as the Primary controller and the other as a Standby controller, and either controller can be put in the Primary state, but the other must be in the Standby state or offline.

Primary and Standby Controllers

The Primary controller executes the application program, controls the remote I/O, and updates the Standby controller after every scan (program cycle). If the Primary controller fails, the Standby controller takes control within one scan. To determine if the Primary controller failed, note controller's status displayed in the HE CPU LCD screen and the RIO Head's status displayed by the RIO Head's LEDs. (See *Troubleshooting the Primary, p. 133*)
The Standby controller does not execute the full application program but only the first section, and the Standby controller does not control the remote I/O but checks out the availability of the Modicon Quantum Hot Standby with Unity equipment.

Switchover Capability

Either of the two controllers may function as the Primary controller and the other as the Standby controller.
Primary and Standby states are switchable.
Therefore, if one of the two controllers is functioning as the Primary controller, the other must be in Standby mode. Otherwise, the second controller is in the default mode, which is offline.
The remote I/O is always controlled by the Primary controller.

Monitoring the System

The Primary and the Standby controllers communicate with each other constantly to monitor the functionality of the system.

- If the Primary controller fails, the state of the controllers is switched.
  The Standby controller becomes the Primary, executes the application program, and controls the remote I/O.

- If the Standby controller fails, the Primary controller continues to run without redundancy and acts as a stand alone system.

Power Cycle

On power cycle, the controller that has the lowest MAC address will become the Primary. The second system automatically becomes the Standby.

Handling I/O

Note: The Modicon Quantum Hot Standby with Unity system supports I/O connected to a Remote I/O network and Ethernet I/O scanning.

Handling Local I/O

Local I/O is not supported in a Modicon Quantum Hot Standby with Unity system environment. However, local I/O can be configured and run but will not have any corresponding backup.

Software Requirements

Required to use a Quantum Modicon Hot Standby with Unity system:

- Unity Pro 2.0 or higher
- CRA firmware: Release 1.25 or higher
- CRP firmware: Release 1.14 or higher

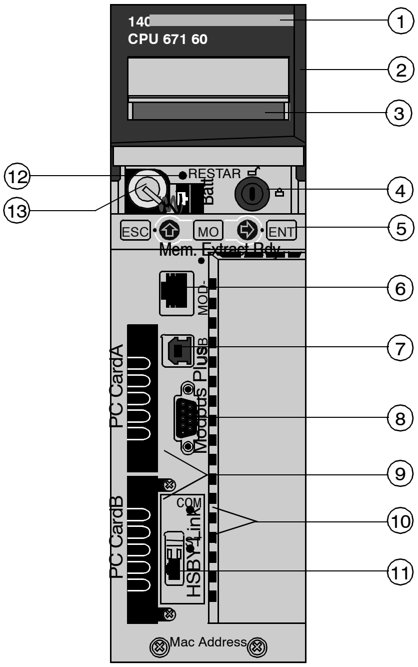
Configuring Modbus Plus (MB+) Addresses

Note: Configure MB+ address first time
1. Default MB+ address = 1 (new 140 CPU 671 60 from factory)
2. Change MB+ address at first configuration (on both controllers)
Schneider Electric recommends: do not change MB+ address after first configuration because unintended operation may result.)
(See *Configuring a System with the Unity Pro Tabs and Dialogs, p. 70*)

Modicon Quantum Hot Standby with Unity 140 CPU 671 60 Module Overview

Illustration

The following figure shows the Modicon Quantum Hot Standby (with Unity) 140 CPU 671 60 module and its components. Its HSBY fiber optic communications port differentiates this High End CPU module from the 140 CPU 651 60.



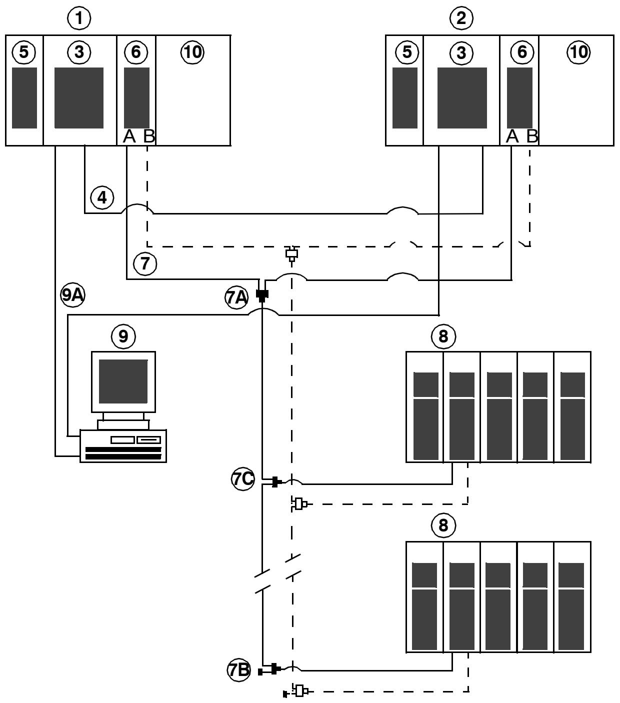
1 Model number, module description, color code
2 Lens cover (open)
3 LCD Display (here covered by lens cover)
4 Key switch
5 Keypad (with 2 red LED indicators)
6 Modbus port (RS-232) (RS-485)
7 USB port
8 Modbus Plus port
9 PCMCIA slots A and B (Type II, Type III)
10 LED indicators (yellow) for Ethernet communication
11 HSBY fiber optic communications port
12 Restart button
13 Battery (user installed)

Note: Unity Quantum High End CPUs are equipped with two receptacles (A and B) in which to install PCMCIA cards. PCMCIA is a standard type of memory card.

Modicon Quantum Hot Standby with Unity System Overview

System Components

The following graphic shows the components required for a Modicon Quantum Hot Standby with Unity system.



1 Primary PLC

2 Standby PLC

3 Modicon Quantum Hot Standby with Unity controller with integrated coprocessor

4 Fiber Optic Cable to connect to both controllers

5 Modicon Quantum power supply module: Install power supply in first slot for better rack layout.

6 Modicon Quantum RIO head

7 Coaxial cable with splitters (7A) (MA-0186-100), trunk terminators (7B) (52-0422-000), and tap (7C) (MA-0185-100) for connecting the RIO heads (6) with the RIO drops (8). The dashed connections represent a redundant connection in the RIO network, which is not required for the Modicon Quantum Hot Standby with Unity system.

8 Modicon Quantum RIO drop

9 Unity Pro computer connected to both controllers via Modbus or Modbus Plus (9A)

10 Optional modules (NOMs, NOEs) if required

Software Requirements

Please note

- CRA modules must have V1.25 or higher of the firmware
  The Unity Hot Standby system is NOT compatible with previous versions of CRA modules.
- CRP modules must have V1.14 or higher of the firmware
  The Unity Hot Standby system is NOT compatible with previous versions of CRP modules.

Modicon Quantum Hot Standby with Unity 140 CPU 671 60 Components

Lens Cover

Protects and provides access to
- Key Switch
- Battery
- Reset Button

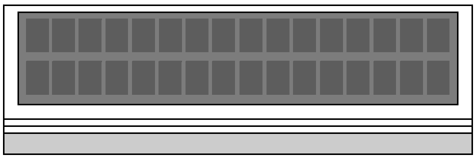
Open the lens cover by sliding upwards.

LCD Display

Has a 2 lines by 16 characters LCD display with a backlight (dims) and adjustable contrast.
The backlight turns on when
- keypad driver detects a key press
- key switch state is changed
- error message is displayed on the LCD

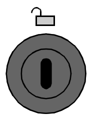
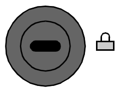
The backlight dims if
- no key switch or keypad activity
  Backlight dims in 5 seconds.
- error message is generated
  Backlight remains on until the error is corrected and the error message stops.

2 Lines by 16 characters LCD



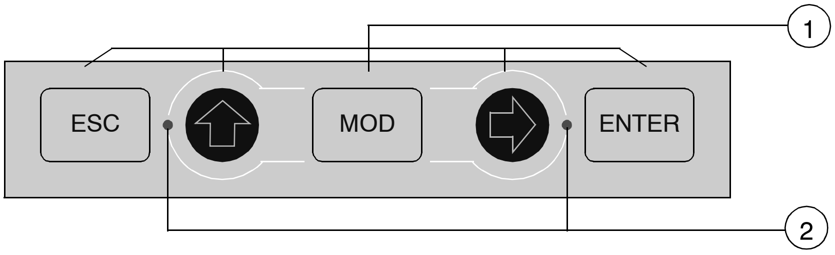
Key Switch

Use the key switch as a security feature and memory protection switch.
The key switch has two positions: locked and unlocked.

Key position	PLC operation
unlocked 	● all system menu operations are able to be invoked and all changeable module parameters are able to be modified by the operator via the LCD and keypad ● memory protection is OFF
locked 	● no system menu operations are able to be invoked and all module parameters are read only ● memory protection is ON
Switching the key switch position from locked to unlocked or vice versa will turn on the LCD's backlight.	

Keypad

The Modicon Quantum Hot Standby with Unity 140 CPU 671 60 keypad consists of five keys that are mapped to a hardware address.
5-key keypad with 2 LEDs



1 5 keys

2 2 LEDs

Use the keys on the keypad to access the Modicon Quantum Hot Standby with Unity set of system menus, which enable you to
- perform PLC operations
  for example: Start PLC, Stop PLC
- display module parameters
  for example, communications parameters

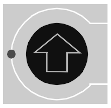
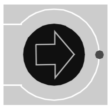
Reset Button

Forces a cold start of the PLC.

Operating the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 Keypad

Using the Keys

Functionality

Key	Function	
ESC	To cancel an entry, or suspend or stop an action in progress To display the preceding screens successively (step up the menu tree)	
ENTER	To confirm a selection or an entry	
MOD	To set a field on the display into modify mode	
	LED: on	key active ● To scroll through menu options ● To scroll through modify mode field options
	LED: flashing	key active ● Field in modify mode has options to scroll through
	LED: off	key inactive ● No menu options, no field options
	LED on	key active ● To move around in a screen, field to field ● To go to the sub-menu
	LED flashing	key active ● To move around in a field that is in modify mode, digit to digit
	LED off	key inactive ● No sub-menu for menu option ● No moving around in a screen ● No moving around in a field

Adjusting the Contrast

The contrast is adjustable from the keypad when the Default screen is displayed as follows:

Step	Action
1	Press the `MOD` key: MOD
2	To adjust the contrast darker press: ⇧
3	To adjust the contrast lighter press: ⇨
4	To confirm the setting press: ENTER

Using the Backlight

Pressing a key will turn on the LCD backlight (if it was off). When the user presses the `ESC` key and the LCD backlight was off, the LCD backlight will turn on and the Default Screen will stay as the displayed screen.
If at any time the executive detects an error in the CPU it will display an error message to the LCD and the LCD's backlight will turn on until the error condition disappears

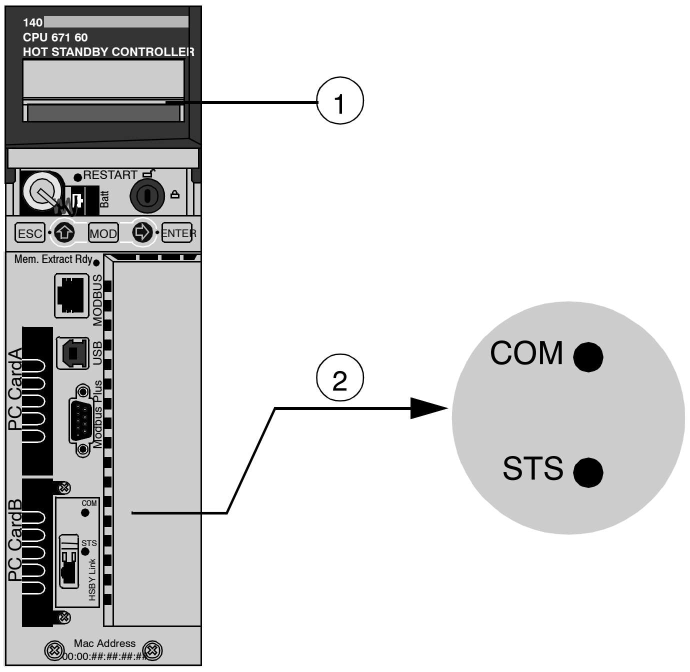
Using the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 LED Indicators

Overview

The Modicon Quantum Hot Standby with Unity 140 CPU 671 60 offers two indicators:

1. LCD display screen
   (See *Using the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 LCD Display Screens, p. 27*)
   The default display screen serves as a controller status screen. (See *Understanding the Default Screen, p. 29*)
2. LED Indicators
   (See *Interpreting the LED Indicators, p. 26*)

Position of indicators on Modicon Quantum Hot Standby with Unity 140 CPU 671 60



1	LCD Display (lens cover closed)
2	LED Indicators

Interpreting the LED Indicators

The LEDs provide information

CPU 671 60 (HSBY)			
LEDs	**Color**	**Description**	**Indicates**
COM	Yellow	Controlled by the Coprocessor[1] hardware	Communication activity between Primary and Standby controllers
STS	Yellow	Controlled by the Coprocessor[1] firmware	Status of Copro ● Blinking ● system is redundant and data are exchanged from the Primary to Standby controller ● Steady on ● system is NOT redundant ● Copro booting from power-on to end of self-tests ● Steady off ● Copro auto tests failed
Note: No activity returns the LEDs to the default. 1 The Modicon Quantum Hot Standby with Unity HE CPU uses an embedded coprocessor (Copro) to provide a dedicated communications link, which transfers data between the Primary and Standby controllers.			

Using the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 LCD Display Screens

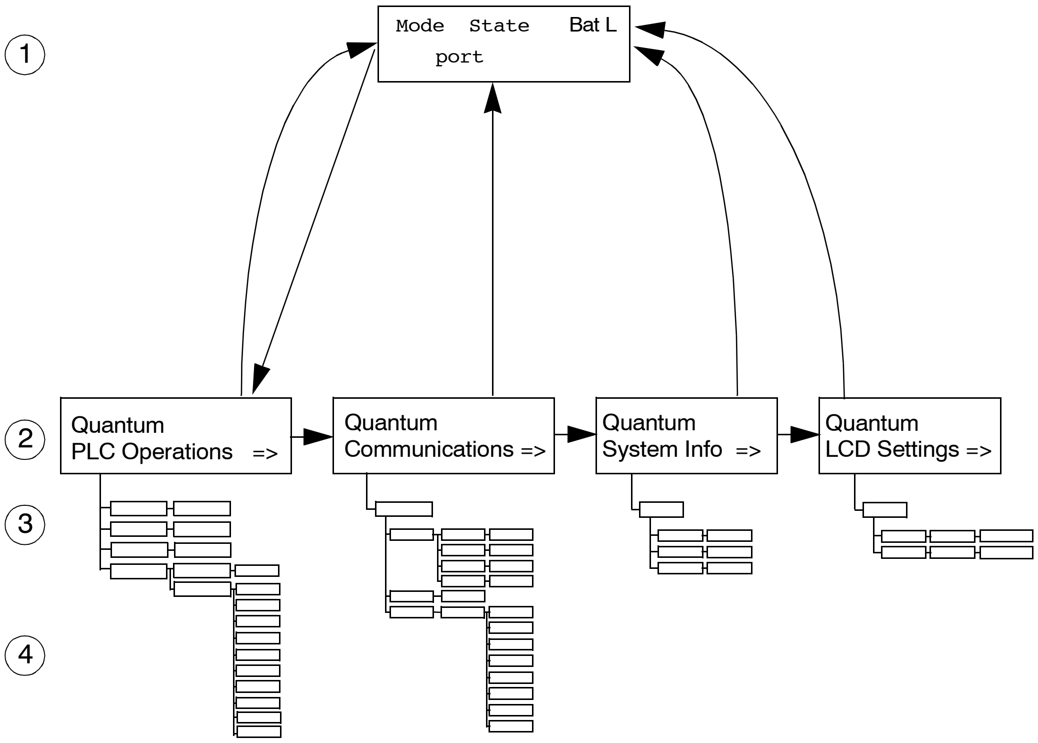
Overview

The controller's LCD displays messages. These messages indicate the controller's status. There ae four levels of menus and submenus. All menus are accessed using the keypad on the front of the controller.

For detailed information about the menus and submenus see:

- *Using the PLC Operations Menus and Submenus, p. 30*
- *Using the Communications Menus and Submenus, p. 33*
- *Using the System Info Menus and Submenus, p. 36*
- *Using the LCD Settings Menus and Submenus, p. 37*

Structure: LCD display menus and submenus



1 Default Screen

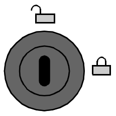
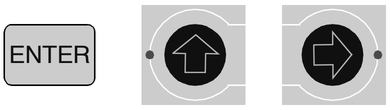
2 System Menus

3 Sub Menus

4 Sub Screens

Accessing the Screens

Use the keys on the keypad to access the system menus and submenus.

Step	Action
1	To access the screens, ensure that the key switch is in the unlocked position . 
2	To step down to a lower menu, operate one of the following keys: 
3	To return to the previous menu, press:

Understanding the Default Screen

Default screen displays the following information

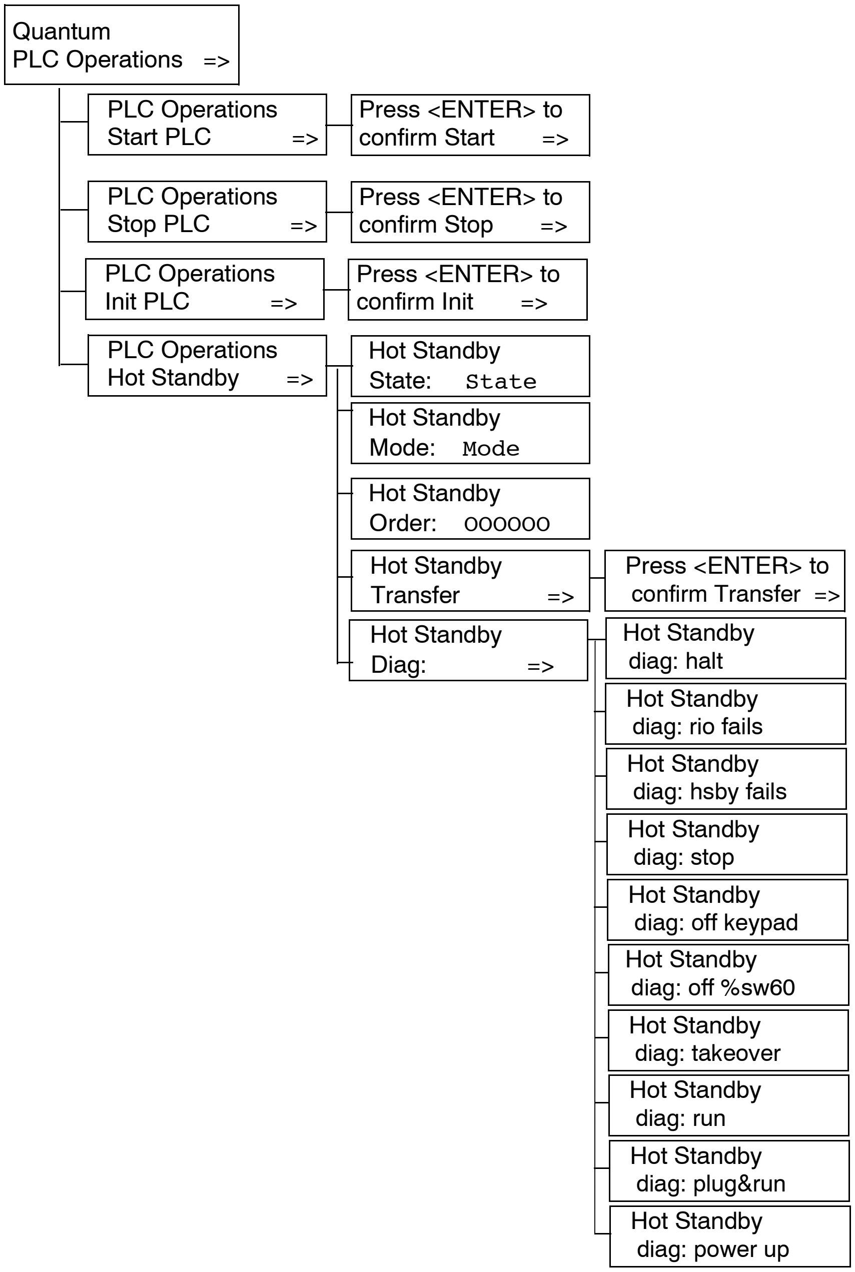
```
Mode   State    Bat L
   port    PCM
```

The default screen is read only.

Default Screen Displays	Fields Available		Options Available	Description
Default	`State`		RUN	Application program is running
				RUN Primary
				RUN Standby
				RUN Offline
			STOP	Application program is NOT running
				STOP Offline
			No Conf	CPU has no application program
	BatL			Indicates health of battery ● Steady = Battery is low ● No message = Battery is OK
	Port	USB		Indicates that port has activity
		Modbus Plus	MB+	Indicates Modbus Plus activity
			mb+	No activity
		Modbus	232	Serial port activity for RS-232
			485	Serial port activity for RS-485
		PCM	1	Indicates the card in slot 1 is being accessed The status displayed indicates the health of the battery ● Steady = Battery is OK ● No message = Batery is low
			2	Blinks, when the card in slot 2 is being accessed The status displayed indicates the health of the battery ● Steady = Battery is OK ● No message = Batery is low

Using the PLC Operations Menus and Submenus

Structure: PLC Operations menu and submenus



Submenu: PLC Operations: Start, Stop, Init

Start, Stop, Init Screens Display	**Fields Available**	**Description**
Start PLC	Press <ENTER> to confirm Start	Pressing <ENTER> starts the controller
Stop PLC	Press <ENTER> to confirm Stop	Pressing <ENTER> stops the controller
Init PLC	Press <ENTER> to confirm Init	Pressing <ENTER> initializes the controller

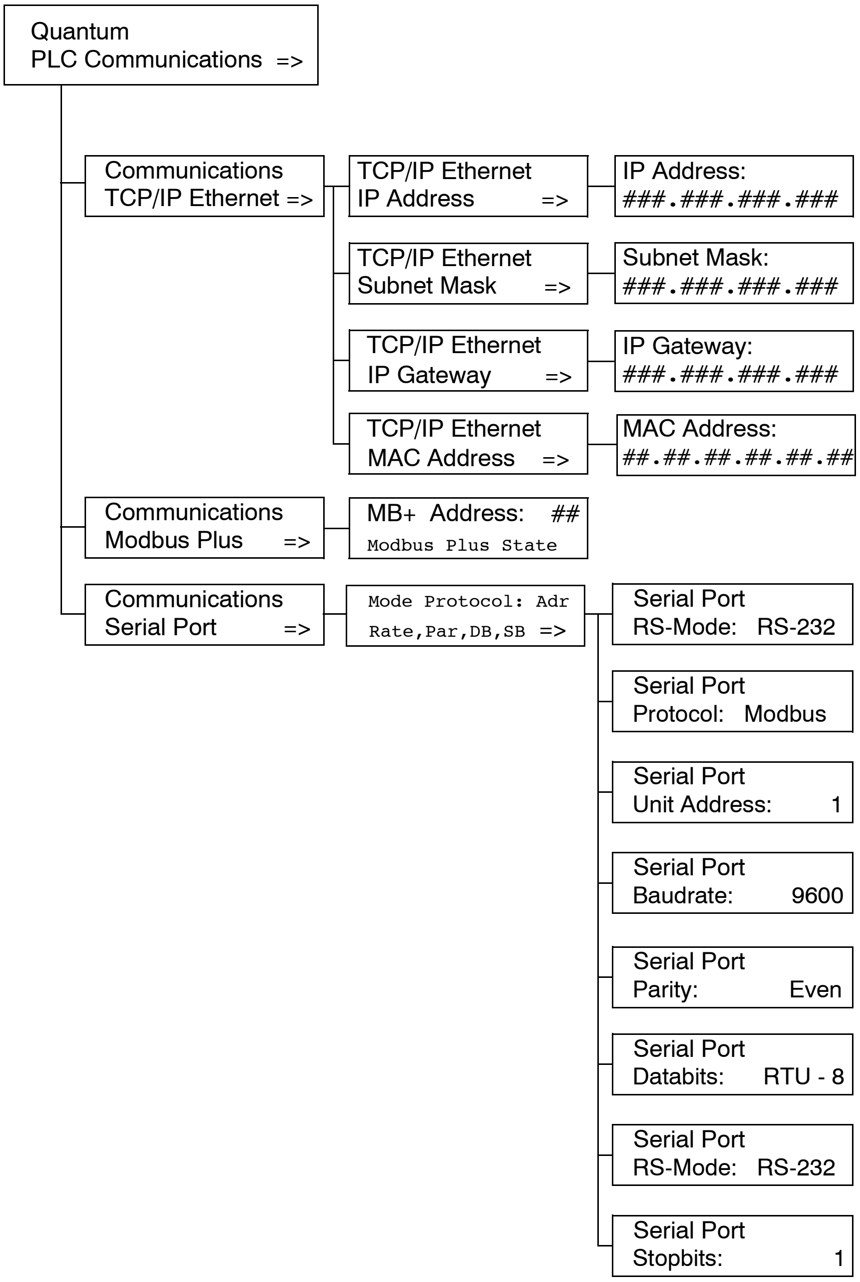
Submenu: PLC Operations: Hot Standby

Hot Standby Screen Displays	**Fields Available**	**Options Available**		**Description**
Hot Standby State:	`State` (read only)	PRIMARY		Controller serves as Primary
		STANDBY		Controller serves as Standby
		Off Line		Controller is offline
Hot Standby Mode:	`Mode` modifiable only if ● key switch is in the unlocked position ● Invalidate Keypad is not selected	RUN	steady	Controller is active and is either serving as the Primary or is capable of taking over the Primary role if needed
			blinking	Controller is waiting for configuration
		OFFLINE	steady	● Controller is taken out of service without stopping it or disconnecting it from power ● If the controller is the Primary when the Mode state is changed to OFFLINE, control switches to the Standby ● If the Standby is taken OFFLINE, the Primary continues to operate without a backup ● OFFLINE mode does not manage the Remot I/O (RIO). (Only Primary state manageds the RIO)
			blinking	Controller is waiting for configuration
Hot Standby Order:	000000 (read only)	A		Hot Standby Power Order The order comes from the MAC address. The controller with the lowest MAC address is A.
		B		

Hot Standby Screen Displays	**Fields Available**	**Options Available**	**Description**
Hot Standby Transfer:	`Mode` modifiable only if ● key switch is in the unlocked position ● Invalidate Keypad is not selected		Pressing the <ENTER> key confirms the Transfer. The transfer initiates the request for an application program update from the Primary controller. Pressing any other key cancels the Transfer request and returns the Hot Standby Transfer menu option screen to the display.
Hot Standby Diag	Order of diagnostic screens varies with the operation; therefore your order may be different from the list here.		
	Halt		User’s task in halt mode
	RIO fails		Error reported by RIO head
	HSBY fails		Error reported by optical link
	Stop		Stop command ordered
	Off keypad		Offline command entered on keypad
	Off %sw60		Offline command set in command register
	Take over		Standby switched to Primary mode
	Run		Run command ordered
	Plug & Run		Standby plugged and started
	Power up		User powered up controller

Using the Communications Menus and Submenus

Structure: Communications menu and submenus structure


Quantum PLC Communications =>
Communications TCP/IP Ethernet =>
TCP/IP Ethernet IP Address =>
IP Address: ###.###.###.###
TCP/IP Ethernet Subnet Mask =>
Subnet Mask: ###.###.###.###
TCP/IP Ethernet IP Gateway =>
IP Gateway: ###.###.###.###
TCP/IP Ethernet MAC Address =>
MAC Address: ##.##.##.##.##.##
Communications Modbus Plus =>
MB+ Address: ## Modbus Plus State
Communications Serial Port =>
Mode Protocol: Adr Rate,Par,DB,SB =>
Serial Port RS-Mode: RS-232
Serial Port Protocol: Modbus
Serial Port Unit Address: 1
Serial Port Baudrate: 9600
Serial Port Parity: Even
Serial Port Databits: RTU - 8
Serial Port RS-Mode: RS-232
Serial Port Stopbits: 1

Submenu: PLC Communications: TCP/IP Ethernet

TCP/IP Ethernet Screen Displays	**Fields Available**	**Options Available**	**Description**
TCP/IP Ethernet IP Address[1,2]	`###.###.###.###` (not modifiable)	decimal numbers	displays IP address
TCP/IP Ethernet Subnet Mask[1]	`###.###.###.###` (not modifiable)	decimal numbers	displays Subnet Mask address
TCP/IP Ethernet IP Gateway[1]	`###.###.###.###` (not modifiable)	decimal numbers	displays Ethernet IP Gateway address
TCP/IP Ethernet MAC Address	`##.##.##.##.##.##` (read only)	hexadecimal numbers	displays MAC (Medium Access Control) address

Submenu: PLC Communications: Modbus Plus

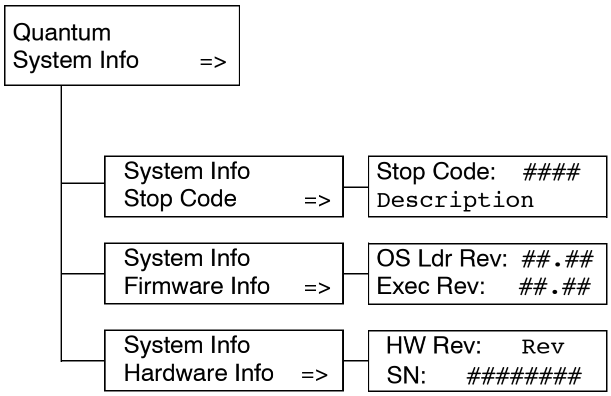
Modbus Plus Screen Displays	**Fields Available**	**Options Available**	**Description**
Modbus Plus Address	## (modifiable only if the key switch is in the unlocked position)	1-64	to enter a valid Modbus Plus address
	Modbus Plus State	Monitor Link	Modbus Plus State
		Normal Link	
		Sole Station	
		Duplicate address	
		No Token	

Submenu: PLC Communications: Serial Port

Seriial Port Screen Displays	**Fields Available***	**Options Available**	**Description**
Serial Port	Mode	232	RS mode
		485	
	Protocol	ASCII	Protocols available
		RTU	
	Adr	1 - 247	Unit address
		for Modbus switchover Primary 1-119 Standby 129 - 247	
	Rate	50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 3600. 4800, 7200, 9600, 19200 bits/s	Baud rate
	Par	NONE	Parity
		ODD	
		EVEN	
	DB	7,8	Databits: if Protocol is Modbus then RTU-8 or ASCII-7
	SB	1,2	Stopbits
	* If the key switch is in the unlocked position, all fields are modifiable.		

Using the System Info Menus and Submenus

Structure: System Info menus and submenus

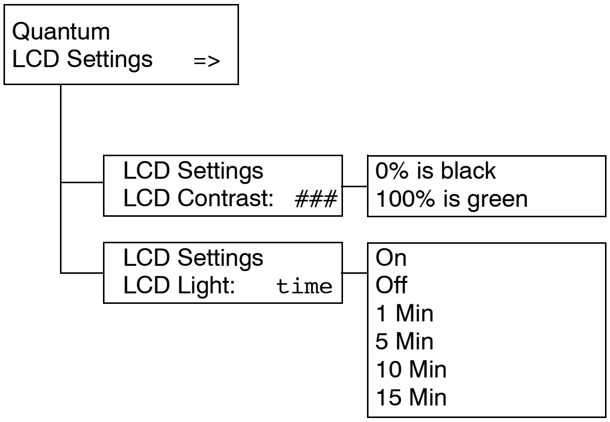


Submenu: PLC Communications: System Info

System Info Screen Displays	**Fields Available***	**Option Available**	**Description**
Stop Code	####		shows the machine stop code
	Description		shows the description to the machine stop code
Firmware Info	##.##		shows the number of OS Loader Revision
	##.##		shows the number of Exec Revision
Hardware Info	Rev		shows the number of Hardware Revision
	########		shows the serial number of Hardware
	* All fields are read only.		

Using the LCD Settings Menus and Submenus

Structure: LCD Settings menus and submenus



Submenu: LCD Settings: LCD Contrast

LCD Screen Contrast Screen Displays	Fields Available	Description
LCD Contrast:	####	A lower percent is darker. A higher percent is brighter. Use the arrow keys to adjust the setting. ● Up arrow increases percent ● Down arrow decreases percent

Submenu: LCD Settings: LCD Light

Screen Displays	Fields Available	Description
LCD Light:	On	LCD light remains on permanently or until changed
	Off	LCD light remains off permanently or until changed
	1 Min	LCD light remains on for one minute
	5 Min	LCD light remains on for five minutes
	10 Min	LCD light remains on for ten minutes
	15 Min	LCD light remains on for fifteen minutes

Modicon Quantum Hot Standby with Unity Compatibility, Differences, and Restrictions

2

Introduction

Overview

In this chapter you will find an overview of compatibilities within a system that has already been installed, differences from Legacy Hot Standby systems, and restrictions for the Modicon Quantum Hot Standby with Unity system.

What's in this Chapter?

This chapter contains the following topics:

Compatibility with Installed Systems

Modicon Quantum Legacy Systems

If you install a Unity Pro executive, you have to replace the Legacy CPU (16 and 32 bit) and the CHS option module with a Modicon Quantum Hot Standby with Unity 140 CPU 671 60. Otherwise, Modicon Quantum Hot Standby with Unity will not be available.

Note: EXISTING FIBER CONNECTIONS
Fiber connections used on the CHS module will NOT work with the Modicon Quantum Hot Standby with Unity 140 CPU 671 60.

Note: CHANGING FROM LEGACY
To install a Modicon Quantum Hot Standby with Unity 140 CPU 671 60 controller in the backplane requires two sequential slots.
Legacy systems required two slots in the backplane, but the two slots did not need to be sequential.

Copro and Remote I/O Head

Instead of a Modicon Quantum Hot Standby Option Module (140 CHS 110 00), an embedded coprocessor (Copro) provides a dedicated communications link transferring data between the Primary and Standby controllers. This dedicated link cannot be used for any other communications.
S908 Remote I/O Head Option Modules (140 CRP 93 x00) are required in the system for communicating with the remote I/O drops and exchanging status between the Primary and Standby controllers.

Understanding System Words and System Bits

Overview

In conforming with IEC standards, Unity uses global objects called system bits and system words. Users of legacy Schneider Electric products may be familiar with registers (984LL notation). Regardless of notation, the behavior remains the same.

System Word %SW60

System Word %SW60 can be used to read from and to write to the Modicon Quantum Hot Standby with Unity Command Register.

Note: %SW60 is described using the IEC convention.

System Word %SW61

System Word %SW61 can be used to read the contents of the Modicon Quantum Hot Standby with Unity Status Register.

Note: %SW61 is described using the IEC convention.

System Word %SW62 and %SW63

System Words %SW62 and %SW63 are reverse registers reserved for the Reverse Transfer process. Both reverse registers can be written to the application program (first section) of the Standby controller and are transferred at each scan to the Primary controller.

Understanding Multitasking Restrictions

General

In a Modicon Quantum Hot Standby with Unity system, the Standby controller is kept ready to assume the role of the Primary controller by having the same application loaded (in the Standby) and by receiving from the Primary—once per scan—a copy of the Primary's data. During the scan, there is a tight synchronization between the Primary and Standby.

MAST

Schneider Electric recommends using only MAST to transfer data during a scan. Tasks are handled singly and sequentially. Using MAST is consistent with current Modicon Quantum Hot Standby systems because multi-tasking is not provided, and data transfer will be synchronized with MAST.

Asynchronous Events

Using a Modicon Quantum Hot Standby with Unity system in a multitasking environment may cause data to change between scans. Because in a multi-tasking system, events may occur asynchronously to the normal scan. Those events may happen at a faster rate, the same rate, or at a slower rate. The result is that data modified by these events can be changed during a transfer.

FAST and AUX

Note: FAST and AUX can be used.
Ensure that you both analyze your system needs and account for problems that may arise if you use FAST or AUX.

Local I/O and Distributed I/O Restrictions

General

Note the two following restrictions:

- Although local I/O and distributed I/O (DIO) can be used in a Modicon Quantum Hot Standby with Unity system, they are not considered as part of the redundant system.
- When either local I/O and/or distributed I/O (DIO) are used in a Hot Standby system, each controller in the configured Hot Standby system controls ONLY its own local I/O and/or DIO respectively.

Understanding Other Module Restrictions

General

The Modicon Quantum Hot Standby with Unity, V2.0 does not support the following modules.

Model	Support Provided
140 NOE 771 00	Module NOT supported in Unity V2.0
140 NOE 771 10	Module NOT supported in Unity V2.0
140 NOE 311 00	Module NOT supported in Unity V2.0
140 NOE 351 00	Module NOT supported in Unity V2.0
140 CHS 110 00	Module NOT supported in Unity V2.0
140 NOA 611 10	Module NOT supported in Unity V2.0
140 NOA 622 00	Module NOT supported in Unity V2.0
140 NOL 911 10	Module NOT supported in Unity V2.0
140 CRP 811 00	Module NOT supported in Unity V2.0
140 HLI 340 00	Module NOT supported in Unity V2.0

Understanding USB Link Restrictions

No Hot Standby Switchover through the USB Link

USB link switchover is not available in a Modicon Quantum Hot Standby with Unity system because the USB link is connected to only one CPU, allowing Unity Pro to communicate only to this local controller.

Therefore, USB cannot be used for transparent access to the Primary controller.

Understanding Application Restrictions

Timer Events and I/O Errors

Timer events are NOT synchronized in Modicon Quantum Hot Standby with Unity applications. Schneider Electric recommends not using timer events.

Note: NOT EXCHANGING I/O ERRORS
If timer events are used, I/O errors are not exchanged between Primary and Standby.

Using IEC Logic and Modicon Quantum Hot Standby with Unity

3

Introduction

Overview

This chapter provides information about using IEC Logic with a Modicon Quantum Hot Standby with Unity system.

What's in this Chapter?

This chapter contains the following topics:

Modicon Quantum Hot Standby with Unity and IEC Logic

Overview

A Modicon Quantum Hot Standby with Unity system requires two backplanes configured with identical hardware, software, and firmware. One of the controllers (PLC) functions as the Primary controller and the other as a Standby controller.
- The Primary updates the Standby after every scan.
- The Primary and Standby communicate constantly monitoring the health of the system.
- If the Primary fails, the Standby takes control within one scan.

Data Transfer and User Data

In a Modicon Quantum Hot Standby with Unity system, data is transferred from Primary to Standby after every scan.
The following data transfers after every scan:
- Located Variables (State RAM 128 Kb)
- all Unlocated variables up to 512 Kb
- All instances of the DFB and EFB type
- SFC variable area
- System Bits and Words

Note: Forced Bits at Transfer
At each scan, all forced bits are transferred from the Primary to the Standby.

State RAM Definition

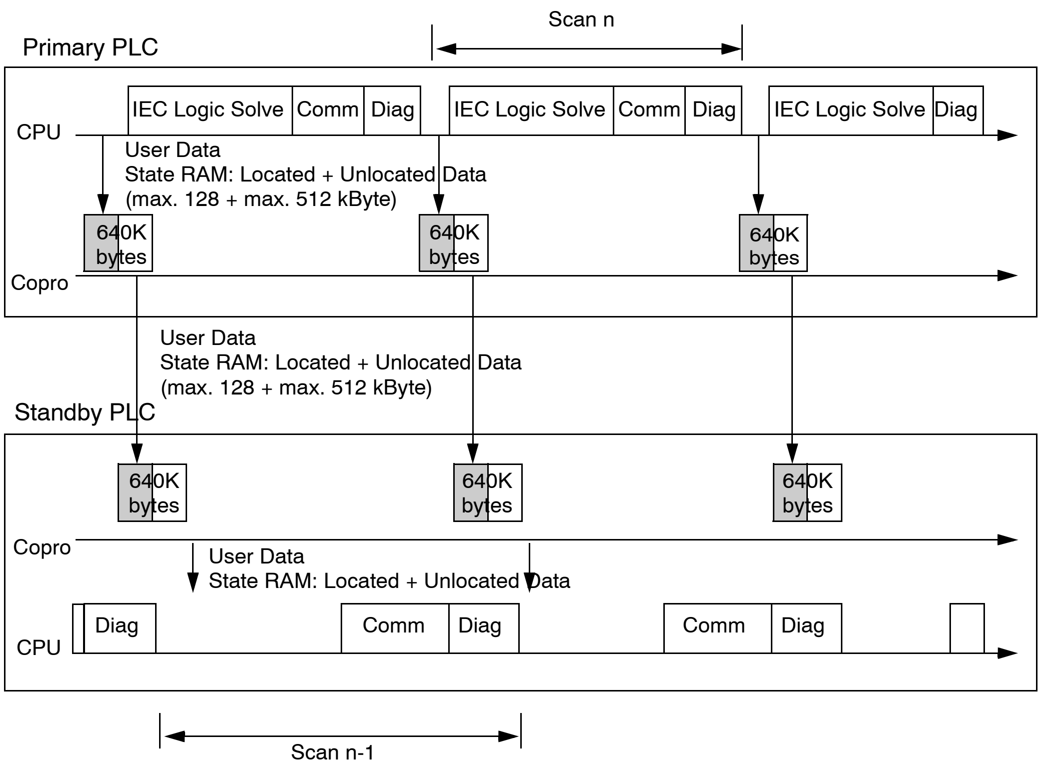
State RAM is the memory range, which is used for
- word-orientated input and output components (for example, analog modules)
- bit oriented input and output components (for example, digital modules)
- binary and word variables for the application program

State RAM is assigned the four reference types: %IW, %QW, %I and %Q.

Understanding the Modicon Quantum Hot Standby with Unity State RAM Transfer Process

Hot Standby Transfer Diagram

The following illustrates the transfer of data from the Primary to the Standby Copro:



Understanding System Scan Time in Modicon Quantum Hot Standby with Unity Systems

Effect on System Scan Time

The scan time of any Modicon Quantum Hot Standby with Unity system depends on the amount of data transferred.
Because data must be transferred from Primary to Standby, any Modicon Quantum Hot Standby with Unity system always has a higher scan time than a comparable standalone system.

Note: CHANGING FROM LEGACY
In legacy systems, the CPU performed both
- application program (project) processing
- communication transfer

In a Modicon Quantum Hot Standby with Unity system, in parallel
- CPU performs application program processing
- Copro performs communication transfer

Result: Greatly reduced transfer time with Unity

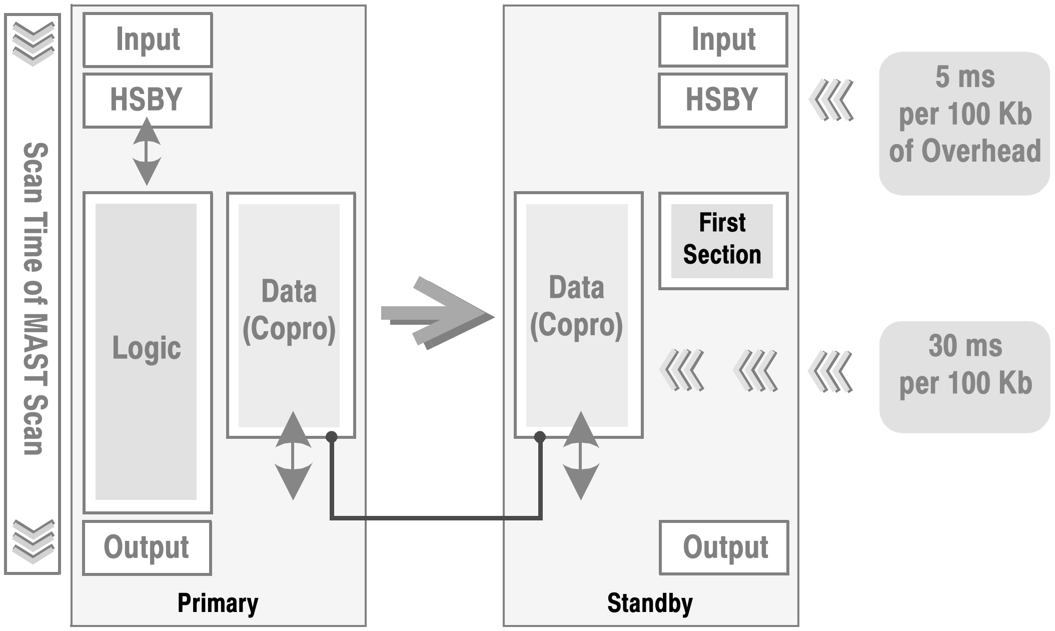
Performance Considerations

A Modicon Quantum Hot Standby with Unity system increases the length of a MAST scan, creating system overhead.

Note: System Overhead
System overhead is the time required to copy the application data to the communication link layer.

The network scan (communication between Primary and Standby copros)
1. exchanges data between both controllers
2. runs in parallel with the application program

A Hot Standby system

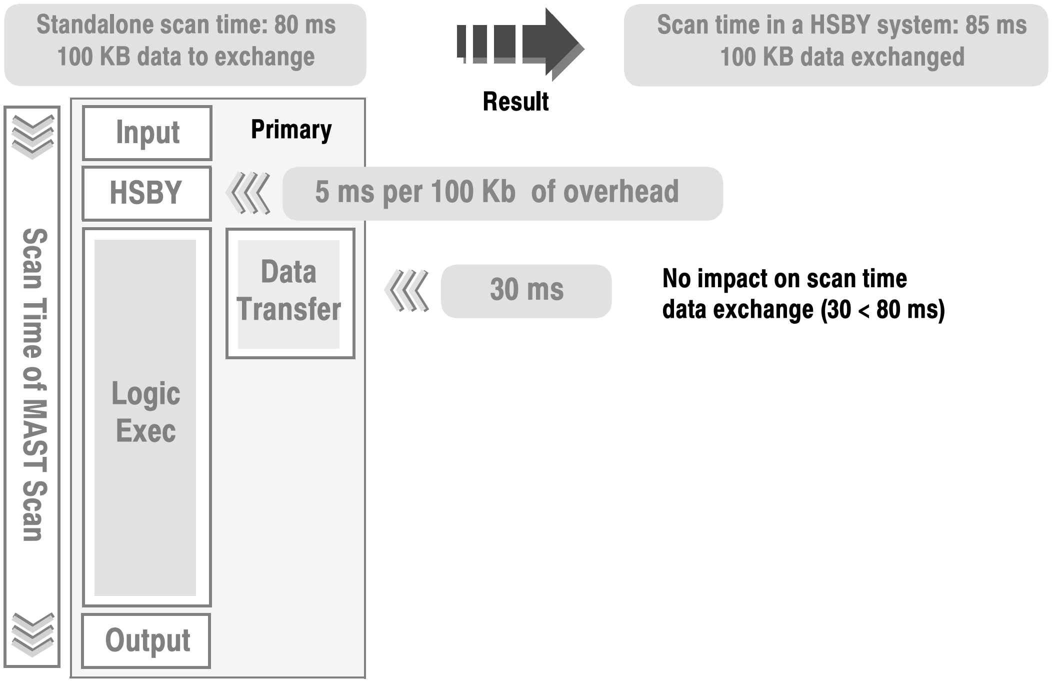


Most of time, the MAST scan hides the network scan.

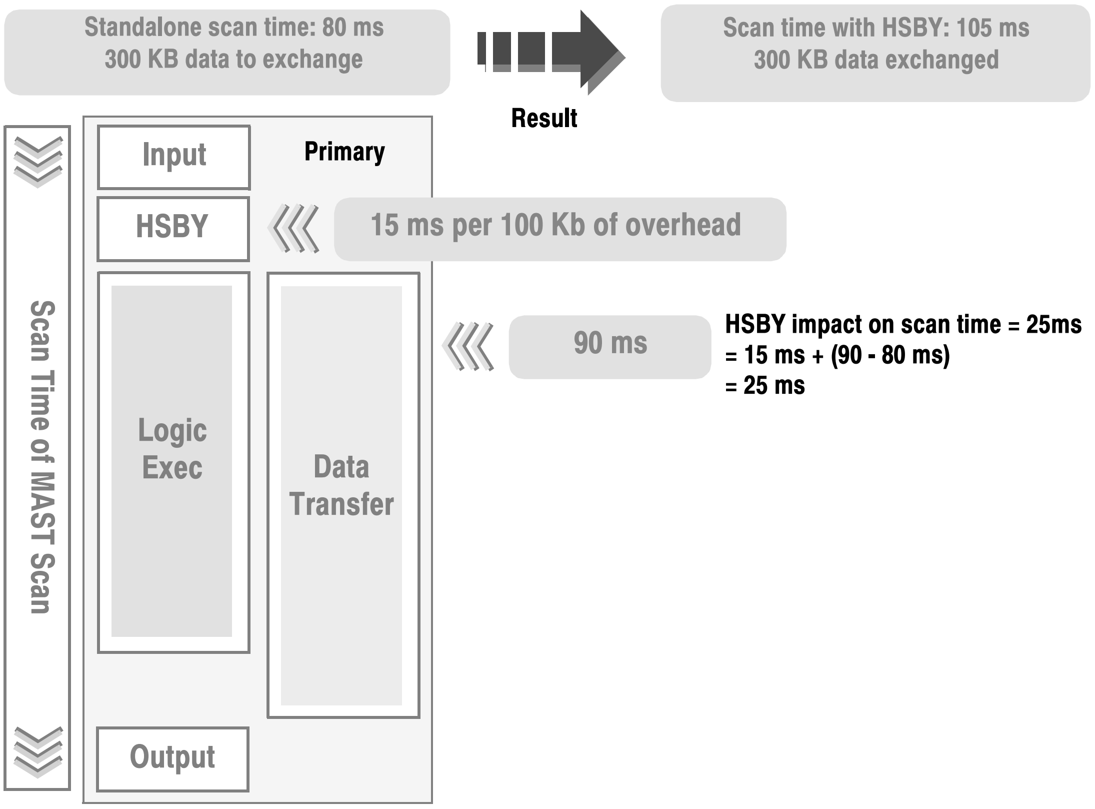
Examples

However, when processing some application programs, additional system overhead may occur.

Example #1
- Standalone application scan time: 80 ms
- Data (state RAM + unlocated variables): 100 Kb


Standalone scan time: 80 ms
100 KB data to exchange
Result
Scan time in a HSBY system: 85 ms
100 KB data exchanged
Scan Time of MAST Scan
Input
Primary
HSBY
5 ms per 100 Kb of overhead
Data Transfer
30 ms
No impact on scan time data exchange (30 < 80 ms)
Logic Exec
Output

Example #2
- Standalone application scan time: 80 ms
- Data (state RAM + unlocated variables): 300 Kb


Standalone scan time: 80 ms
300 KB data to exchange
Result
Scan time with HSBY: 105 ms
300 KB data exchanged
Scan Time of MAST Scan
Input
Primary
HSBY
15 ms per 100 Kb of overhead
Logic Exec
Data Transfer
90 ms
HSBY impact on scan time = 25ms
= 15 ms + (90 - 80 ms)
= 25 ms
Output

Transferring Application Data in a Modicon Quantum Hot Standby with Unity System

Changing from Legacy

Current Modicon Quantum controllers that use the Concept software have an application data transfer limit of approximately 128 Kb. This limit includes located data (in state RAM) and unlocated data. To transfer the unlocated data, the system must use a part of the 3x area in the state RAM. Schneider Electric chose this method to be compatible with the existing CHS option module (140 CHS 110 00). Thus, a trade-off is necessary: the more unlocated data, the less state RAM and vice versa.

Modicon Quantum Hot Standby with Unity

In the Modicon Quantum Hot Standby with Unity 140 CPU 671 60, the CHS option module is no longer used. Both the controller and Hot Standby functions are in the same unit. Thus, there is no need to force unlocated data through the 3x area. Not forcing means that all of the state RAM can be used as state RAM (up to 128 Kb). In addition to the state RAM, you may have a maximum of 512 Kb of unlocated data.

Memory Consumption

The amount of data to be transferred is automatically adjusted by the system.
For Information on the size of the memory consumption, select **PLC** → **Memory Consumption**.

Setting up and Maintaining a Modicon Quantum Hot Standby with Unity System

II

At a Glance

Purpose

This part describes three important processes in using a Modicon Quantum Hot Standby with Unity system.

- setting up, installing, and cabling a Modicon Quantum Hot Standby with Unity system
- configuring a Modicon Quantum Hot Standby with Unity system using the Unity Pro software
- maintaining a Modicon Quantum Hot Standby with Unity system once installed

What's in this Part?

This part contains the following chapters:

Setting up, Installing, and Cabling a Modicon Quantum Hot Standby with Unity System

4

Introduction

Overview

This chapter provides an overview of setting up, installing, and cabling a Modicon Quantum Hot Standby with Unity system.

What's in this Chapter?

This chapter contains the following topics:

Setting Up the Modicon Quantum Hot Standby with Unity System

Overview

Schneider Electric is a leader in offering fault-tolerant, redundant systems, Hot Standby. Setting up a Modicon Quantum Hot Standby with Unity system involves a number of processes, summarized in the following paragraphs here and explained in detail elsewhere.

Mapping the Backplane Extensions

A Modicon Quantum Hot Standby with Unity requires two backplanes with at least four slots.
You must map the two backplanes in an identical manner:

- same Modicon Quantum Hot Standby with Unity HE CPU with integrated coprocessor (Copro)
- same firmware
- same revision level
- same Modicon Quantum power supply module
- same Modicon Quantum RIO Head

And, if other modules are used, for example local I/Os, NOMs, NOEs, those modules must be identical.

Connecting Two High End CPUs

Connect the two Modicon Quantum Hot Standby with Unity High End CPUs with a fiber optic cable as described in *Connecting Two Modicon Quantum Hot Standby with Unity HE CPU 671 60s, p. 62*.

Establishing the Primary and Standby Controllers

The system determines that one of the two Modicon Quantum Hot Standby with Unity HE CPUs will be the Primary controller and the second controller as the Standby.
The Keypad may provide status information. Therefore, to view the status, use the Modicon Quantum Hot Standby with Unity HE CPU's keypad by selecting **Quantum PLC Operations => → PLC Operations Hot Standby => → Hot Standby Order**. See *Using the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 LCD Display Screens, p. 27*.

Connecting the Remote I/O

Connect the Modicon Quantum RIO Heads with each other and with the RIO drops as described in *Connecting the Remote I/O, p. 63*.

Configuring in Unity Pro

Using Unity Pro, configure a network that is appropriate for the installed backplanes and the cabling.
Configure the Hot Standby Register for the Modicon Quantum Hot Standby with Unity HE CPU in Unity Pro as described in *Accessing the Base Configuration, p. 73*.

Transferring and Sending the Program from Primary to Standby

Transfer the program from your PC to High End CPU using the Unity Pro command **PLC → Transfer program to PLC**.
See *Overview of Application Program Transfer, p. 160*.
Send your program from the Primary to the Standby using the Primary's keypad.
Select **Quantum PLC Operations => → PLC Operations Hot Standby => → Hot Standby Transfer => → Press <ENTER> to confirm Transfer =>**.
See *Using the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 LCD Display Screens, p. 27*.

Note: A program can be sent only from the Primary controller to the Standby controller.

Mapping the Backplane Extension

Requiring Identical Backplanes

Two backplanes must be configured with identical hardware, software, and firmware in identical order. Then, both controllers may function either as a Primary controller or as a Standby controller.

Note: INSTALLING CONTROLLERS
Schneider Electric recommends referring to Schneider Electric planning and installation guidelines. You will find more information in the ***Quantum Automation Series Hardware Reference Guide 840 USE 100 00*** and in ***Remote I/O Cable System Planning and Installation Guide 840 USE 101 00*** .

Noting the Module Version

The Primary and Standby must belong to the Modicon Quantum Hot Standby with Unity product family.
The Modicon Quantum RIO drops can be from Schneider Electric's 800 series of modules.

Installing Components and Modules

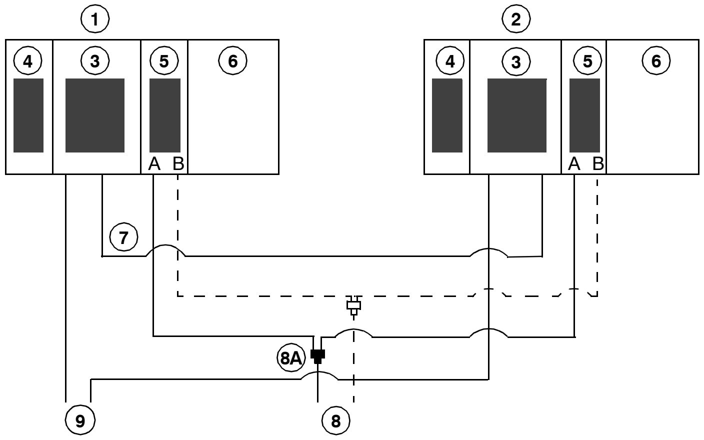
A Modicon Quantum Hot Standby with Unity system requires two backplanes with at least four slots.

The backplanes (1, 2) must be identically equipped with:

- Modicon Quantum Hot Standby with Unity 140 CPU 671 60 with integrated coprocessor (Copro) (3)
- Modicon Quantum power supply module (4)
- Modicon Quantum RIO Head (5)
- Other modules for example, Modicon Quantum NOMs, NOEs (6)

Note: The sequence of the modules on the backplane is not predefined, but the sequence of the modules on the backplanes of the Primary and the Standby must be identical. Otherwise, a Modicon Quantum Hot Standby with Unity system does not exist.

The following graphic shows a possible scheme for components and their connectors.



1 Primary controller backplane
2 Standby controller backplane
3 Modicon Quantum Hot Standby with Unity 140 CPU 671 60 with integrated coprocessor (Copro)
4 Modicon Quantum power supply module: Install power supply in first slot for better rack layout.
5 Modicon Quantum RIO head
6 Other modules, for example Modicon Quantum NOMs, NOEs
7 Fiber Optic Cable to connect to both Modicon Quantum Hot Standby with Unity 140 CPU 671 60s.
8 Coaxial cable with splitters (8A) for connecting the RIO heads (5) with the RIO drops in the network. The dashed connection represents a redundant connection in the RIO network, which is not required for the Modicon Quantum Hot Standby with Unity system.
9 Connection to the Unity Pro computer via Modbus or Modbus Plus

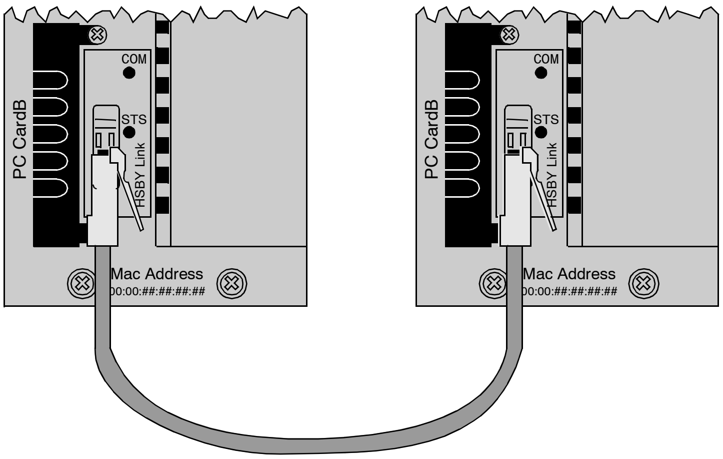
Connecting Two Modicon Quantum Hot Standby with Unity HE CPU 671 60s

Handling Cable Connections

If the cable is not connected properly, the Modicon Quantum Hot Standby with Unity HE CPU 671 60s cannot communicate, and the Hot Standby system will not function. Therefore, the Primary operates without a backup, and the Standby remains offline.
Fiber optic cables are sold separately.

Model	Description
490NOR0003	3 m MTRJ/ MTRJ
490NOR0005	5 m MTRJ/ MTRJ
490NOR0015	15 m MTRJ/ MTRJ

Controllers connected by a crossed fiber optic cable.



Note: REDUCING FAILED COMPONENTS
Hubs and switches are not allowed as part of the fiber optic link.
Therefore, the fiber connection between Primary and Standby must be a direct cable connection, which reduces the components that could fail in the redundant system.

Connecting Two Backplanes

However, the Primary and Standby backplanes may be placed as much as 2 km apart. If you will be placing the modules more than 15 m apart, use 62.5/125 micrometer cable with MTRJ type connectors. Refer to *Modicon Quantum Hot Standby with Unity Additional Information, p. 183* for details.

Connecting the Remote I/O

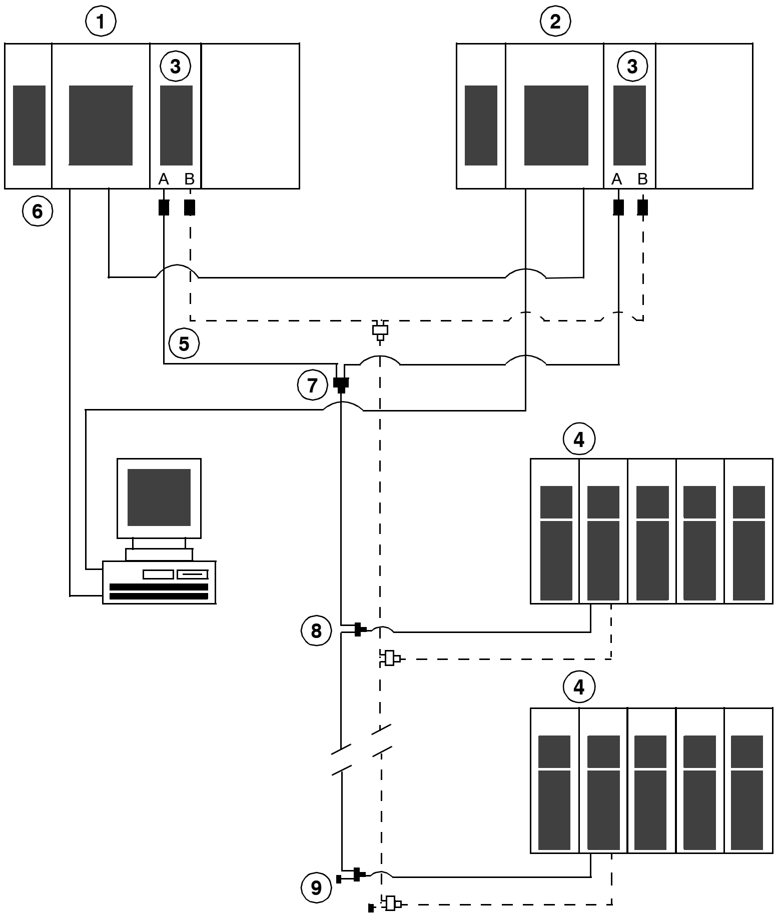
Connecting Cables to Remote I/O

In each configuration:
- The cables connecting the RIO head processors to the RIO network have to be fitted with self-terminating F adapters.
- An MA-0186-100 coaxial splitter has to be installed between the RIO head processors and the RIO network.
- The remote drops have to be connected to the trunk cable via an MA-0185-100 tap and a drop cable.
- The last tap on a trunk cable has to be terminated with a 52-0422-000 trunk terminator. Remote drops have not be connected directly to the trunk cable.
- An optional 60-0545-000 Ground Block at the head will provide earth ground connection when the cable and RIO processor are disconnected. Ground blocks may also be used at other ground points along the trunk cable, as required.

Refer to the *Remote I/O Cable System Planning and Installation Guide, 890 USE 101 00* for details.

Note: CABLING REQUIREMENTS
- If you are using a Modicon Quantum Hot Standby with Unity system for data logging, the RIO heads have to be configured and connected with coaxial cable, and you have to configure one (1) or more RIO drops.

The following diagram shows the hardware required for the Remote I/O cabling.



1	Primary controller
2	Standby controller
3	Modicon Quantum RIO head
4	Modicon Quantum RIO drop
5	Coaxial cable (components shown with dashed lines are not mandatory)
6	Self-terminating F adapter
7	Splitter (MA-0186-100)
8	Tap (MA-0185-100)
9	Trunk Terminator (52-0422-000)

Connecting over Long Distances

If you intend to place the units more than 3 meters apart, you have to consider the effect on the RIO network and any Modbus Plus network.

The controllers are linked to the RIO network by coaxial cable. The longer the distance between the controllers, the higher the grade of trunk cable required to maintain signal integrity.

Refer to the *Remote I/O Cable System Planning and Installation Guide, 890 USE 101 00* for details regarding cable grades, distances, and signal integrity.

If no coaxial cable will be sufficient to maintain signal integrity throughout the RIO network, fiber optic repeaters may be used to boost the signal.

Refer to the *Modbus Plus Network Planning and Installation Guide, UNY USE 10410 V10E* for details on extending a Modbus Plus network.

Testing the Modicon Quantum Hot Standby with Unity System

Testing Methods (First Time)

Follow these steps to conduct tests to observe
- Hot Standby start-up
- automatic Application Program Transfer
- switchover of control from Primary to Standby

These tests are not necessary but helpful. If your backplanes are horizontally parallel and within 1 meter (3 feet) apart, the transfer process is easier to observe.

Hot Standby Start-up and Application Program Transfer

Follow these steps.

Step	Action
1	Configure two backplanes with identical hardware and firmware in identical order.
2	Connect to a Remote I/O (RIO) drop. *Establishing the Primary and Standby Controllers, p. 58* Note: Ensure that the fiber optic cable is connected between the controllers.
3	Start Unity Pro software and configure the local rack and the Remote I/O drop as per your physical configuration.
4	After completing Step 3, execute the `Build Project` command, and save your application program.
5	Power up and connect to one controller. Note: The front panel keypad will display `No Conf`.
6	Download your application program and RUN the controller. Note: The controller will become RUN Primary.
7	Power up the other controller. Note: Application Program Transfer will occur automatically. The "other" controller will become RUN Standby.
8	Ensure the Primary and Standby controllers are in RUN Primary and RUN Standby mode.

Preparing to Switchover

After completing the preceding steps, your Modicon Quantum Hot Standby with Unity system is ready to perform a switchover. Perform the switchover using either:

- Hot Standby submenu on the front panel keypad
- Command Register, system bit %SW60.1 or %SW60.2

Note: Observing the Switchover
If you would like to observe a switchover effect on the I/O modules, configure the Remote I/O (RIO) drop with a discrete output module during your initial start-up. Before performing a switchover, connect to the Primary and force the output bits in the module. Perform the switchover and take note of the bumpless switchover effect on the forced bits.

Switchover Test Using Front Panel Keypad

To force a switchover using the front panel keypad, do the following:

Step	**Action**
1	Access the front panel keypad of the Primary controller.
2	Go to PLC Operation menu.
3	Go to Hot Standby submenu.
4	Go to Hot Standby mode
5	Modify Run to Offline. Note: Ensure that Standby switched to Primary.
6	Modify offline to run. Note: Ensure that the LCD displays `Run Standby`.

Switchover Test Using Command Register

Follow these steps.

Step	Action
1	Connect to the Primary.
2	Observe whether the controller order on the Primary is A or B. Note: Observe using either of the following methods: ● Front panel keypad of the Primary PLC Operation | Hot Standby | Hot Standby Order ● Unity Pro status dialog Refer to the bottom of the Unity Pro window when connected online
3	Access the Command Register system bit ● %SW60.1 (If the connected Primary order is A.) ● %SW60.2 (If the connected Primary order is B.)
4	Set bit to 0. Note: Ensure that the Standby switched to Primary
5	Connect to the new Primary.
6	Access the Command Register system bit. Choose the same bit selected in Step 3.
7	Set bit to 1. Note: Ensure Standby displays RUN Standby.
8	Ensure the Primary and Standby controllers are in RUN Primary and RUN Standby mode.

Configuring a Modicon Quantum Hot Standby with Unity System

5

Introduction

Overview

This chapter describes configuring the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 module.

What's in this Chapter?

This chapter contains the following sections:

5.1 Configuring a System with the Unity Pro Tabs and Dialogs

At a Glance

Purpose

Use the Unity Pro editor dialog tabs to

1. select options for configuring the Modicon Quantum Hot Standby with Unity 140 CPU 671 60
2. obtain system status information

This material describes how you can

- *Accessing the Base Configuration, p. 73*, including Modbus Ports and HSBY
- *Configuring with Unity Pro, p. 86*
- *Configuring with Unity Pro, p. 87*

What's in this Section?

This section contains the following topics:

Topic	Page
Introducing Unity Pro	71
Accessing the Base Configuration	73
Using the Summary Tab	74
Using the Overview Tab	75
Using the Configuration Tab	76
Using the Modbus Port Tab	79
Using the Animation Tab and PLC Screen Dialogs	81
Using the Hot Standby Tab	85
Configuring the PCMCIA Cards	86
Configuring the Modbus Plus Communication Type	87
Setting the Invalidate Keypad Option	88
Swapping Network Addresses at Switchover	90

Introducing Unity Pro

Overview

Unity Pro software is a fully Windows compatible application. Unity Pro supports only the IEC method of configuration with some simplifications:

- Removes the legacy requirement to reserve the 3xxxx area for transferring unlocated variables
  (Unlocated variables are transferred with the State RAM).
- Uses system words for the command and status registers, which are removed from the State Ram.

No Loadables Needed

Note: CHANGING FROM LEGACY
The current Modicon Quantum Hot Standby loadable (CHS) is no longer needed.

For Unity Pro Modicon Quantum Hot Standby with Unity systems, the control functionality will be embedded in the executive.
For legacy Modicon Quantum Hot Standby systems (Modsoft, Concept, or ProWORX), the CHS module owns the control functionality.

Command Register

The Command Register defines the basic operational parameters of a Modicon Quantum Hot Standby with Unity solution. The command register's functionality is described in *Understanding the Unity Command Register, p. 110*.

Changes from Concept

- Command and Status Registers are no longer stored in the State RAM.
- Command and Status Registers are accessible in the system words %SW60 and %SW61.
- Reverse Transfer registers are no longer stored in the State RAM.
- System automatically allocates system words %SW62 and %SW63 as Reverse Transfer words.
- Reverse Transfer words are no longer part of the Non-Transfer Area of the 4xxxx registers.

Changes from LL984

Note: CHANGING FROM LEGACY
- There is no longer a Non-Transfer Area for the 0xxx, 1xxx, and 3xxx registers.
- Transferring over multiple scans is no longer available.
  In current Modicon Quantum Hot Standby Systems using the CHS option module, additional state RAM could be transferred over multiple scans. Not transferring over multiple scans minimizes the impact of state RAM transfers.

In the Unity Pro Modicon Quantum Hot Standby with Unity 140 CPU 671 60, transfer speeds will be much faster, and the amount of state RAM used for transfers will be smaller since unlocated data will be used instead.

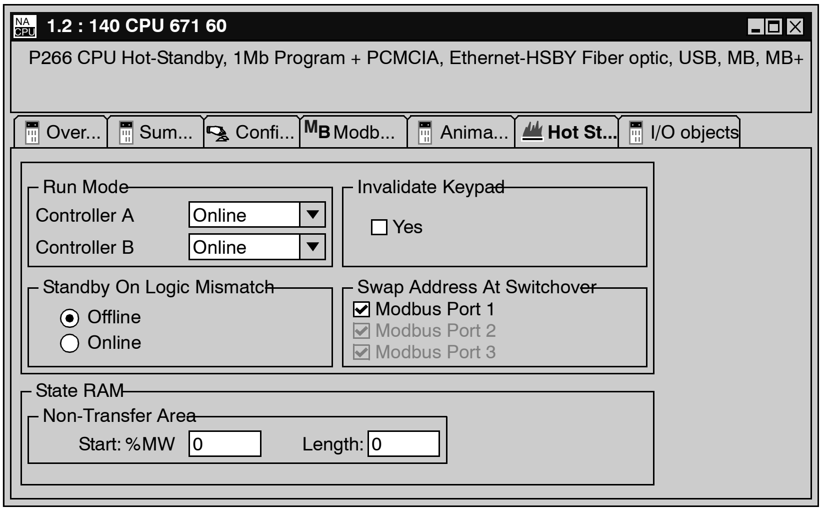
Opening the Editor Dialog

After starting Unity Pro, go to the Local Bus in the Structural View of the Project Browser.,

Step	Action
1	Open the Local configuration editor either by double-clicking on the Local Bus or by selecting the Local Bus and executing right-click Open A graphical representation of the local bus appears in the configuration editor.
2	Select the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 module and right-click. The context menu appears.
3	Select Open Module.
4	The editor appears. The Summary tab is the default.

Unity Pro Hot Standby Editor Dialog

The editor with the Hot Standby tab selected


1.2 : 140 CPU 671 60

P266 CPU Hot-Standby, 1Mb Program + PCMCIA, Ethernet-HSBY Fiber optic, USB, MB, MB+

Run Mode
Controller A: Online
Controller B: Online

Invalidate Keypad
☐ Yes

Standby On Logic Mismatch
[✓ Offline]
Online

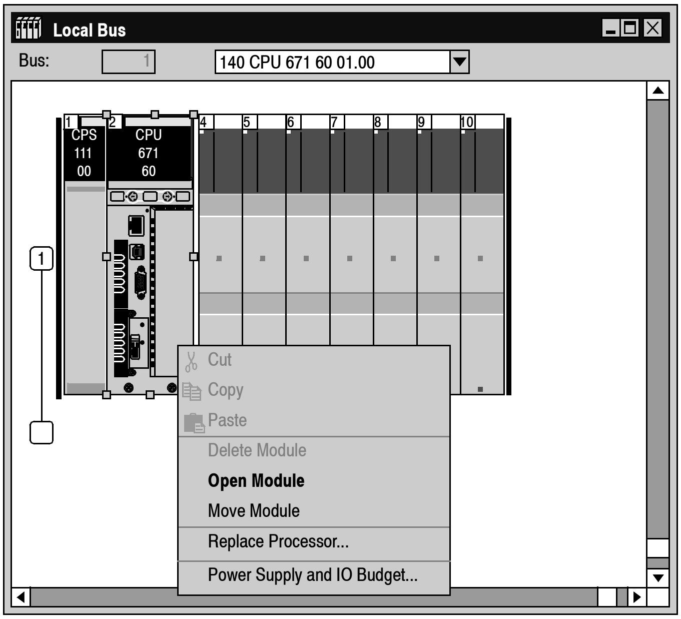
Swap Address At Switchover
☑ Modbus Port 1
☑ Modbus Port 2
☑ Modbus Port 3

State RAM
Non-Transfer Area
Start: %MW 0 Length: 0

Accessing the Base Configuration

Accessing with Unity Pro

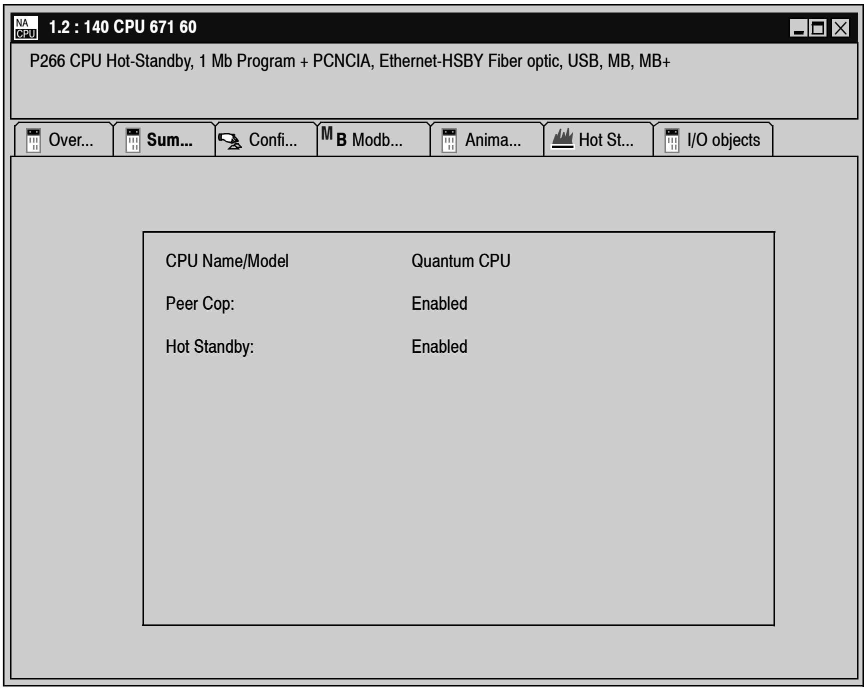
After starting Unity Pro, go to the Local Bus in the Structural View of the Project Browser.

Step	Action
1	Open the Local Bus configuration editor either by double-clicking on the Local Bus or by selecting the Local Bus and executing right-click Open. A graphical representation of the local bus appears in the configuration editor.
2	Select the Modicon Quantum Hot Standby with Unity HE CPU module and right-click. The context menu appears.  Local Bus Bus: 1 140 CPU 671 60 01.00 CPS 111 00 CPU 671 60 Cut Copy Paste Delete Module Open Module Move Module Replace Processor... Power Supply and IO Budget...
3	Select Open Module. The editor appears. The Summary tab is default.
4	Choose one of these tabs: ● Summary (See *Using the Summary Tab, p. 74*) ● Overview (See *Using the Overview Tab, p. 75*) ● Configuration (See *Using the Configuration Tab, p. 76*) ● Modbus Port (See *Using the Modbus Port Tab, p. 79*) ● Animation (See *Using the Animation Tab and PLC Screen Dialogs, p. 81*) ● Hot Standby (See *Using the Hot Standby Tab, p. 85*)

Using the Summary Tab

Viewing

Use the Summary tab of the Unity Pro editor to determine if Peer Cop and Hot Standby are enabled.



P266 CPU Hot-Standby, 1 Mb Program + PCNCIA, Ethernet-HSBY Fiber optic, USB, MB, MB+

CPU Name/Model Quantum CPU
Peer Cop: Enabled
Hot Standby: Enabled

Describing

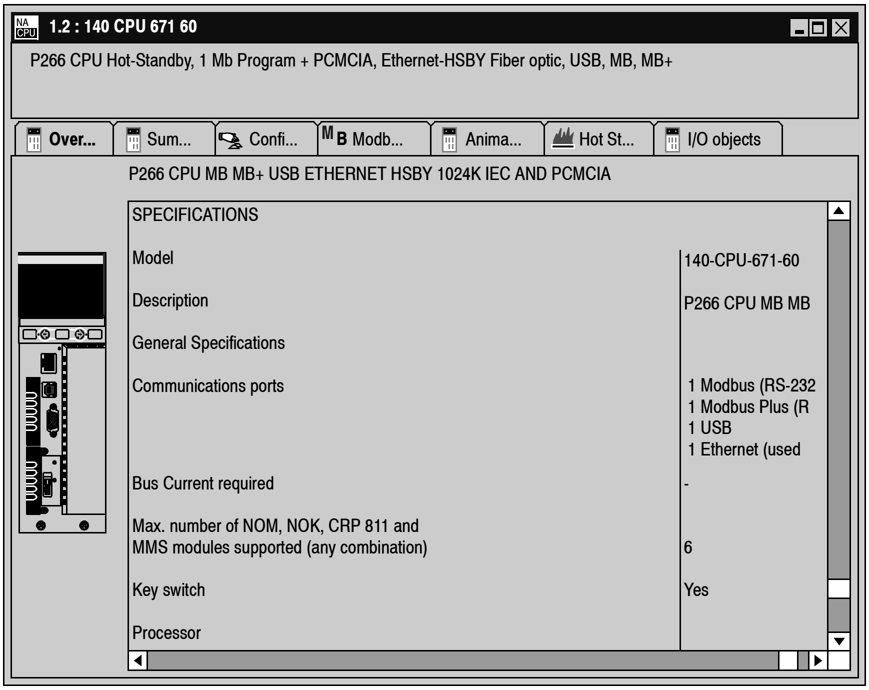
Summary tab:

Item	Option	Value	Description
CPU Name/Model:	Quantum CPU	N/A	Read Only
Peer Cop:	Disabled	Enabled	Read Only
			Peer Cop="Enabled" if the function is valid in the Modbus Plus menu
Hot Standby:	Enabled	Enabled	Read Only

Using the Overview Tab

Viewing

The read only Overview tab of the editor displays detailed information about the module's specifications.


1.2 : 140 CPU 671 60

P266 CPU Hot-Standby, 1 Mb Program + PCMCIA, Ethernet-HSBY Fiber optic, USB, MB, MB+

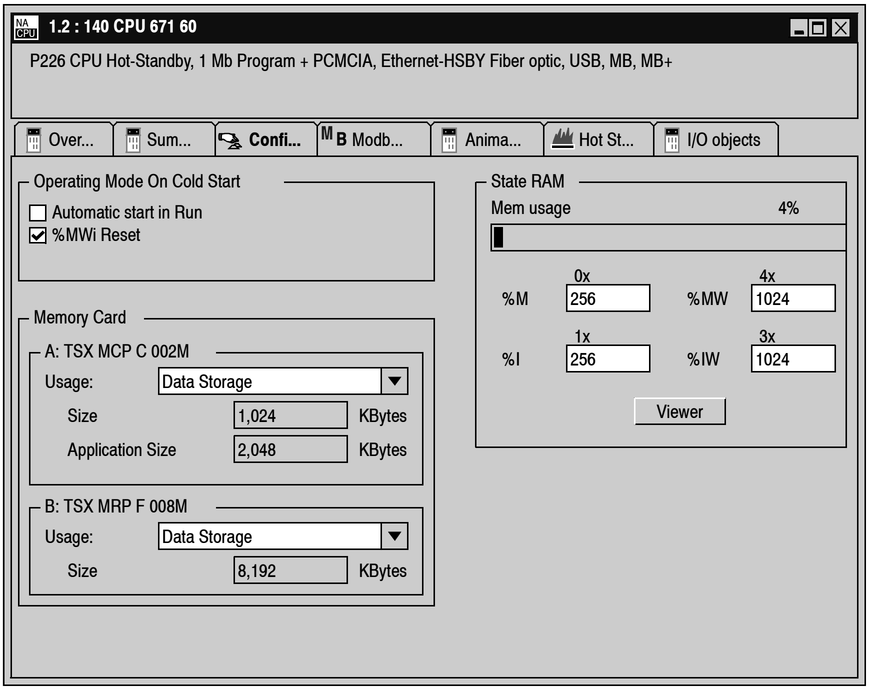
P266 CPU MB MB+ USB ETHERNET HSBY 1024K IEC AND PCMCIA

SPECIFICATIONS	
Model	140-CPU-671-60
Description	P266 CPU MB MB
General Specifications	
Communications ports	1 Modbus (RS-232 1 Modbus Plus (R 1 USB 1 Ethernet (used
Bus Current required	-
Max. number of NOM, NOK, CRP 811 and MMS modules supported (any combination)	6
Key switch	Yes
Processor	

Using the Configuration Tab

Viewing

Change values using the Configuration tab of the editor.



1.2 : 140 CPU 671 60

P226 CPU Hot-Standby, 1 Mb Program + PCMCIA, Ethernet-HSBY Fiber optic, USB, MB, MB+

Operating Mode On Cold Start

- [ ] Automatic start in Run
- [✓] %MWi Reset

Memory Card

A: TSX MCP C 002M

Usage:	Data Storage	
Size	1,024	KBytes
Application Size	2,048	KBytes

B: TSX MRP F 008M

Usage:	Data Storage	
Size	8,192	KBytes

State RAM

Mem usage 4%

	0x		4x	
%M	256	%MW	1024	
	1x		3x	
%I	256	%IW	1024	

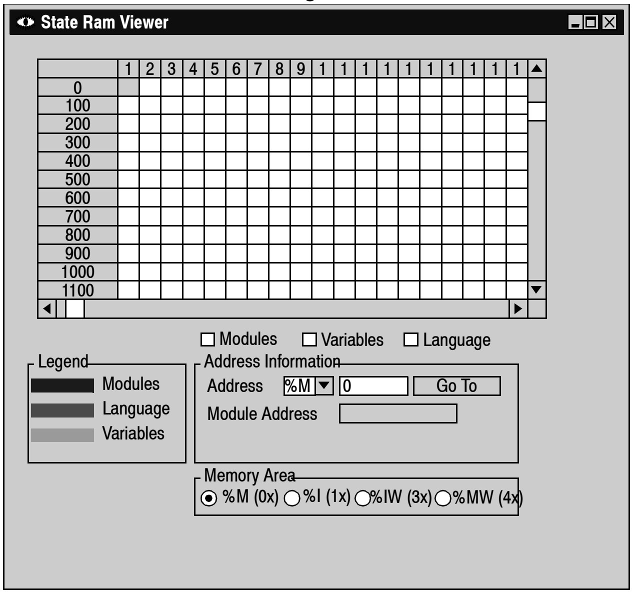
Describing

Configuration tab:

Item	Option	Value	Description
Operating Mode On Cold Start	Automatic start in Run	x	Determines the operating condition during Cold Start
	%MWi Reset on cold start	x	
Memory Cards	A:	N/A	Displays the configuration in the PCMCIA Slots
	B:	N/A	
State RAM	Mem usage	1.	A bar displays percent of memory used.
	%M-0x	2.	Size of the different memory areas **Note:** The values for %IW and %MW have to be divisible by 8.
	%MW-4x	2.	
	%I-1x	2.	
	%IW-3x	2.	
	Viewer	N/A	Opens the State RAM Viewer tab, which displays the allocation of used memory. (See the illustration following.)
1. The value (expressed as a percentage and displayed on the scale) depends on the memory usage of the Hot Standby configuration. 2. Enter the appropriate values. All values depend on Hot Standby configuration.			

Using the State RAM Viewer

The State RAM Viewer dialog



Each cell in the grid represents an address location and displays the entity stored in that location. The contents of the grid may be changed by selecting options in either of two filters:

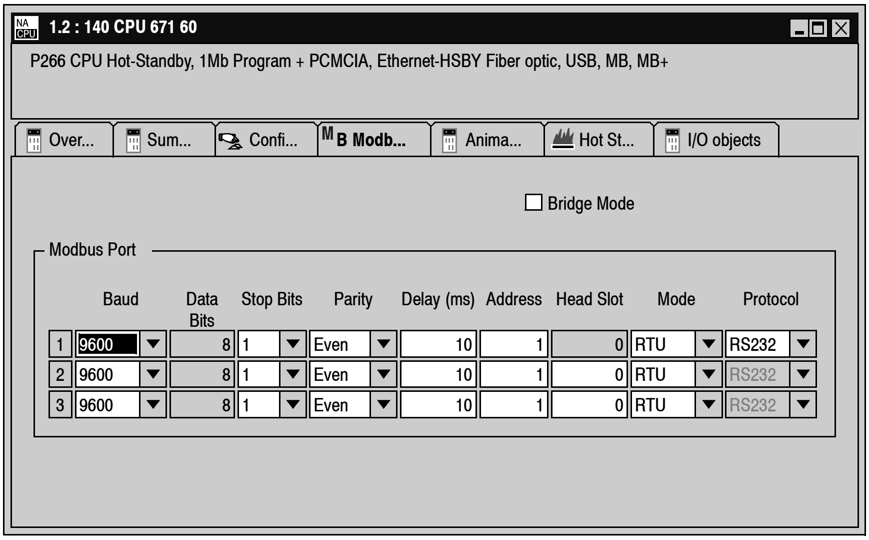
1. Memory used grid options
   Select one—or all—of the three options (using the check box) and one to three bar graphs appear.
   - Modules
     Indicates the topological address used in the modules. Address appears as a bar graph in the grid.
   - Language
     Indicates the topological address used in the program. Address appears as a bar graph in the grid.
   - Variables
     Indicates the topological address used in the variables. Address appears as a bar graph.
2. Memory Area options
   Using this option, you designate a state RAM address. Select one of four reference types.
   - %M
   - %I
   - %IW
   - %MW

Your choice appears in the Address field of the Address Information area.

Using the Modbus Port Tab

Viewing

You may change Modbus communication options using the Modbus Port tab of the Unity Pro editor:



P266 CPU Hot-Standby, 1Mb Program + PCMCIA, Ethernet-HSBY Fiber optic, USB, MB, MB+

☐ Bridge Mode

Modbus Port

	Baud	Data Bits	Stop Bits	Parity	Delay (ms)	Address	Head Slot	Mode	Protocol
1	9600	8	1	Even	10	1	0	RTU	RS232
2	9600	8	1	Even	10	1	0	RTU	RS232
3	9600	8	1	Even	10	1	0	RTU	RS232

Note: FINDING MODBUS ADDRESS
If you need the Modbus address of the controller, go to the 140 CPU 671 60 module and find the address using the keypad. (See *Understanding the Default Screen, p. 29*)

Describing

Modbus Port tab:

Item	Option	Value	Description
Modbus Port	Baud	9600	Data must be specified for every link.
		50-19200 kBit/s	
	Data Bits	8	
	Stop Bits	1 or 2	
	Parity	EVEN	
		ODD	
		NONE	
	Delay (ms)	1 ms	
	Address	1 -247	
		for Modbus switchover 1 - 119 (Primary) 129 - 247 (Standby)	
	Head Slot	0	
	Mode	RTU	
		ASCII	
	Protocol	RS232	
		RS485	

Using the Animation Tab and PLC Screen Dialogs

Accessing the PLC Screen Dialogs

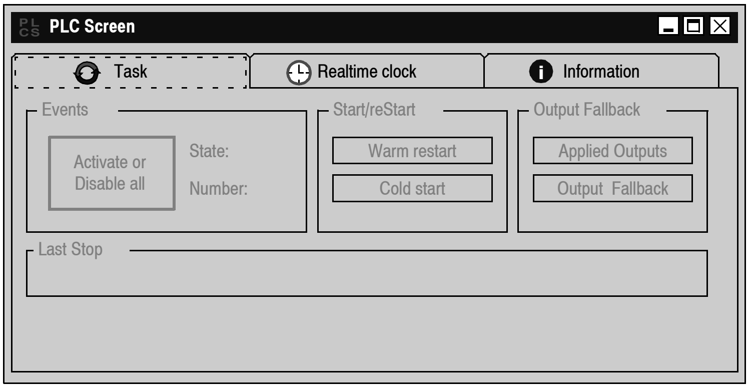
To access the Task, Realtime clock, and Information tabs of the Unity Pro Animation tab,

Step	Action
1	Select the Animation tab.
2	The PLC screen tab appears automatically.

Note: The dialogs illustrated here are depicted in offline mode. When Unity Pro is connected to a PLC, the information displayed in these tabs changes.

Viewing the Task Tab

Unity Pro Task tab dialog:



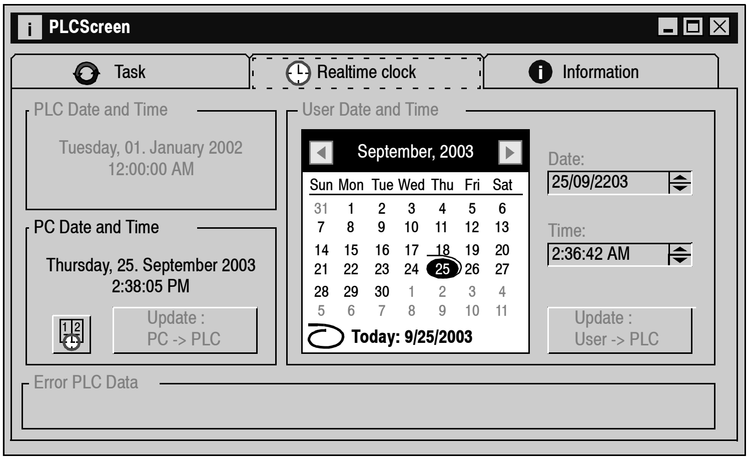
Describing the Task Tab

Description of the Task tab:

Item	Option	Value	Description
Events	State:	xxx	Status information of events available Online
	Number:	xxx	N/A
	Activate or Disable all	Click button	Button to control the events
Start/reStart	Warm Start	Click button	To initialize Warm Start
	Cold Start	Click button	To initialize Cold Start
Output fallback	Applied Outputs	N/A	Not used in Modicon Quantum Hot Standby with Unity system
	Output Fallback	N/A	
Last Stop	Read only	● Day ● DD/MM/YY ● Time	Indicates the day, date, time, and cause of the last controller stop

Viewing the Realtime Clock Tab

Unity Pro Realtime clock tab dialog:



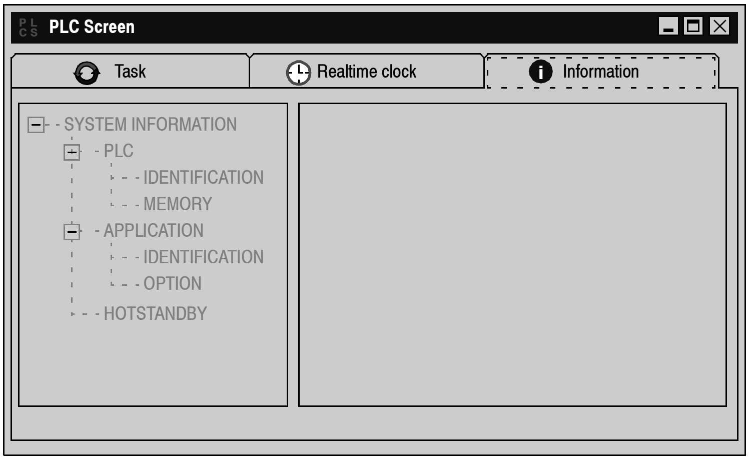
Describing the Realtime Clock Tab

Description of the Realtime clock tab:

Item	Option	Description
PLC Date and Time	Read only	Indicates the current PLC date and time
PC Date and Time	Update PC->PLC	Updates the PLC with the PC system time
User Date and Time	Update User->PLC	Updates the PLC with the time set by the user

Viewing the Information Tab

Unity Pro Information tab dialog:



Describing the Information Tab

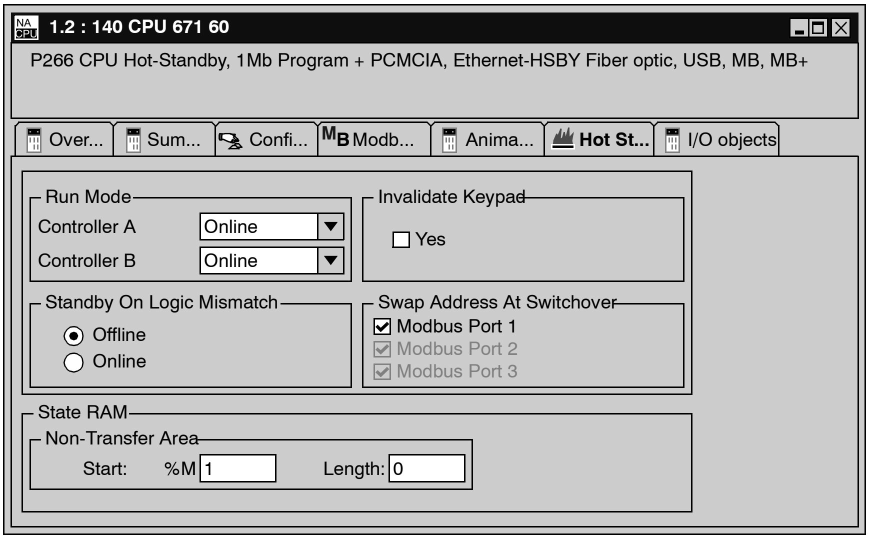
Description of the Information tab:

Item	Option	Value	Description
System Information	PLC / Identification	PLC Range	Only Online available
		Hardware ID	
		Processor Name	
		Processor Version	
		Network address	
	PLC / Memory		
	Application / Identification	Name	
		Creation Product	
		Date	
		Modification Product	
		Date	
		Version	
		Signature	
	Application / Option	Empty Terminal Support	
		Upload Information	
		Comments	
		Animation Table	
		Global Protection	
		Section Protection	
		Application Diagnostic	
		Forced Bits	
	Hot Standby	Bit Number	
		Status Register	
		PLC Mode	
		Other PLC Mode	
		PLCs matching Logic	
		PLC switch	
		Copro Health	
		Hot Standby Capability	

Using the Hot Standby Tab

Viewing the Hot Standby Tab

Configure Hot Standby values in the Hot Standby tab of the Unity Pro editor:


1.2 : 140 CPU 671 60

P266 CPU Hot-Standby, 1Mb Program + PCMCIA, Ethernet-HSBY Fiber optic, USB, MB, MB+

Run Mode
Controller A: Online
Controller B: Online

Invalidate Keypad
☐ Yes

Standby On Logic Mismatch
● Offline
○ Online

Swap Address At Switchover
☑ Modbus Port 1
☑ Modbus Port 2
☑ Modbus Port 3

State RAM
Non-Transfer Area
Start: %M 1 Length: 0

Describing the Hot Standby Tab

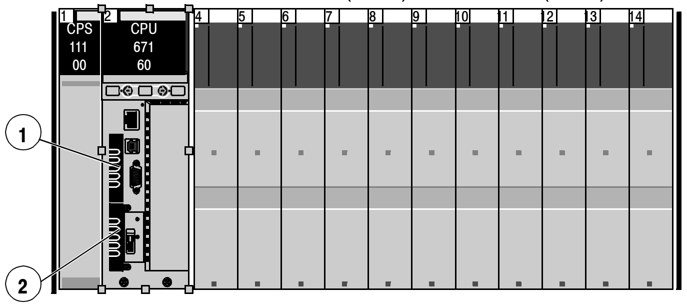
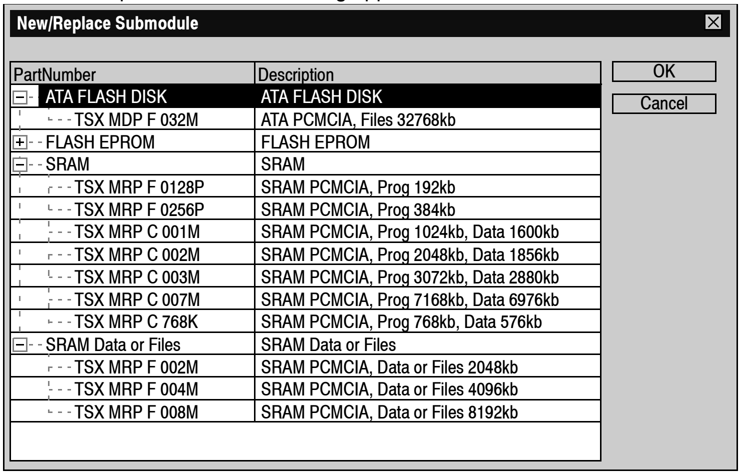
Description of the Hot Standby tab:

Item	Option	Value	Description
Run Mode	Controller A	Offline/Online	Indicates which controller is offline and which controller is online
	Controller B	Offline/Online	
Invalidate Keypad	Disable	Yes is NOT selected	When selected, you prevent keypad changes to the Hot Standby submenu.
	Enable	Yes is selected (Check mark displays)	
Standby On Logic Mismatch	Offline	Default Offline button selected	If mismatch is detected, Standby goes Offline
	Online	-	If button is selected and mismatch is detected, Standby remains Standby
Swap Address At Switchover	Modbus Port 1	x	When selected, enables Modbus switchover to occur.
State RAM: Non-Transfer Area	Start: %MW	1.	%MW is not transferred.
	Length:	1.	Specify the range of the length.
1. Enter the appropriate values. All values depend on Hot Standby configuration.			

Configuring the PCMCIA Cards

Configuring with Unity Pro

Allocating memory to the memory card

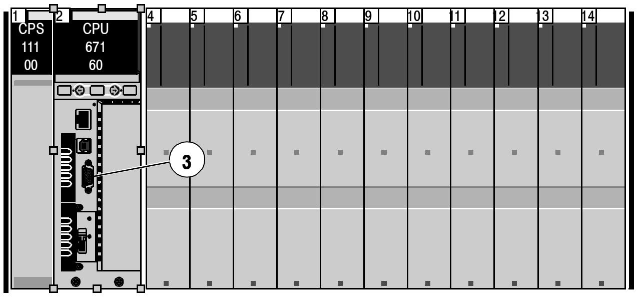
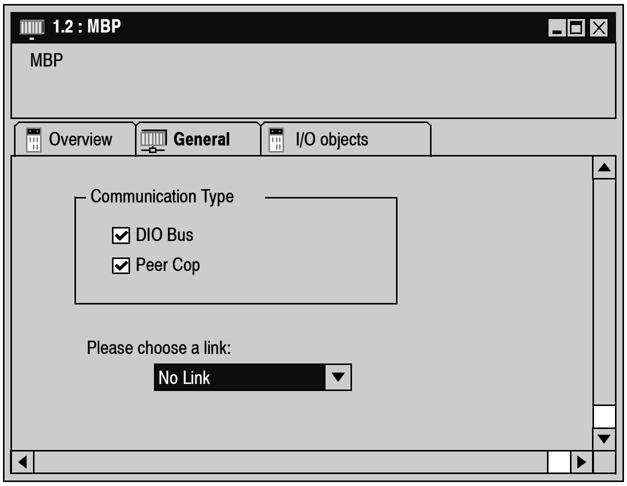
Step	Action
1	If not opened, open the Local Bus configuration editor.
2	Go to the local bus in the Structural View of the Project Browser.
3	Open the local bus either by double-clicking on the Local Bus or by selecting the Local Bus and executing right-click Open. A graphical representation of the local bus appears.
4	Point to and select either PC CardA (1 slot) or PC CardB (2 slot).  1 2 CPS 111 00 CPU 671 60 1 2 4 5 6 7 8 9 10 11 12 13 14 **1** Memory configuration of the PCMCIA card 1 **2** Memory configuration of the PCMCIA card 2
5	Double-click or right-click either PCMCIA card. The New/Replace Submodule dialog appears.  New/Replace Submodule OK Cancel (see dialog table below)
6	Add or replace the desired memory.

PartNumber	Description
ATA FLASH DISK	ATA FLASH DISK
TSX MDP F 032M	ATA PCMCIA, Files 32768kb
FLASH EPROM	FLASH EPROM
SRAM	SRAM
TSX MRP F 0128P	SRAM PCMCIA, Prog 192kb
TSX MRP F 0256P	SRAM PCMCIA, Prog 384kb
TSX MRP C 001M	SRAM PCMCIA, Prog 1024kb, Data 1600kb
TSX MRP C 002M	SRAM PCMCIA, Prog 2048kb, Data 1856kb
TSX MRP C 003M	SRAM PCMCIA, Prog 3072kb, Data 2880kb
TSX MRP C 007M	SRAM PCMCIA, Prog 7168kb, Data 6976kb
TSX MRP C 768K	SRAM PCMCIA, Prog 768kb, Data 576kb
SRAM Data or Files	SRAM Data or Files
TSX MRP F 002M	SRAM PCMCIA, Data or Files 2048kb
TSX MRP F 004M	SRAM PCMCIA, Data or Files 4096kb
TSX MRP F 008M	SRAM PCMCIA, Data or Files 8192kb

Configuring the Modbus Plus Communication Type

Configuring with Unity Pro

Configuring the Modbus Plus communication type

Step	Action
1	If not opened, open the Local Bus configuration editor.
2	Go to the local bus in the Structural View of the Project Browser.
3	Open the Local Bus editor either by double-clicking on the Local Bus or by selecting the Local Bus and executing right-click Open. A graphical representation of the local bus appears.
4	Point to the Modbus Plus port, No. 3.  1 2 CPS 111 00 CPU 671 60 4 5 6 7 8 9 10 11 12 13 14 3
5	Double-click or right-click on the Modbus Plus port. The Submodule dialog appears. The General tab is default. 1.2 : MBP MBP Communication Type ☑ DIO Bus ☑ Peer Cop Please choose a link: No Link
6	Select one or both Communication Type: ● DIO bus ● Peer Cop

Setting the Invalidate Keypad Option

Overview

The keypad is located on the front panel of the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 module.
Setting the Invalidate Keypad option can disable the Hot Standby submenu (`PLC Operations | Hot Standby`). (See *Accessing the Screens, p. 28*) When the Invalidate Keypad option is selected, the Hot Standby submenu is read only.
You may choose to prevent access to the Hot Standby control through the keypad
- to avoid the possibility of accidental (or malicious) state changing
- for security or convenience

Methods for Selecting the Invalidate Keypad Option

There are two methods for selecting/enabling this option:

Method Used	Description
Hot Standby tab	Select the Invalidate Keypad option in the Hot Standby tab using the Unity Pro software. (See *Using the Hot Standby Tab, p. 85*) Selecting the Invalidate Keypad option requires that the application program be downloaded to the CPU.
Command Register	Set the system bit, %SW60.0 to 1. Selecting the system bit %SW60.0 must be performed online in the Primary controller.

Note: By setting the Invalidate Keypad option, the Run/Stop PLC control option on the PLC Operation menu is NOT disabled.

Disabling Options

Two Hot Standby options/controls are disabled using the front panel keypad

- Changing the HSBY mode (Run/Offline)
- Application program transfer to/from Standby

Note: CHANGING FROM LEGACY
In the legacy Quantum Hot Standby system, setting command register bit 16 affects both the mode (offline or run) of controllers A and B and affects the state of bit 14 and bit 15

- Bit 16 set to 0
  - disables (overrides) Command Register bit 14 and bit 15 state
  - enables key switch state
- Bit 16 set to 1
  - enables Command Register bit 14 and bit 15 state
  - disables key switch state

In Unity,

- the state/condition of system bit %SW60.0 ONLY disables/enables the Hot Standby submenu option in the front panel keypad.
- setting system bit %SW60.0 does NOT affect the state of system bits %SW60.1 and %SW60.2
- regardless of the setting for system bit %SW60.0, system bits %SW60.1 and %SW60.2 control the mode (offline or run) of controllers A and B. (See *Setting the Bits in the Command Register, p. 110*)

Swapping Network Addresses at Switchover

Overview

The following material describes handling network addresses at Switchover. A Modicon Quantum Hot Standby with Unity system can communicate data over different network protocols:
- Modbus
- Modbus Plus
- TCP/IP

Handling Modbus Addresses at Switchover

In a Modicon Quantum Hot Standby with Unity system, the Modbus port addresses are:
- Primary: 1-119
- Standby: Offset +128
- Maximum address: 247
  Range 1-247

The Modbus port addresses can be changed using one of two methods:
- Communication menu in the front panel keypad
- Modbus Port tab in the Unity Pro editor

Changing addresses:

Using the Communication menu in the Front Panel Keypad	
Change address on either	
Primary **1.** Access the front panel keypad of the Primary. **2.** Go to Communication menu **3.** Go to Serial Port submenu **4.** Select address **5.** Change address **6.** Perform application program transfer **7.** Verify Standby Modbus address is +128.	Standby **1.** Access the front panel keypad of the Standby. **2.** Go to Communication menu **3.** Go to Serial Port submenu **4.** Select address **5.** Change address **6.** Perform switchover **7.** Ensure Standby switched to Primary **8.** Perform application program transfer **9.** Verify Standby Modbus address is +128
Using the Modbus Port Tab in Unity Pro Editor	
To change address, download application program. (See *Offline Modification of an Application Program and Logic Mismatch, p. 151*)	
Note: If the Modbus address is changed in the Primary using the front panel keypad, ensure that application program transfer is made to enable the corresponding Modbus switchover in the Standby.	

Note: CHANGING FROM LEGACY
In a Modicon Quantum Hot Standby with Unity system only one port is available for Modbus.

By default address swap at switchover is maintained between the Primary and Standby Modbus ports. This default condition can be changed using the following two methods:

- Using Hot Standby menu in the Unity Pro editor
  This choice requires the application program to be downloaded.
- Using the Command Register system bit %SW60.8
  This choice MUST be performed online in the Primary.

Selecting/deselecting address swap at Switchover

Using Hot Standby Menu in Editor	Using the Command Register system bit %SW60.8
1. Open Hot Standby menu in Unity Pro **2.** Go to Swap Address at Switchover area **3.** Deselect Modbus Port 1 **4.** Verify modifications **5.** Download application program to controller. (See *Offline Modification of an Application Program and Logic Mismatch, p. 151*) **6.** Perform switchover **7.** Ensure Standby switch to Primary **8.** Perform application program transfer	**1.** Connect to Primary **2.** Access the Command Register System bit %SW60.8 **3.** Set bit to 1 Default is 0

Swap Modbus Addresses at Switchover

If controller A is the Primary controller and its Modbus port has an address of 1, then the default addresses for the comparable port on controller B, the Standby, is 129, which is 1 plus the offset of 128.
If controller B becomes the Primary controller as the result of a switchover, its Modbus port assumes the address of 1, and the comparable port on controller A assumes the address of 129.

No Swap Modbus Addresses at Switchover

If controller A is the Primary controller and its Modbus port 1 address is 1, then that port address remains at 1 after the switchover occurs. Likewise, if controller B becomes the Primary controller as a result of a switchover, its Modbus port 1 address is remains at 1.

Important Information

Note: Important Information

1. If you change the options, the port addresses are not affected until a switchover occurs.
2. If NOM modules are used in the configuration, the offset of the Modbus address is +/-32 following the Modbus Plus address switchover.

Handling Modbus Plus Addresses at Switchover

In a Modicon Quantum Hot Standby with Unity system, the Modbus Plus port addresses on the Standby controller are offset +/-32 from the comparable ports on the Primary controller.
Modbus Plus address swap behavior at switchover

Default Behavior at Switchover
● Controller A = Primary MB+ address = 1 ● Controller B = Standby MB+ address = 33 (1 +32) (+32 = Offset)
Switchover occurs.
● Controller A = new Standby MB+ address = 33 (1 +32) ● Controller B = new Primary MB+ address = 1
Note: Numerical address of both ports (A and B) range: 1 - 64. If Primary address = 50, corresponding Standby = 18 (50 - 32)

The Modbus Plus address of the controllers can be changed using the front panel keypad: `Communication | Modbus Plus | Modify Address`
Modbus Plus address swap behavior when addressed is changed

Forced Behavior at Switchover
● Controller A = Primary MB+ address = 1 ● Controller B = Standby MB+ address = 33 (1 +32) (+32 = Offset)
Change address of Primary = 5.
● Controller A = Primary MB+ address = 5 ● Controller B = Standby MB+ address = 33
Perform Application Program Transfer.

Forced Behavior at Switchover
● Controller A = Primary MB+ address = 5 ● Controller B = Standby MB+ address = 37 (5 +32)
Force switchover.
● Controller A = new Standby MB+ address = 37 (5 +32) ● Controller B = new Primary MB+ address = 5
If he Modbus Plus address is modified, perform an Application Program Transfer. (See *Transferring an Application Program with Unity Pro, p. 159*) Failure to perform a transfer creates a different offset address in the Standby.

Note: SWAPPING ADDRESSES
At switchover, the Modicon Quantum Hot Standby with Unity system and NOMs swap Modbus Plus addresses almost instantaneously (within one or two milliseconds). This almost instantaneous switchover means that host devices which are polling the controller should be talking to the Primary controller and that the network should have minimal network interruption during switchover.

Note: EXEC UPGRADE USING OSLOADER
When using Modbus Plus communication and OSLoader, only address 1 is valid. (See *Executing the EXEC Upgrade Procedure, p. 139*)

Handling TCP/IP Addresses at Switchover

When used in a Modicon Quantum Hot Standby with Unity system, the Modicon Quantum Ethernet TCP/IP network option modules NOE 771 01 and 11 support address swapping at switchover. The swapping of IP addresses behaves much like the address swap of the Modbus Plus ports, except that the offset is 1 instead of 32. At switchover, the modules exchange their IP addresses. NOE 771 address swapping occurs automatically and can not be controlled by options selected in any of the tabs of the editor or controlled by turning ON/OFF any of the bits in the command register.
All standard rules apply to IP addressing with the additional restriction that the IP address cannot be greater than 253 or the broadcast address minus 2. Also, no other device should be assigned the configured IP +1 address.

Note: NOE 771 01 and 11 ADDRESS SWAP
- NOE 771 01 and 11 are the only Ethernet option modules that support the IP address swap in Modicon Quantum Hot Standby with Unity system V2.0.
- NOE 77101 and 11 modules must be configured in the same slot of the Primary and Standby backplanes.
- NOE 771 01, 11 requires minimum firmware revision 2.0 or higher.

5.2 Configuring a NOE with Unity Pro

At a Glance

Purpose

This material describes configuring a NOE, a Quantum Ethernet module, using Unity Pro. For a complete description of all models of the NOE, see the *Quantum NOE 771 xx Ethernet Modules User Guide, 840 USE 116 00*.

What's in this Section?

This section contains the following topics:

Overview of Modicon Quantum Hot Standby with Unity Solution for NOEs

Please Note

The Modicon Quantum Hot Standby with Unity system supports up to six NOE 771 Ethernet adapters on bus controllers.

Description of the Hot Standby Solution

The NOE Hot Standby allows automatic IP Address swap. Both controllers are configured identically. One controller is the Primary NOE; the other controller, the Secondary NOE. In case of a failure, the controllers switchover and the system recovers.
The NOEs coordinate the swapping of IP addresses. After closing both the client and the server connections, each NOE sends a swap UDP message to its peer NOE. The sending NOE then waits a specified timeout (500 ms) for the peer swap of UDP messages. Either after receiving the messages or after a timeout, the NOE changes its IP address.

Note: NOEs must communicate with each other in order to swap IP Addresses. Schneider Electric recommends that you connect the primary and Secondary NOEs to the same switch because
- Communication failures between the NOEs increases the time to swap
- Connecting two NOEs to the same switch, minimizes the probability of a communication failure

Note: Schneider Electric recommends that a switch (not a hub) is used to connect the NOEs to each other or to the network. Schneider Electric offers switches; please contact a local sales office for more information.

The NOE waits for either a change in the controller's Hot Standby state or the swap of UDP messages. Then the NOE performs one of two Hot Standby actions.
If the NOE:
1. Detects that the new Hot Standby state is either primary or standby:
   The NOE changes the IP address
2. Receives a swap UDP message:
   The NOE transmits a Swap UDP message and swaps the IP address

All client/server services (I/O Scanner, Global Data, Messaging, FTP, SNMP, and HTTP) continue to run after the switchover from the old to the new Primary NOE.

Note: Failure of an NOE module is not a condition for the primary system to leave the primary state.

Hot Standby and NOE Module Functionality

The NOE 771 family provides different Ethernet services. Some services are enabled or disabled in a Modicon Quantum Hot Standby with Unity system. The following table shows which services are enabled and disabled.

Service	**NOE 771 x1**
I/O Scanning	Enabled
Global Data	Enabled
Modbus Messaging	Enabled
FTP/TFTP	Enabled
SNMP	Enabled
HTTP Server	Enabled
DHCP	Disabled

Note: Only the 140 NOE 771 01 or 140 NOE 771 11 (TCP/IP Ethernet Modules) support a Modicon Quantum Hot Standby with Unity V2.0 system.

NOE Operating Modes and Modicon Quantum Hot Standby with Unity

The NOE Modes

The NOE modes are

- **Primary Mode**
  The Hot Standby state is primary, and all client/server services are active.
- **Secondary Mode**
  The Hot Standby state is standby, and all server services are active except DHCP.
- **Standalone Mode**
  Occurs when NOE is in a nonredundant system, or if the HE CPU module is not present or is not healthy.
- **Offline Mode**
  CPU is stopped.
  CPU module is in Offline mode.

The Modicon Quantum Hot Standby with Unity and the NOE operating modes are synchronized by the conditions described in the following table.

HE CPU Module Status	HSBY State	NOE Operating Mode
Present and Healthy	Primary	Primary
Present and Healthy	Standby	Secondary
Present and Healthy	Offline	Offline
Present and Healthy	Unassigned	Standalone
Not present or unhealthy	N/A	Standalone

Any one of four events will affect the NOE operating mode. These four events occur when the NOE is powered-up, when an NOE executes a Hot Standby switchover, when an NOE goes to offline mode, or when a new application is downloaded to the NOE.

Power-Up and IP Address Assignment

An NOE obtains its IP Address assignment at power-up as follows:

If the HSBY state is ...	Then the IP Address assigned is ...
Unassigned	Configured IP Address
Primary	Configured IP Address
Secondary	Configured IP Address + 1
Unassigned to Offline	See the *Offline Mode at Power-up Sequence* table following

If two NOEs power-up simultaneously, a "resolution algorithm" determines the Primary NOE, and after determining the Primary NOE, the "resolution algorithm" assigns the configured IP Address to the Primary NOE and then assigns the configured IP Address + 1 to the Secondary NOE.
Offline Mode at Power-up Sequence table:

Offline Mode at Power-up Sequence	Result
Controller A powers-up before controller B	● IP Address of controller A is configured IP Address ● IP Address of controller B is the configured IP Address + 1
Both controller A and controller B power-up a the same time	The resolution algorithm will assign controller A the configured IP address and will assign controller B the configured IP address + 1.

The NOE performs a "duplicate IP" test by issuing an ARP request to the configured IP Address. If a response is received within 3 seconds, the IP Address remains at the Default IP and blinks a diagnostic code.
If no IP configuration exists, the NOE remains in standalone mode, and the IP Address must be obtained from either a BOOTP server or from a MAC address.

Power-Up and Ethernet Services

The following table shows how the status of an NOE service is affected by the Modicon Quantum Hot Standby with Unity HSBY state.

HSBY State	**Status of NOE Services**					
	Client Services		**Client/ Server Services**	**Server Services**		
	I/O Scanner	**Global Data**	**Modbus Messaging**	**FTP**	**SNMP**	**HTTP**
Unassigned	Run	Run	Run	Run	Run	Run
Primary	Run	Run	Run	Run	Run	Run
Secondary	Stop	Stop	Run	Run	Run	Run
Offline	Stop	Stop	Run	Run	Run	Run

Hot Standby Switchover

The following steps describe how NOEs coordinate the Hot Standby switchover.

Step	Action
1	NOE A (installed in a HSBY rack) detects that its local controller changed from Primary to Offline.
2	NOE A changes its HSBY state from Primary to Offline with the same Ethernet services running, starts its watch-dog timer (with 500 ms timeout setting), and expects from its peer NOE a UDP request to swap the IP Address.
3	NOE B (installed in peer HSBY rack) detects that its local controller changed state from Secondary to Primary.
4	NOE B stops all Ethernet services, sends a UDP request to its peer NOE (NOE A) for the synchronization of the IP Address swap, starts its watch-dog timer (with 500 ms timeout setting), and then waits for an UDP response from its peer NOE.
5	Once NOE A receives the UDP request from NOE B (or after its watch-dog timer times out), it stops all Ethernet services, sends a UDP response to NOE B (no UDP response is sent to NOE B for watch-dog timeout case), swaps IP Address as Secondary, and starts Secondary services.
6	As soon as NOE B receives the UDP response from NOE A (or after its watch-dog timer times out), it swaps IP Addresses and starts Ethernet services as Primary.
7	After NOE A senses that its local controller changes state from Offline to Standby, it changes to Secondary accordingly.
8	The Secondary NOE now becomes the Primary NOE.
9	Primary NOE opens all client connections and listens for all server connections and re-establishes those connections.
10	Simultaneously, Secondary NOE listens for all server connections and re-establishes those connections.

Going to Offline

When either the CPU stops or the Hot Standby state goes to offline mode, two events occur:

1. NOE mode goes to Offline
2. NOE uses the IP Address of the present configuration

IP Address Assignment and Going Offline

HSBY State	IP Address Assigned Is ...
Primary to Offline	Configured IP Address, if other controller **does not** go to Primary
Standby to Offline	Configured IP Address + 1

IP Address Assignment

Configuring the NOE

The NOE can be configured to work in conjunction with the Modicon Quantum Hot Standby with Unity controller. Since the Primary and Secondary controllers must have an identical configuration, the configured IP Addresses will be the same. The NOE's IP Address is either the configured IP Address or the configured IP Address +1. The IP Address is determined by the current local Hot Standby state.
In the Offline state, the IP Address is determined by whether or not the other controller is in transition to the Primary state.

Note: For a Modicon Quantum Hot Standby with Unity system, the two IP Addresses will be consecutive.

The following table shows the IP Address assignments.

Hot Standby State	IP Address
Primary	Configured IP Address
Standby	Configured IP Address + 1
Transition from Primary to Offline	Configured IP Address, if peer controller **does not** go to Primary
Transition from Standby to Offline	Configured IP Address + 1

Note: Offline - Results depend on whether or not the other controller is detected as in transition into the primary state. If Current IP is the configured IP Address, then change the IP Address to the configured IP Address + 1.

IP Address Restriction

Note: Configuring NOE
Do not use either broadcast IP Address or broadcast IP Address - 2 to configure a NOE.

IP Address Transparency

For continued Ethernet communication, the new Primary NOE must have the same IP Address as the former Primary NOE. The IP Address in the Secondary NOE (an NOE in the secondary state) is IP Address + 1.
The NOEs integrated into the Modicon Quantum Hot Standby with Unity configuration coordinate this swapping IP Address with the management of Ethernet services used.

Note: Do not use the address IP + 1. For a Modicon Quantum Hot Standby with Unity system, do not use consecutive addresses of the configured IP Address. If you configure the last IP Address (255), NOE returns diagnostic code "Bad IP configuration".

Address Swap Times

Description

The following table details what the "time for an Address swap" comprises, such as the time to close connections, time to swap IP addresses, or time to establish connections.
The following table shows the swap time for each of the Ethernet services.

Service	Typical Swap Time	Maximum Swap Time
Swap IP Addresses	6 ms	500 ms
I/O Scanning	1 initial cycle of I/O Scanning	500 ms + 1 initial cycle of I/O scanning
Global Data	For swap times, please see the 840USE11600, *Quantum NOE 771 xx Ethernet Modules User Guide*	500 ms + 1 CPU scan
Client Messaging	1 CPU scan	500 ms + 1 CPU scan
Server Messaging	1 CPU scan + the time of the client reestablishment connection	500 ms + the time of the client reestablishment connection
FTP/TFTP Server	The time of the client reestablishment connection	500 ms + the time of the client reestablishment connection
SNMP	1 CPU scan	500 ms + 1 CPU scan
HTTP Server	The time of the client reestablishment connection	500 ms + the time of the client reestablishment connection

Network Effects of Modicon Quantum Hot Standby with Unity Solution

Overview

The Modicon Quantum Hot Standby with Unity solution is a powerful feature of NOEs, a feature that increases the reliability of your installation. Hot Standby uses a network, and using the Hot Standby feature over a network can affect the behavior of

- Browsers
- Remote and Local clients
- I/O Scanning service
- Global Data service
- FTP/TFTP server

The following are factors you may encounter while using the Modicon Quantum Hot Standby with Unity solution.

Browsers

Note: In Modicon Quantum Hot Standby with Unity configuration the NOE's I/O scanner is enabled.

If a browser requests a page and during the process of downloading that page an IP Address swap occurs, the browser will either hang or time out. Click the **Refresh** or **Reload** button.

Remote Clients

Hot Standby swaps affect remote clients.
An NOE will reset under the following conditions:

- **Remote Connection Request during Hot Standby Swap**
  If a remote client establishes a TCP/IP connection during a Hot Standby swap, the server closes the connection using a TCP/IP reset.
- **Hot Standby Swap during Remote Connection Request**
  If a remote client makes a connection request and a Hot Standby swap occurs during the connection request, the sever rejects the TCP/IP connection by sending a reset.
- **Outstanding Requests**
  If there is an outstanding request, the NOE will not respond to the request, but the NOE will reset the connection.

The NOE will do a Modbus logout if any connection has logged in.

Local Clients

During a swap, the NOE will reset all client connections using a TCP/IP reset.

I/O Scanning Service

The I/O Scanning provides the repetitive exchange of data with remote TCP/IP nodes I/O devices. While the PLC is running the Primary NOE sends Modbus Read/ Write, read or write request to remote I/O devices, and transfer data to and from the PLC memory. In the secondary controller, the I/O scanning service is stopped.
When the Hot Standby swap occurs, the Primary NOE closes all connections with I/ O devices by sending a TCP/IP reset. The I/O scanning service in this NOE is standby.
After the swap, the new Primary NOE re-establishes the connection with each I/O devices. It restarts the repetitive exchange of data with these re-connections.
The NOE 771 01 and 11 provides the I/O scanning feature. Configure using either

- Unity Pro software
- Internal I/O Scanner Web page

Using either method, the configuration and transfer of data between network addresses can be done without using the MSTR/IEC function block.

Note: I/O SCANNING AND SWITCHOVER WITH CRITICAL APPLICATIONS
Account for the following Ethernet I/O scanning considerations during a switchover.

- If MSTR/IEC function block is used for TCP/IP, only some of the Op Code will be used. Therefore, the block will not complete its transaction and returns error code 0x8000.
- While the NOE is in the process of performing the transaction, a new MSTR/IEC function block may become active.
- The output states of the scanned I/Os will follow the state defined in the last value option configured in the I/O scanning table of the NOE module (in Unity Pro software).
  These two states are either
  1. set to 0
  2. Hold last

With the above considerations, Schneider Electric recommends using switchover with Ethernet I/O scanning for less critical applications.

Global Data (Publish/ Subscribe) Service

The Hot Standby NOE is one station within a distribution group. Distribution groups exchange application variables. Exchanging application variables allows the system to coordinate all the stations in the distribution group. Every station publishes local application variable in a distribution group for all other stations and can subscribe to remote application variables independent of the location of the producer.
The communication port has only one multicast address.
In this network service, the Modicon Quantum Hot Standby with Unity controllers are viewed like only one station. The Primary NOE publishes the Hot Standby application variables and receives the subscription variables. The Secondary NOE global data service is in a stopped state.
When the Hot Standby swap occurs, the Primary NOE stops the Global Data service. The NOE does not publish the local variable during a swap. And after the swap, the new Primary NOE starts to publish application variables and to receive the subscription variables.

FTP/TFTP Server

The File Transfer Protocol/Trivial File Transfer Protocol (FTP/TFTP) server is available as soon as the module receives an IP address. Any FTP/TFTP client can logon to the module. Access requires the correct user name and password. Modicon Quantum Hot Standby with Unity allows only one active FTP/TFTP client session per NOE module.
When the Hot Standby swap occurs, the Primary and Secondary NOEs close the FTP/TFTP connection. If a user sends an FTP/TFTP request during the swap, the communication is closed.
Whenever you re-open communication, you must re-enter a user name and a password.

5.3 Configuring Registers with Unity Pro

At a Glance

Purpose

This material describes configuring a Modicon Quantum Hot Standby with Unity system by selecting options that affect the registers. You may want to use this method if your system has specific configuration needs.

What's in this Section?

This section contains the following topics:

Understanding the Non-Transfer Area, Transferring State RAM, and Reverse Transfer Words

Designating a Non-Transfer Area

Using the Hot Standby tab of the editor dialog, you may designate a block of %MW words as a Non-Transfer area.

Step	Action
1	Ensure that the Hot Standby tab is selected. If you want to review the process for starting Unity Pro and opening the editor dialog, please see *Accessing the Base Configuration, p. 73*.
2	Enter the starting address in the system word field, %MW. The field is located in the Non-Transfer Area of the Hot Standby tab.
3	Enter the number of contiguous registers in the Length: field. The field is located in the Non-Transfer Area of the Hot Standby tab.

Non-Transfer Area of State RAM

The designated registers will be ignored when state RAM values are transferred from the Primary controller to the Standby. Placing registers in the Non-Transfer Area is one way to reduce scan time.

Note: With the new hardware design of the Modicon Quantum Hot Standby with Unity 140 CPU 671 60s, the scan time optimization provided by the Non-Transfer area may be very low.

Transferring Data to the Primary

A pair of system words,%SW62 and %SW63, are dedicated to transfer data from the Standby controller to the Primary.

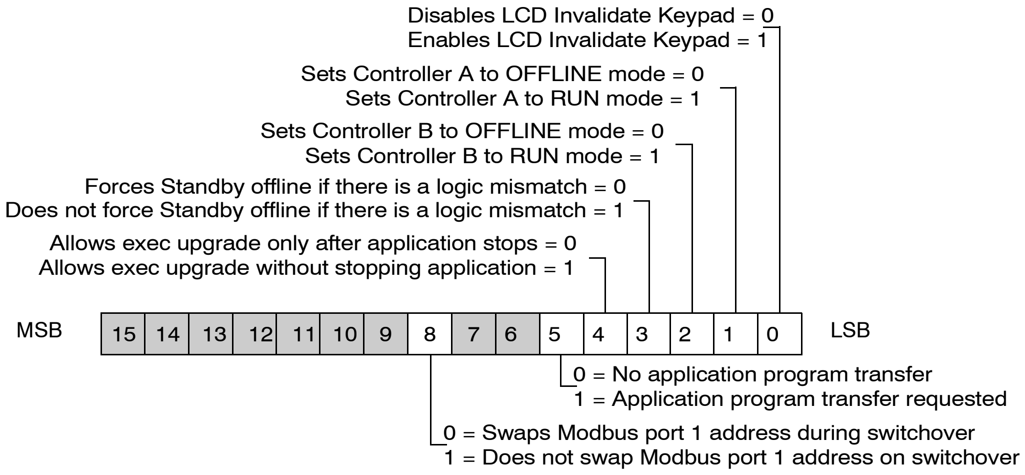
These system words can be used by the application program (in the first section) to register diagnostic information.

The data coming from the Standby are transferred at each scan and are available to the Primary.

Understanding the Unity Command Register

Setting the Bits in the Command Register

The Command Register defines the operating parameters of a Hot Standby application for both the Primary and Standby and is located at system word %SW60. At each scan, the Command Register is replicated and transfers data from the Primary to the Standby. Transfer occurs only from Primary to Standby. Any changes made to the Command Register on the Standby will have no effect because the values transferred from the Primary overwrite the values in the Standby.
The following illustration identifies the operating options provided by the Command Register.


Disables LCD Invalidate Keypad = 0
Enables LCD Invalidate Keypad = 1
Sets Controller A to OFFLINE mode = 0
Sets Controller A to RUN mode = 1
Sets Controller B to OFFLINE mode = 0
Sets Controller B to RUN mode = 1
Forces Standby offline if there is a logic mismatch = 0
Does not force Standby offline if there is a logic mismatch = 1
Allows exec upgrade only after application stops = 0
Allows exec upgrade without stopping application = 1
MSB
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
LSB
0 = No application program transfer
1 = Application program transfer requested
0 = Swaps Modbus port 1 address during switchover
1 = Does not swap Modbus port 1 address on switchover

System Word %SW60.0

Invalidate Keypad is an option that allows a controller to accept or refuse commands from the Hot Standby submenu in the front panel keypad.

- %SW60.0 = 1
  Invalidate Keypad enabled.
  The Modicon Quantum Hot Standby with Unity system refuses all changes from the Hot Standby submenu in the front panel keypad.
- %SW60.0 = 0
  Invalidate Keypad disabled.
  The Modicon Quantum Hot Standby with Unity system accepts all changes from the Hot Standby submenu in the front panel keypad.

(See *Setting the Invalidate Keypad Option, p. 88*)

System Word %SW60.1

Controller A OFFLINE/RUN mode
- %SW60.1 = 1
  Controller A goes to Run mode
- %SW60.1 = 0
  Controller A goes to Offline mode

System Word %SW60.2

Controller B OFFLINE/RUN mode
- %SW60.2 = 1
  Controller B goes to Run mode
- %SW60.2 = 0
  Controller B goes to Offline mode

System Word %SW60.3

Logic mismatch
- %SW60.3 = 0
  If a logic mismatch is detected, Standby forced to Offline mode.
- %SW60.3 = 1
  Standby operates normally even if a mismatch occurs.

(See *Handling Logic Mismatch with Unity Pro, p. 141*)

System Word %SW60.4

EXEC upgrade
- %SW60.4 = 1
  Allows the executive to be upgraded on the Standby and the Primary continues to control the process.
- %SW60.4 = 0
  Allows the executive to be upgraded and to stop the Primary's control of the process.

Upgrading allows
- a Hot Standby system to operate with different versions of the OS running on the Primary and Standby
- upgrades without shutting down the process

To perform the executive upgrade, the Standby must be stopped. When started again, the Standby operates as a valid Standby. (See *Enabling EXEC Upgrade with Unity Pro, p. 137*)

System Word %SW60.5

Commands Standby to initiate an application transfer.

- %SW60.5 = 1 means Standby requests an application program transfer from Primary
- %SW60.5 = 0 is default and no transfer occurs

Note: %SW60.5 is a Monitor Bit
%SW60.5 monitors an action. Once the action occurs, %SW60.5 returns to the default, which is zero (0).

System Word %SW60.8

Swap Modbus port

- %SW60.8 = 1
  Swaps Modbus addresses on port 1when a switchover occurs.
  Note: In a Modicon Quantum Hot Standby with Unity system only Modbus port 1 is available for use.

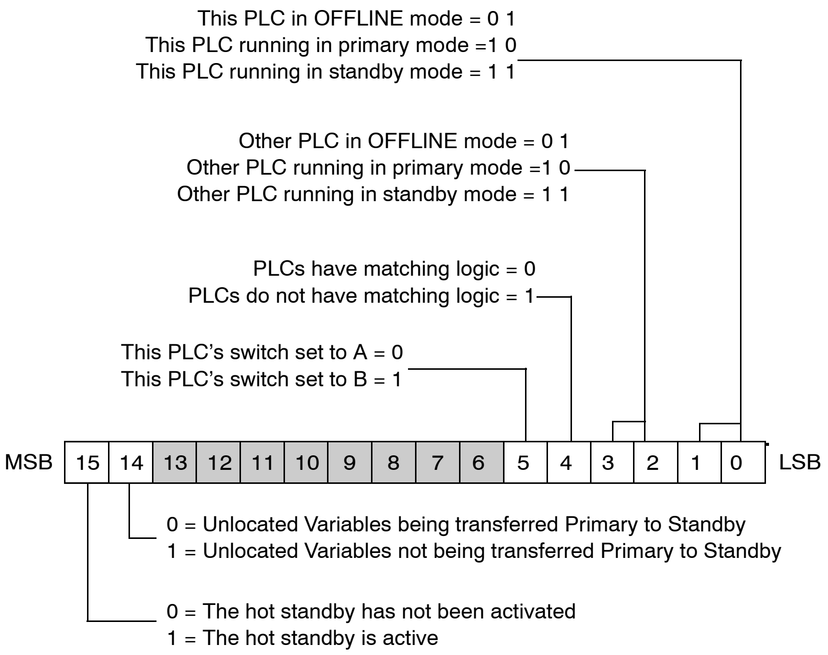
Understanding the Unity Status Register

Bits in the Hot Standby Status Register

The Hot Standby Status Register is a readable register located at system word %SW61 and is used to monitor the current machine status of the Primary and Standby.

Both the Primary and the Standby/Offline have their own copy of the Status register. The Status register is not transferred from Primary to Standby. Each PLC must maintain its local Status Register based on the regular communication between the two controllers.

The following illustration identifies the operating options provided by the Status Register.


This PLC in OFFLINE mode = 0 1
This PLC running in primary mode =1 0
This PLC running in standby mode = 1 1
Other PLC in OFFLINE mode = 0 1
Other PLC running in primary mode =1 0
Other PLC running in standby mode = 1 1
PLCs have matching logic = 0
PLCs do not have matching logic = 1
This PLC's switch set to A = 0
This PLC's switch set to B = 1
MSB
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
LSB
0 = Unlocated Variables being transferred Primary to Standby
1 = Unlocated Variables not being transferred Primary to Standby
0 = The hot standby has not been activated
1 = The hot standby is active

System Words %SW61.0 to %SW61.3

These four bits display the states of the local and remote Hot Standby controllers.
Status of local PLC
- %SW61.1 = 0 and %SW61.0 = 1means local PLC is in OFFLINE mode
- %SW61.1 = 1 and %SW61.0 = 0 means local PLC is running in Primary mode
- %SW61.1 = 1 and %SW61.0 = 1 means local; PLC is running in Standby mode

Status of remote PLC
- %SW61.3 = 0 and %SW61.2 = 1means remote PLC is in OFFLINE mode
- %SW61.3 = 1 and %SW61.2 = 0 means remote PLC is running in Primary mode
- %SW61.3 = 1 and %SW61.2 = 1 means remote PLC is running in Standby mode

System Word %SW61.4

%SW61.4 is set = 1 whenever a logic mismatch is detected between the Primary and Standby controllers.
%SW61.4 depends on %SW60.3 (Command Register) set = 1.

System Word %SW61.5

%SW61.5 identifies the Order reported by the Copro at start time.
The order depends on the range of the MAC addresses.
- If the A/B designation is A, then bit 5 will be set = 0.
- If the A/B designation is B, then bit 5 will be set = 1.

Note: On controller LCD displays
- A
- B

System Word %SW61.14

If %SW61.14 is set = 1, the setting indicates that a logic mismatch has been detected, which prevents Unlocated Variables to be transferred from the Primary to Standby.

System Word %SW61.15

If %SW 61.15 is set = 1, the setting indicates that the Copro device is set up correctly and working.

Transferring User Data

General

At end of scan in a redundant system the Primary must send its data to the Standby in order to keep in ready to assume the role of Primary if the need arises.

Variables, Instances, Bits, Words

The user data that will be transferred includes:

- Located variables (in state RAM)
- All unlocated variables
- All instances of DFB and EFB data
- SFC states
- System Bits and Words

Using Initialized Data

Loading at Cold-start Time

The Modicon Quantum Hot Standby with Unity 140 CPU 671 60 supports initialized data.
Initialized data allows you to specify initial values for the data that are to be loaded at cold-start time. Declare the variables before a cold start.

Updating Online

In addition to declaring values before a cold start, you can update the initial values online.
Updating the initial values online creates a mismatch situation in a redundant system.

Handling Problems at Switchover

Updating the initial values online presents a problem: if a switchover occurs to the non-updated PLC, then you execute a cold-start, the older initial values will be used.

Note: WINDOW OF TIME
Pay attention to the fact that there is a window of time during which a mismatch can occur. Mismatches may cause inconsistent operations.

Solving Mismatch Problems

However, logic mismatches cause the same problems. Thus, value mismatches will be treated in the same way as logic mismatches. Value mismatches give the same indications and the same update requirements.

Synchronizing Time-of-Day Clocks

Setting the Time-of-Day Clocks in the Primary and Standby Controllers

In a Modicon Quantum Hot Standby with Unity system, the Primary and Standby controllers have their own Time-of-Day clocks, which are not implicitly synchronized. If the clocks are not synchronized, then at switchover, the Time-of-Day would change by the difference between the two clocks. Non synchronization of the clocks could cause problems if you are controlling a time critical application.

Maintaining a Modicon Quantum Hot Standby with Unity System

6

Introduction

Overview

This chapter provides information about maintaining a Modicon Quantum Hot Standby with Unity system.

What's in this Chapter?

This chapter contains the following topics:

Verifying the Health of a Modicon Quantum Hot Standby with Unity System

Generating and Sending Health Messages

The Modicon Quantum Hot Standby with Unity modules exchange a health message approximately every 10 ms.
If the Primary has an error, the Standby is notified and assumes the Primary role.
If the Standby has an error, the Primary continues to operate as a standalone.The RIO head processors periodically verify communication with one another.
The Primary sends a health message to the Standby either

1. every 10 milliseconds when no other data is being sent on the high speed Copro link
2. every 5 milliseconds if no communication is required with any drop on RIO link.

If the Standby never receives any message on either link, the Standby will try to determine the cause of the failure and assumes control if necessary.
If the Primary does not receive a valid response from the Standby, the Primary will operate as if there was no back up available as if the Primary were a standalone.

Performing Automatic Confidence Tests

The system automatically performs two kinds of confidence tests on the Modicon Quantum Hot Standby with Unity Copro:

- Startup tests
- Run time tests

Conducting Startup Tests

Startup confidence testing on the Modicon Quantum Hot Standby with Unity Copro attempt to detect hardware errors in the module before the application is allowed to run.
If the module fails any of its tests, it will remain offline and will not communicate with the other Modicon Quantum Hot Standby with Unity module.

Conducting Run Time Tests

Run time tests are performed whenever the Copro is in the operational state. Run time tests are executed in small slices to prevent delays in scan time.
If the module fails any of its tests, the module remains offline and will not communicate with the other module.

Detecting and Diagnosing Failures in a Modicon Quantum Hot Standby with Unity System

Important Information

Please note.

If...	Then ...
Component of Primary fails	Control shifts to Standby
Component of Standby fails	Standby goes offline
Fiber optic cable link fails	Standby goes offline

Understanding Health Messages

The Primary sends a health message to the Standby every 10 milliseconds.

If ...	Then Primary Sends Health Message ...
No communication is required with any drop on RIO link	every 5 milliseconds
All systems OK	every scan

Exceptions

If ...	Then ...
Standby never receives any message on either link	**1.** Standby determines cause of failure **2.** Standby assumes control
Primary does not receive a valid response from the Standby	Primary operates as if **1.** no back up available **2.** Primary were a standalone Standalone = 1) no working Copro 2) no Hot Standby Functionality

Finding Diagnostic Information with Unity Pro

Errors and switchovers are logged in the diagnostic buffer. To view the log,

Step	Action
1	Select **Tools** → **Diagnostic Viewer** from the main menu.

Finding More Information in this Manual

Refer to the following sections

Type of failure	Refer to section
Primary controller	*Detecting Primary Controller, Copro, and RIO Head Failures, p. 123*
Primary Copro	
Primary RIO head	
Standby controller	*Detecting Standby Controller, Copro, and RIO Head Failures, p. 125*
Standby Copro	
Standby RIO head	
High speed data link failures	*Detecting High-Speed Data Link (HDSL) Failures, p. 126*
Remote I/O link	*Detecting Remote I/O (RIO) Link Failures, p. 129*
Application program checksum failures	*Checking for Identical Application Programs—Checksum, p. 131*

Detecting Primary Controller, Copro, and RIO Head Failures

Understanding CPU to Copro Communication

Facts

1	On every scan, CPU communicates with Copro.
2	Main CPU executes the Hot Standby control at the start of the scan, the main CPU asks the Copro to service its requests.
3	CPU reports any errors detected.
4	If Primary Copro fails, Primary Controller operates as a standalone. Standalone = 1) no working Copro 2) no Hot Standby functionality

Failure Detection between Two Controllers

If an error occurs in either one of two controllers,

Situation	**Response**
Controller with error	Reports error to other controller by sending a message through either **1.** high speed Copro transfer link **2.** RIO link
Controller without error	Detects error from a timeout which occurs because of no activity on link

Note: Primary maintains continuous activity on link, which ensures Standby can detect an error as soon as possible.

Failure Detection within One CPU — Hard Errors

Facts

1	RAM failure is a hard error.
2	Copro detects hard errors.

Detecting failures:

If ...	**Then ...**
Hard error occurs	**1.** Copro sends a `take control` command to the Standby **2.** Primary Copro stops because of an interface error

Failure Detection in Either Copro

Detecting failures

If ...	Then ...
Primary Copro reports any error	**1.** Primary controller acknowledges the error **2.** Primary controller attempts to transfer control to the other controller by sending a `take control` command to the Standby through the RIO link
Primary Copro does not respond within 5 milliseconds	**1.** Primary controller acknowledges the error **2.** Primary controller attempts to transfer control to the other controller by sending a `take control` command to the Standby through the RIO link
Primary Copro sends a `take control` command to the other Copro	**1.** Primary Copro relinquishes control **2.** Primary Copro does not expect any response
Standby copro experiences an error	**1.** Standby controller reports the error by sending a No Standby message **2.** Standby controller goes offline

Failure Detection by an RIO Head

Table with two columns

If ... RIO Head	Then ... Primary Controller
Responds	Releases control and the Standby station becomes a Standalone. Standalone = 1) no working Copro 2) no Hot Standby functionality
Does NOT respond	Continues to scan the I/O.

Understanding RIO Head Failure

If the RIO Head fails,

1	Main CPU times out when it fails to communicate with the RIO Head.
2	Main CPU stops.
3	Main CPU reports RIO failure to log.
4	Main CPU reports RIO failure error to the Copro.
5	Copro goes offline.

Detecting Standby Controller, Copro, and RIO Head Failures

Standby CPU Failure

When Standby CPU fails,

Stage	Description
1	The Standby CPU reports errors to the Standby Copro.
2	The Standby Copro sends a `No Standby` message to the Primary Copro.
3	The Standby CPU and the standby copro go offline.

Standby Copro Failure

When Standby Copro fails,

Stage	Description
1	When the Primary CPU communicates with the Standby, the Standby Copro reports its error to the Primary.
2	The Primary requests the Copro to go offline.
3	The Standby Copro will also report its error to the Primary Copro by sending a `No Standby` message.
4	Standby goes offline.

Standby RIO Head Failure

When the Remote IO Head fails,

Step	Description
1	The CPU stops and reports a RIO failure.
2	The CPU reports the error to the Copro
3	The Copro sends a `No Standby` command to the Primary.
4	The Standby goes offline.

Detecting High-Speed Data Link (HDSL) Failures

Important Information

Facts

1	High-speed data link connects the two Copros.
2	Using the high-speed data link, the Primary controller communicates with the Standby every 10 milliseconds.
3	Primary sends either **1.** data message **2.** health message

Note: If both the Primary and Standby do not hear from each other, either station can detect a high speed data link failure.

Standby Detects a Failure

At first,

Step	Action	Result
1	Standby does not hear from the Primary on the high-speed data link	**1.** Standby requests the Primary CPU to monitor the RIO link **2.** Primary CPU sends a request to the RIO Head

When the RIO Head receives the request,

If ...	Then ...
RIO Head finds the RIO link not active	**1.** RIO Head assumes that the Primary must be down **2.** Standby assumes control
RIO Head finds the RIO link is active	Message received from Primary CPU must be either **1.** health message Messages are sent every 5 milliseconds from Primary RIO Head to Standby RIO Head. **2.** I/O transaction data message Messages are sent from the Primary RIO Head to the I/O drops at the request of the controller.

Facts about the I/O

1	If the message is an I/O transaction, the RIO Head **1.** concludes the failure occurred on the high-speed data link **2.** informs the Primary controller to go to offline
2	If you never configure an I/O drop, the failure on the high-speed data link could cause the Standby to assume control since the Standby RIO head will never receive any I/O transaction message.
3	After any CPU fails, **1.** RIO Head will not perform drop communication **2.** RIO Head sends only health messages

Standby Assumes Control

The Standby becomes Primary

Step	Action	Result
1	After the Primary controller goes offline,	A health message from the Standby controller is the only message received by the Standby RIO Head.
2	Standby controller listens to the high-speed data link for one scan.	
3	If Standby controller hears nothing,	Standby knows that the failure must be on both the Primary Copro and Primary CPU.
4	Standby assumes control.	

Detecting Remote I/O (RIO) Link Failures

Important Information

Facts

1	Remote I/O (RIO) Link connects the two RIO Heads.
2	Primary RIO Head performs a health check on the RIO link by sending health messages.
3	Primary RIO Head sends a health message every 5 milliseconds.
4	Unlike the health communication check performed on the Copro link, the Primary Copro does not wait for a response from the Standby Copro. Instead the Primary Copro expects a reply every second. Expecting a reply every second minimizes the impact on the Primary's performance.

Standby Controller and Messages

How the Standby handles messages depends on:

If Standby ...	**Then ...**	**Action**
Never Responds to any message	Primary assumes that the Standby RIO Head failed.	Standby continues to control the drops.
Never Receives a message from the Primary	Standby assumes failure may be in the RIO link.	Standby cannot assume control.

Standby Monitors RIO and Copro Links

To start the process,

Step	Action	Result
1	Standby RIO Head sends a request to the Primary RIO Head.	Confirm whether Primary RIO **1.** Head failed or **2.** link failed
2	Standby requests that the Main CPU monitor the Copro link.	Main CPU passes this request to Copro either as a **1.** `monitor RIO` request **2.** `Copro link` request

To complete the process, the Standby determines

If ...	Then ...
Copro link is down and the Primary is down	Standby assumes control
Copro link is up	Standby Copro sends a message to the Primary Copro and **1.** Primary Copro passes this request to the Primary CPU **2.** Primary checks the Primary RIO link

Understanding Communication Status to the Drops

Depending on the status, the Primary RIO Head continues either to operate as the Primary or goes offline.

If communication to drops is	Then	Action
Healthy	RIO link failure must be on Standby side.	**1.** The station continues to operate as the Primary **2.** Standby RIO Head shows the link error pattern on the LEDs
Not healthy	RIO link failure is on Primary side.	**1.** The Primary RIO Head displays a link error **2.** Standby assumes control

Checking for Identical Application Programs—Checksum

Important Information

Please note

Fact	Result
A Hot Standby system requires that both stations must have the same application program.	This requirement prevents the Standby from executing a different application program if transfer of control occurs.

Note: OVERRIDING SAME APPLICATION PROGRAM REQUIREMENT
To override the requirement that both controllers have the same application program, ensure that the Command Register's %SW60.3 is set = 1. (See *System Word %SW60.3, p. 111*)

Standby Checks for Mismatches

Checking for identical application programs

Step	Action	Result
1	At each scan, the application program's instruction, checksum (CKSM), is transferred from the Primary to the Standby along with any other necessary data.	The Standby validates the new checksum (CKSM) against its existing checksum (CKSM).
2	Standby determines if mismatch occurs.	**1.** Mismatch: Standby goes Offline **2.** No mismatch: system operates normally
3	The controller returns to Online and is the Standby as soon as the application programs are identical.	

Replacing a Faulty Module

Important

You may replace a faulty module while a system is running.
Ensure that the module being replaced:

1. installs into the Standby backplane
2. resides in the same position in both backplanes
3. is same type of module

Same type of module means NOE replaces NOE, CRP replaces CRP.

Note: IMPORTANT INFORMATION

1. Perform a switchover if replacing a Primary.
2. Do NOT remove a Primary controller under power supply (Hot Swap).

Troubleshooting the Primary Controller

Troubleshooting the Primary

To determine which component failed, note controller's status displayed in the HE CPU LCD screen and the RIO Head's status displayed by the RIO Head' LEDs.

Controller Status	RIO Head Status	Failure Type	Description
Stop	All LEDs off except READY on and Com Act blinks four times	Controller	An Interface error occurred.
Offline	All LEDs off except READY on	Fiber Optic connection between both controllers	A Com Act error occurred.
Stop	All LEDs off except READY on and Com Act displays error pattern	RIO Head	A Com Act error occurred.
Stop	READY on and Com Act blinks four times	RIO Cable Failure at Primary End	In a dual cable system, if only one cable fails, the Error A or Error B indicator on the RIO Head lights instead of stopping the system, and the system continues to operate. When the RIO cable fails at the Primary end, input data may be reset to 0 for one scan because the communication failure to the drop occurs before the broken link is detected.

Troubleshooting the Standby Controller

Troubleshooting the Standby

To determine which component failed, note controller's status displayed in the HE CPU LCD screen and the RIO Head's status displayed by the RIO Head's LEDs.

Controller Status	RIO Head Status	Failure Type	Description
Stop	All LEDS off except READY on or READY on and Com Act blinks once a second	Controller	An Interface error occurred.
Offline	READY on and Com Act stops blinking	Fiber Optic connection between both controllers	A Com Act error occurred.
Stop	Com Act displays error pattern	RIO Head	After you have replaced the module and cycled power, to ensure that the controllers have identical application programs, you must perform an application program update.
Stop	READY on and Com Act blinks four times	RIO Cable Failure at Standby end	In a dual cable system, the RIO Head gives no indication if only one cable has failed.
Offline	Com Act stops blinking	Fiber Link failures: ● from Standby Transmit to Primary Receive ● from Primary Transmit to Standby Receive	

Understanding the Modicon Quantum Hot Standby with Unity System Special Features

III

At a Glance

Purpose

This part describes the special features of a Modicon Quantum Hot Standby with Unity system.

- enabling an EXEC upgrade
- handling logic mismatch
- transferring application programs

What's in this Part?

This part contains the following chapters:

Enabling EXEC Upgrade with Unity Pro

7

Introduction

Overview

In this chapter you will find information regarding the EXEC upgrade method for a Modicon Quantum Hot Standby with Unity system. Upgrading allows you to update the EXEC for the standby controller while the process is still controlled by the primary controller.

What's in this Chapter?

This chapter contains the following topics:

Overview of Modicon Quantum Hot Standby with Unity EXEC Upgrade

Upgrading while Process is Running

The Executive Upgrade feature allows upgrading the EXEC of the Standby controller while the Primary controller continues to control the process. However, during the upgrade, the system can no longer be considered redundant. That is, there is no Standby available to assume control if the Primary should fail before the Standby upgrade is complete.

Upgrading EXEC without Stopping

Under normal operating conditions, both controllers in a redundant system must have the same versions of firmware.
In fact, there are checks by the controllers to detect if there is a mismatch in firmware.
Normally, when a mismatch exists, performing a switchover would not be possible because the Standby controller would not be allowed to go online.
However, to allow an EXEC Upgrade without stopping the application, overriding is possible by setting the Command Register system bit %SW60.4. Details of the Modicon Quantum Hot Standby with Unity command register can be found in *Understanding the Unity Command Register, p. 110*.

Note: Enabling EXEC upgrade without stopping the application overrides the process of checking whether the Primary and Standby are configured identically. Disable the upgrade without stopping bit as soon as the EXEC upgrade is finished.

Note: IMPORTANT INFORMATION
EXEC upgrade is possible only with compatible firmware.

Executing the EXEC Upgrade Procedure

General

Perform an EXEC upgrade using the installed OSLoader tool. Use one of two communication methods available in the OSLoader:
- Modbus RTU
- Modbus Plus

Using Modbus RTU

Follow these steps.

Step	Action
1	Connect to the Primary.
2	Access the Command Register system bit %SW60.4; set bit to 1.
3	Disconnect the fiber optic cable on both controllers.
4	Open the OSLoader tool.
5	Select the Modbus communication option.
6	Stop the Standby.
7	Connect to the Standby using Modbus. Note: Use the Standby's Modbus address.
8	Download the OS to the Standby.
9	After completing the OS download, perform application program transfer to the Standby.
10	Reconnect the fiber optic cables.
11	Put in RUN mode. Note: Ensure Primary and Standby are in RUN Primary and RUN Standby mode.
12	Perform a switchover. Note: Ensure Standby becomes Primary.
13	Repeat Steps 4 through 9 on the new Standby.
14	Connect to the new Primary.
15	Access Command Register system bit %SW60.4; set bit to 0).

Important

If you upgrade using Modbus Plus, only address 1 is allowed for downloading. Otherwise, there is no communication.
Ensure that no device in the Modbus Plus network is using the address ‘1’. (See *Handling Modbus Plus Addresses at Switchover, p. 92*)

Using Modbus Plus

Follow these steps.

Step	Action
1	Connect to the Primary.
2	Access the Command Register system bit %SW60.4; set bit to 1.
3	Note: Before stopping the Standby, note the Modbus Plus address. Stop the Standby.
4	Disconnect the fiber optic cable from both controllers. Note: Primary operates without a Standby.
5	Switch off power, and switch on power to the Standby.
6	If not set to 1, change the Modbus Plus address of the Standby to 1.
7	Open the OSLoader tool.
8	Connect the Standby using Modbus Plus. Note: Use the Standby's Modbus Plus address.
9	Download the OS to the Standby.
10	Download application program to the Standby. Note: Ensure that you download a valid application program.
11	Ensure that the Modbus Plus address is the same as the address noted in Step 3.
12	Reconnect fiber optic cable to both controllers. Note: Primary operates with a Standby.
13	Put in RUN mode. Ensure Primary and Standby are in RUN Primary and RUN Standby mode.
14	Perform switchover. Note: Ensure Standby becomes Primary.
15	Repeats Steps 3 through 12 to the new Standby. Ensure Primary and Standby are in RUN Primary and RUN Standby mode.
16	Connect to the new Primary, and access the Command Register system bit %SW60.4; set to 0.

Compatibility Issues

To upgrade a Modicon Quantum Hot Standby with Unity EXEC without shutting down the process, the current application program must be executable by the new EXEC.
Observe this requirement when installing minor revisions targeted for bug fixes or minor enhancements.
When a major function enhancement needs to be made, maintaining this compatibility may not be possible.
In this case, to perform an EXEC upgrade requires a system shut down.

Handling Logic Mismatch with Unity Pro

8

Introduction

Overview

This chapter provides information about using the Logic Mismatch feature available in Unity Pro.

What's in this Chapter?

This chapter contains the following topics:

Understanding Modicon Quantum Hot Standby with Unity Logic Mismatch

Needing Identical Application Programs

In a fault-tolerant redundant system and under normal operating conditions, both controllers must load the identical application program (also called a logic program). The application program is updated every scan by transferring data from the Primary to the Standby. Both controllers conduct tests to detect if a mismatch exists between the application programs.

The following conditions cause a mismatch in the application program: a difference between:

- programs
- animation tables
- comments (on variables)

Note: Animation Tables and Comments
Both animation tables and comments (on variables) may be excluded from the mismatch by not including in the upload information.

- Exclude by selecting `Tools | Project Settings | Build tabs` (default). In the Upload Information area, select `without`.
- Not including requires downloading application program

When a mismatch exists, a switchover is not possible, and the Standby controller would NOT go online. However, there are situations when you may want to allow a mismatch between the application programs. To enable this condition, use the Modicon Quantum Hot Standby with Unity Logic Mismatch feature.

Note: Switchover can NOT occur while the Standby controller is offline.

Defining Logic Mismatch

Logic Mismatch is a Modicon Quantum Hot Standby with Unity feature that allows a mismatch between the application programs of the Primary and Standby controllers. Use the Logic Mismatch feature to modify an application program without stopping the process.

Using the Build Project Function

Note: Build Project vs. Rebuild All Project
1. Use the Build Project function to perform a logic mismatch with Unity Pro. Schneider Electric recommends do not use Rebuild All Project to create a logic mismatch because the Rebuild All Project function creates a completely new project even if nothing has been changed in the application.

Causing a Mismatch

Note: CHANGING FROM LEGACY
Legacy Hot Standby systems reserved areas of the State RAM for user data, which was transferred from the Primary to the Standby during scans. Because of the transfer process, legacy Hot Standby systems could support different application programs in the two controllers. One application program resided in one controller, and a different application program resided in the other controller.
In the legacy system, the user could program the logic (now called application program) and decide where to store the data. With this method of programming, the memory is known as static data memory layout and is necessary to have different user data accessing the same variables.

In the Modicon Quantum Hot Standby with Unity system, all memory is allocated by a memory manager, which automatically transfers the logical memory to a physical memory location.
This dynamic data memory layout is the heart of the programming flexibility and platform independence that Unity Pro provides, but on a Modicon Quantum Hot Standby with Unity system with different user logic, dynamic data memory layout makes a cyclical data update very difficult. Therefore, mismatches occur.

Allowing a Mismatch

In a Modicon Quantum Hot Standby with Unity system, Logic Mismatch allows the following without stopping the application program process.
- modify (edit) online an application program in the Standby while the Primary controls the process
 (See *Online Modifications to an Application Program in the Standby and Logic Mismatch, p. 149*)
- modify online an application program in the Primary while the Primary controls the process
 (See *Online Modifications to an Application Program in the Primary and Logic Mismatch, p. 150*)
- download an offline-modified application program to the Standby and perform a switchover to run the modified application program
 (See *Offline Modification of an Application Program and Logic Mismatch, p. 151*)

Creating a Mismatch

Use one of two methods to create a Logic Mismatch condition:
1. select `Standby on Logic Mismatch`; select online
 (Hot Standby Tab in the Unity Pro dialog)
 This action requires the application program to be downloaded to the controller.
2. set to 1 the Command Register system bit %SW60.3
 This action MUST be performed online in the Primary controller.

Transferring User Data during a Mismatch

The table following shows which user data is transferred when a mismatch occurs

Data Type	Transferred on Logic Mismatch
Located variables (State RAM)	Yes
Unlocated global variables	Yes unless variables exist ONLY in modified controller
DFB & EFB instance data	Yes unless data exist ONLY in modified controller
SFC variable area	Yes unless associated-SFC section is modified
System Bits and Words	Yes

Using Care with Logic Mismatch

WARNING

I/O MAP HAZARD; CONFIGURATION HAZARD

A mismatch in either the I/O map or the configuration is not allowed under any circumstances.
- Ensure that both I/O maps are identical.
- Ensure that both configurations are identical.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

Selecting the Standby On Logic Mismatch option, allows you to override this default condition (Standby going offline).
If you change the parameter in this field from Offline to Running, the Standby remains online if a logic mismatch is detected between the application program of the Standby and the application program of the Primary.

Updating Section Data in an Application Program

All data of a section will be fully updated during every scan if the data in the Standby is equal to the counterpart data on the Primary. Section data will not be updated if it is not equal to its counterpart on the Primary.
If the sections are equal on the Primary and the Standby, the section data that is updated is:
- Internal states of Elementary Function Blocks (EFBs) used in the section
  For example, Timers, Counters, PID
- All Derived Function Block (DFB)-Instance data blocks of each DFB instantiated in the section including nested DFBs.

Updating Global Data in an Application Program

With the Logic Mismatch enabled, application program global data will be updated with every scan. Global data that does not exist on both controllers is not updated. The application program's updated global data includes both:

1. All declared variables in the Variable-Editor.
2. All section and transition variables.

The process of updating the application program global data in a Hot Standby system affects:

- Declared variables
  All declared variable will be updated on every scan as long as they are declared on both controllers.
- Updating Standby
  If a complete application program transfer is done to the controller that did not receive the modified changes, then both controllers will have equal application programs, and the Standby controller is fully updated.
- Deleted and redeclared variables
  If, due to a modification, a global variable has been deleted first, and then **redeclared**, this variable would be treated as a **NEW** variable, even if the same name is used. The update procedure must be followed to bring the controllers to an equalized state.

Note: GLOBAL DATA VARIABLES
The system reserves space for these variables whether they are used in the controller's application program or not.
Unused variables consume space and require time to be transferred from the Primary to the Standby. Therefore, in the Primary's application program, Schneider Electric does not recommend using variables that are defined but not used.

Understanding Switchover Behavior during Logic Mismatch

Modifying the Application Variables

If a switchover occurs during logic mismatch, the new Primary will execute its own application program with the data received from the other controller.
Depending on the modification, different behaviors occur:

Modification	**Effect**
Only code changed (same variables).	All the variables exchanged between the controllers are equal.
Variables added to the initial Primary	Variables are not used by the new Primary.
Variables deleted from the initial Primary	New Primary executes application program using the latest values for these variables.
Variables added to the initial Standby	New Primary executes application program using initial values for these variables.
Variables deleted from the initial Standby	New Primary will not use these variables

Modifying an SFC Section with Unity Pro

The SFC code-generation process does not generate direct executable code but generates a set of data used by the SFC interpreter in the controller's OS to compute the next state.
As with Concept, Unity Pro
- does not maintain the equality between the two application programs when a modification of a SFC section occurs
- does execute an SFC section by restarting the controller from its initial state after a switchover

When a SFC section is modified in the Primary, its data are not transferred to the Standby. When a transfer of logic occurs from the Primary to the Standby, the first section of the logic is diagnostic information.

Note: SFC Programming Language
Schneider Electric recommends not using the SFC programming language.

WARNING

SWITCHOVER HAZARD

If switchover occurs when the Run mode is selected and there is a logic mismatch between the two controllers, the Standby assumes Primary responsibilities and starts solving a different application program from the previous Primary.
- After completing modifications, perform application program transfer to ensure controllers contain the same application and remove logic mismatch.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

Online or Offline Modifications and Logic Mismatch

Modifying Application Programs

Normally, once a fault-tolerant redundant system is configured, programmed, and controlling its process, the system is not shut down—not even for periodic maintenance. However, there may be situations when you may need to make modifications to the application program and continue to control the process. The logic mismatch feature allows you to modify application programs online or offline while controlling the process.

⚠	**WARNING**
	IMMEDIATE CONTROL OF PROCESS Once a new application program is switched to the Standby, the Standby takes control of the process. ● Ensure that you understand the **1.** operation of your process **2.** modifications made ● Monitor all modifications to the application program **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

Online Modifications to an Application Program in the Standby and Logic Mismatch

Executing the Procedure

To make online modifications to an application program (logic program or project) in the Standby controller, follow these steps.

Step	Action
1	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.
2	Connect to the Primary controller and access the Command Register system bit %SW60.3.
3	Set to 1 the Command Register system bit %SW60.3
4	Connect to the Standby controller.
5	Modify online the application program.
6	After completing the modifications, perform `Build Project`.
7	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.
8	Perform a switchover. (See *Switchover Methods and Logic Mismatch, p. 153*) Note: Standby will change to Primary.
9	Perform application transfer to Standby. *Application Program Transfer Method and Logic Mismatch, p. 155*
10	Connect to the new Primary controller and access the Command Register system bit%SW60.3.
11	Set to 0 the Command Register system bit %SW60.3 Note: Command Register is returned to 0 from 1.

Important Reference

(See *Recommendations for Using Logic Mismatch, p. 156*)

Online Modifications to an Application Program in the Primary and Logic Mismatch

Executing the Procedure

To make online modifications to an application program (logic program or project) in the Primary controller, follow these steps.

Step	Action
1	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.
2	Connect to the Primary controller and access the Command Register system bit %SW60.3.
3	Set to 1 the Command Register system bit %SW60.3
4	Modify online the application program.
5	After completing the modifications, perform `Build Project`.
6	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.
7	Perform an application transfer to the Standby. *Application Program Transfer Method and Logic Mismatch, p. 155*
8	Connect to the new Primary controller and access the Command Register system bit %SW60.3.
9	Set to 0 the Command Register system bit %SW60.3 Note: Command Register is returned to 0 from 1.

Important Reference

(See *Recommendations for Using Logic Mismatch, p. 156*)

Offline Modification of an Application Program and Logic Mismatch

Executing the Procedure

To make offline modifications to an application program in either controller, follow these steps.

Step	Action
1	Modify offline the application program.
2	After completing the modifications, perform `Build Project` and save. Note: Do NOT use the `Rebuild All Project` option because using `Rebuild All Project` will cause the Standby to go offline when the application program is downloaded.
3	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.
4	Connect to the Primary controller and access the Command Register system bit %SW60.3.
5	Set to 1 the Command Register system bit %SW60.3
6	Open the modified program and connect to the Standby controller.
7	Download the program and select RUN. Note: Check your controller's state and ensure state is `Run | Standby`.
8	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.
9	Perform a switchover. (See *Switchover Methods and Logic Mismatch, p. 153*) Note: Ensure Standby switched to Primary.
10	Perform application transfer to Standby. *Application Program Transfer Method and Logic Mismatch, p. 155*
11	Connect to the new Primary controller and access the Command Register system bit %SW60.3.
12	Set to 0 the Command Register system bit %SW60.3 Note: Command Register is returned to 0 from 1.

Important Reference

(See *Recommendations for Using Logic Mismatch, p. 156*)

Important

	WARNING
	IMMEDIATE CONTROL OF PROCESS Once a new application program is switched to the Standby, the Standby takes control of the process. ● Ensure that you understand the **1.** operation of your process **2.** modifications made ● Monitor all modifications to the application program **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

Switchover Methods and Logic Mismatch

General

Switchover can be performed using one of two methods:
- Hot Standby submenu on the front panel keypad
- Command Register either system bit %SW60.1 or %SW60.2

Switchover Using Front Panel Keypad

To force a switchover using the front panel keypad, do the following:

Step	Action
1	Access the front panel keypad of the Primary controller.
2	Go to PLC Operation menu.
3	Go to Hot Standby submenu.
4	Go to Hot Standby mode
5	Modify Run to Offline. Note: Ensure that Standby switched to Primary.
6	Modify offline to run. Note: Ensure that the LCD displays `Run Standby`.

Important for Command Register Switchover

To perform the switchover using Command Register system bit %SW60.1 or %SW60.2, ensure that following are considered:
- application program is saved twice. Each save uses a different file name.
  - file 1
    Saved before modification
  - file 2
    Saved after modification
- order of the controller is [(A) or (B)]; use one of two methods:
  - Hot Standby submenu on the front panel keypad (`PLC Operation | Hot Standby | Hot Standby Order`).
  - Unity Pro status dialog (refer to the bottom of the Unity Pro window when connected online)

Switchover Using Command Register System Bit %SW60.1 or %SW60.2

To force a switchover by setting the bits in the Command Register, do the following:

Step	Action
1	Open file 1.
2	Connect to the Primary.
3	Ensure the controller order of the Primary is A or B.
4	Access ● Command Register system bit %SW60.1 If the connected controller order is A. ● Command Register system bit %SW60.2 If the connected controller order is B.
5	Set bit to 0. Note: Ensure that the Standby switched to Primary.
6	Open file 2.
7	Connect to the new Primary controller.
8	Access the Command Register system bit used in Step 4.
9	Set bit to 1. Note: Ensure Standby controller is now online.
10	Ensure both Primary and Standby controllers are in Run Primary and Run Standby mode.

Application Program Transfer Method and Logic Mismatch

General

Application Program Transfer can be performed using one of two methods:
- Hot Standby submenu on the front panel keypad
- Command Register system bit %SW60.5

Application Program Transfer Using Front Panel Keypad

To transfer an application program (logic program or project) to either the Primary or Standby controller using the front panel keypad, do the following>

Step	Action
1	Access the front panel keypad of any controller (Primary or Standby)
2	Go to PLC Operations menu
3	Go to Hot Standby submenu
4	Go to `Hot Standby transfer` and press ENTER to confirm the transfer. Note: Ensure transfer to Standby occurs.

Application Program Transfer Using Command Register System Bit %SW60.5

To transfer an application program (logic program or project) to either the Primary or Standby controller using Command Register system bit %SW60.5, do the following.

Step	Action
1	Connect to the Primary controller.
2	Access Command Register system bit %SW60.5.
3	Set bit to 1. Note: The process of setting the bit toggles the bit from 0 to 1 and back to 0.

Recommendations for Using Logic Mismatch

General

When using the Logic Mismatch feature, Schneider Electric recommends noting that the following are affected
- Upload Information Management
- Online modifications to the Standby
- Application Program Transfer
- Setting the Command Register system bit %SW60.3

Upload Information Management Feature—General

During online modifications, your system detects that the application-program information in the controller differs from the application-program information in the computer. Because this information will be used later when an upload is performed, the system requires you to update this information and constantly presents a confirmation dialog. To avoid constant display of the dialog, use the Upload Information Management feature.

Using the Upload Information Management Feature

Before doing any modifications and at the initial start up of your system, do the following:

Step	Action
1	From the menu, select `Tools	Option`.
2	In the Options window, select the General tab (default).
3	Select Automatic in the Upload Information Management area.
4	Press OK to close the window.
5	Save the program and download to the controller.

Handling Online Modifications to the Standby

For major modifications to the application program on the Standby, ensure the Standby is in offline mode.
Two benefits result from this action:
- Run process continues
- Primary does NOT perform a switchover during modification of the Standby

Note: SWITCHOVER DURING MODIFICATION
If the Standby is online during modifcations, there is a possibilty of switchover occuring. If a switchover occurs, the Standby becomes Primary, and the process may run with incomplete modifications.

Performing Application Program Transfer

When performing an application program transfer, you want to avoid the possibility of having two different application programs running in the Primary and Standby.

Step	Action
1	Perform Application program transfers after completing online modifications with Logic Mismatch.

Resetting Command Register System Bit %SW60.3

When resetting the Command Register system bit %SW60.3 to 0, you want to avoid the possibility of having two different application programs running in the Primary and Standby.

Step	Action
1	Connect to Primary.
2	Access the Command Register system bit %SW60.3.
3	Reset bit to 0.

Transferring an Application Program with Unity Pro

9

Introduction

Overview

This chapter provides information about the Application Program Transfer feature that enables you to configure the Standby controller from the Primary controller.

What's in this Chapter?

This chapter contains the following topics:

Overview of Application Program Transfer

Overview

The Application Program Transfer feature provides you with the ability to configure the Standby from the Primary controller.
Use this feature when you reprogram the Primary controller or replace the Standby controller because the process copies the full application program of the Primary to the Standby. This feature not only saves time but ensures that the controllers have identical configurations.
The system transfers the application program over the dedicated Modicon Quantum Hot Standby with Unity communications link. In a redundant system, this link connects the two Copros.

Methods of Transferring Programs

Application transfer is always from the Primary to the Standby. There are three methods of transferring application programs:
- Hot Standby submenu on the front panel keypad
- Command Register system bit %SW60.5
- Automatic transfer (Occurs when you start a Hot Standby system for the first time.) Therefore, the Primary automatically transfers the application program to the Standby. (See *Automatic Application Program Transfer, p. 163*)

Validating Transfer

The Standby validates the transferred application program. After validating, the Standby starts automatically.

Understanding Transfer Time

Application Program Transfer time depends on the size of the application program, the larger the program, the longer the time. Application Program Transfer takes a few seconds.

Note: During application program transfer, the system can no longer be considered redundant.
If the Primary should fail before the Standby is ready to assume the role of Primary, there is no Standby available.

Updating from the Primary

An application program update may only be performed from the Primary to the Standby.

Note: UPDATING STANDBYS
The Standby controller cannot update the Primary.

Understanding Transfer Size Limits

Note: CHANGING FROM LEGACY
Legacy Modicon Quantum controllers running Concept have an Application Program Transfer limit of 1 megabyte.
In the Modicon Quantum Hot Standby with Unity 140 CPU 671 60 transfer size depends on the configuration. For example, using a card bridge you may transfer up to 7 Mb.

Therefore, transfer the complete application program regardless of the size. This transfer takes place over multiple scans, thus will be broken up into multiple transfer packets.

Executing the Application Program Transfer Procedure Using the Command Register

Overview

To transfer, use the command register in the Unity Pro software tools. The Primary copies the complete application program and data to the Standby.

Transferring the Application Program Using Command Register System Bit %SW60.5

To transfer an application program (logic program or project) to either the Primary or Standby controller using Command Register system bit %SW60/5, do the following.

Step	Action
1	Connect to the Primary controller.
2	Access Command Register system bit %SW60.5.
3	Set bit to 1. Note: The process of setting the bit toggles the bit from 0 to 1 and back to 0.

Automatic Application Program Transfer

Overview

New in a Modicon Quantum Hot Standby system with Unity is automatic application program transfer.
As soon as a Primary controller detects a blank controller, the Primary transfers the program to the blank controller, which becomes the Standby. After application program transfer both controllers have identical application programs.
This new feature works well when two controllers are at a maximum of 2 Km apart.

Note: Same Configuration
The controllers need to have the same configuration (with the same PCMCIA cards or without cards).

Executing the Application Program Transfer Procedure Using the Keypad

Overview

For specifics on setting Modicon Quantum Hot Standby with Unity state, mode, order, and transfer from the keypad, see *Configuring a Modicon Quantum Hot Standby with Unity System, p. 69*.

Using the Keypad

To transfer, use the front panel keypad on the controller unit (Primary or Standby). The Primary copies the complete application program and data to the Standby.

Note: CHANGING FROM LEGACY
In legacy Quantum Hot Standby systems, an application program transfer could be performed ONLY on the Standby controller.
The Standby requested from the Primary an application transfer. The process was performed on the CHS module and required setting the key in the Xfer key position while pushing the update button.
In Modicon Quantum Hot Standby with Unity, an application transfer is performed either

- using the command register
  An application program transfer can be performed at any time.
- automatically
  Transfer occurs first time Primary finds an empty Standby
- using the keypad
  Use either the Primary or Standby.

Transferring the Application Program

The following table shows the Application Program Transfer Procedure.

Step	Action
1	Ensure the Primary Controller is in RUN PRIMARY mode. **Result:** The LCD on the PLC will display the mode as RUN PRIMARY.
2	Check that both **1.** Invalidate Keypad option is NOT selected **2.** the key switch is unlocked
3	Go to the submenu Hot Standby | Transfer.
4	Push Enter to execute the application program transfer from the Primary to the Standby.
5	Note: The Hot Standby | Transfer command can be performed either in the Primary or Standby controller, BUT only the Standby controller will be updated.

Identical Configurations and Application Programs

After the transfer, the Primary and Standby have identical configurations and application programs.
In the event of a failure in the Primary and depending on the mode selected for the Standby (Run or Offline), the Standby may or may not be ready to assume the role of Primary.

Using the Modicon Quantum Hot Standby with Unity EFBs

10

Introduction

Overview

This chapter describes the Modicon Quantum Hot Standby with Unity elementary function blocks (EFBs)

- HSBY_RD
- HSBY_ST
- HSBY_WR
- REV_XFER

What's in this Chapter?

This chapter contains the following topics:

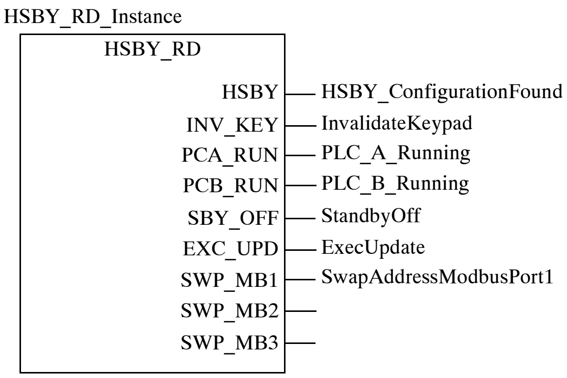
Description: HSBY_RD

Function description

This EFB allows you to use the Hot Standby function. It searches (together with other EFBs in the `Hot Standby` family) the configuration of the respective Quantum PLC for the required components. These components always refer to hardware that is actually connected.
Therefore the correct behavior of this EFB on the simulators cannot be guaranteed.
The `HSBY_RD` EFB independently checks if a Hot Standby configuration exists. (`%SW60`). If a configuration is present the contents of the command register are given and the `HSBY` output is set to "`1`". If there is no Hot Standby configuration present the `HSBY_ConfigurationFound` output is set to "0".
`EN` and `ENO` can be configured as additional parameters.

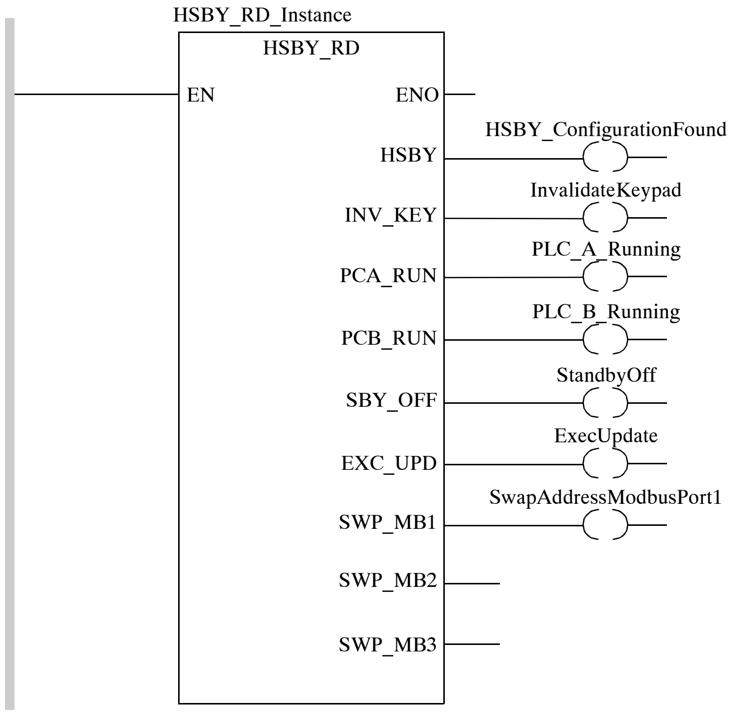
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL HSBY_RD_Instance (HSBY=>HSBY_ConfigurationFound,
        INV_KEY=>InvalidateKeypad, PCA_RUN=>PLC_A_Running,
        PCB_RUN=>PLC_B_Running, SBY_OFF=>StandbyOff,
        EXC_UPD=>ExecUpdate, SWP_MB1=>SwapAddressModbusPort1)
```

Representation in ST

Representation:

```
HSBY_RD_Instance (HSBY=>HSBY_ConfigurationFound,
        INV_KEY=>InvalidateKeypad, PCA_RUN=>PLC_A_Running,
        PCB_RUN=>PLC_B_Running, SBY_OFF=>StandbyOff,
        EXC_UPD=>ExecUpdate,
        SWP_MB1=>SwapAddressModbusPort1);
```

Parameter description

Description of the output parameters:

Parameter	Data type	Meaning
`HSBY`	`BOOL`	"1" = Hot Standby configuration found
`INV_KEY`	`BOOL`	"1" = The submenu for the Hot Standby PLC button is disabled.
`PCA_RUN`	`BOOL`	"1" = The PLC with the Hot Standby CPU **1.** function is "A" on local rack **2.** Command Register is selected RUN
		"0" = The PLC with the Hot Standby CPU **1.** function is "A" on local rack **2.** Command Register is selected OFFLINE
`PCB_RUN`	`BOOL`	"1" = The PLC with the Hot Standby CPU **1.** function is "B" on local rack **2.** Command Register is selected RUN
		"0" = The PLC with the Hot Standby CPU **1.** function is "B" on local rack **2.** Command Register is selected OFFLINE
`SBY_OFF`	`BOOL`	"1" = The standby PLC switches to the offline mode as soon as both PLCs receive a different program.
`EXC_UPD`	`BOOL`	"1" = Exec-(Operating system-)Update in the Standby-PLC is possible with the primary PLC still running. (After Exec-Update the standby PLC changes back to the online mode.)
`SWP_MB1`	`BOOL`	If a switchover has occurred, "1" = No Swap address of Modbus ports 1. "0" = Swap address of Modbus ports 1.
`SWP_MB2`	`BOOL`	Not used. Reserved
`SWP_MB3`	`BOOL`	Not used. Reserved

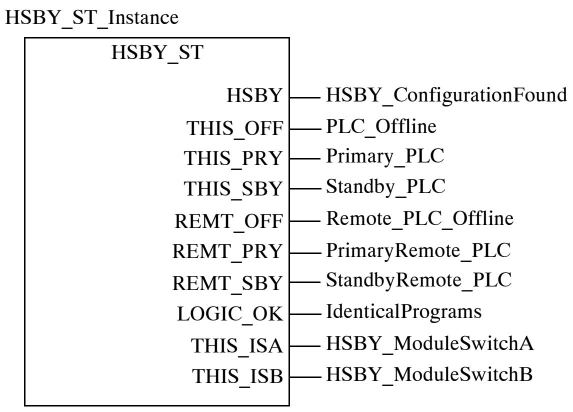
Description: HSBY_ST

Function description

This EFB allows you to use the Hot Standby function. It searches (together with other procedures in the `Hot Standby` family) the configuration of the respective Quantum PLC for the required components. These components always refer to hardware that is actually connected.
Therefore the correct behavior of this EFB on the simulators cannot be guaranteed.
The EFB is used to read the IEC Hot Standby status register (`%SW61`). If there is no Hot Standby configuration present the `HSBY` output is set to "0".
`EN` and `ENO` can be configured as additional parameters.

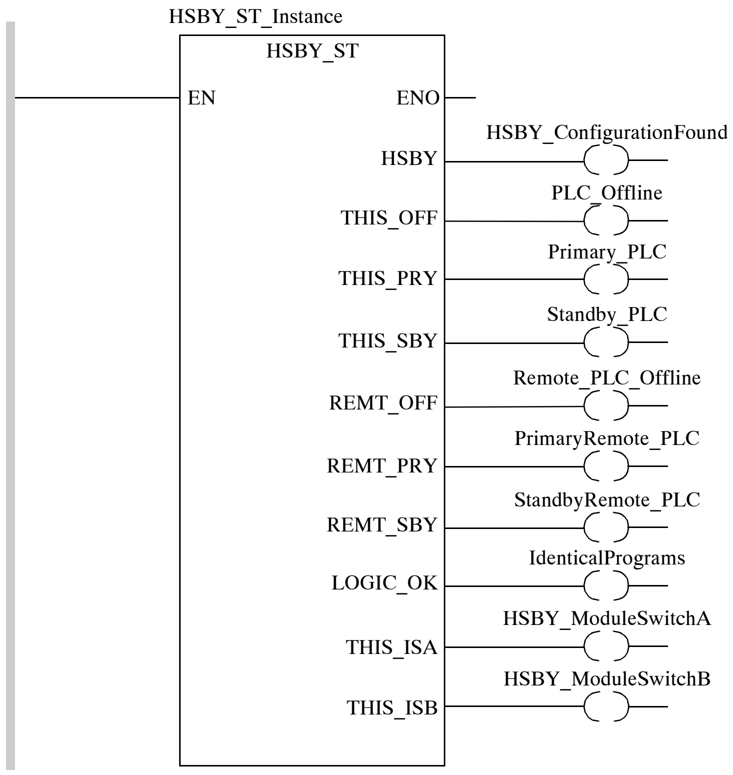
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL HSBY_ST_Instance (HSBY=>HSBY_ConfigurationFound,
         THIS_OFF=>PLC_Offline, THIS_PRY=>Primary_PLC,
         THIS_SBY=>Standby_PLC,
         REMT_OFF=>Remote_PLC_Offline,
         REMT_PRY=>PrimaryRemote_PLC,
         REMT_SBY=>StandbyRemote_PLC,
         LOGIC_OK=>IdenticalPrograms,
         THIS_ISA=>HSBY_ModuleSwitchA,
         THIS_ISB=>HSBY_ModuleSwitchB)
```

Representation in ST

Representation:

```
HSBY_ST_Instance (HSBY=>HSBY_ConfigurationFound,
         THIS_OFF=>PLC_Offline, THIS_PRY=>Primary_PLC,
         THIS_SBY=>Standby_PLC,
         REMT_OFF=>Remote_PLC_Offline,
         REMT_PRY=>PrimaryRemote_PLC,
         REMT_SBY=>StandbyRemote_PLC,
         LOGIC_OK=>IdenticalPrograms,
         THIS_ISA=>HSBY_ModuleSwitchA,
         THIS_ISB=>HSBY_ModuleSwitchB);
```

Parameter description

Description of output parameters:

Parameter	Data type	Meaning
HSBY	BOOL	"1" = Hot Standby configuration found
THIS_OFF	BOOL	"1" = This PLC is offline
THIS_PRY	BOOL	"1" = This PLC is the primary PLC
THIS_SBY	BOOL	"1" = This PLC is the standby PLC
REMT_OFF	BOOL	"1" = The other (remote) PLC is offline
REMT_PRY	BOOL	"1" = The other PLC is the primary PLC
REMT_SBY	BOOL	"1" = The other PLC is the standby PLC
LOGIC_OK	BOOL	"1" = The programs for both PLCs are identical and Logic Mismatch is active.
THIS_ISA	BOOL	"1" = This PLC chose the CPU with the lower IP address between both Hot Standby CPUs. This is the Hot Standby CPU "A".
THIS_ISB	BOOL	"1" = This PLC chose the CPU with the higher IP address between both Hot Standby CPUs. This is the Hot Standby CPU "B".

Description: HSBY_WR

Function description

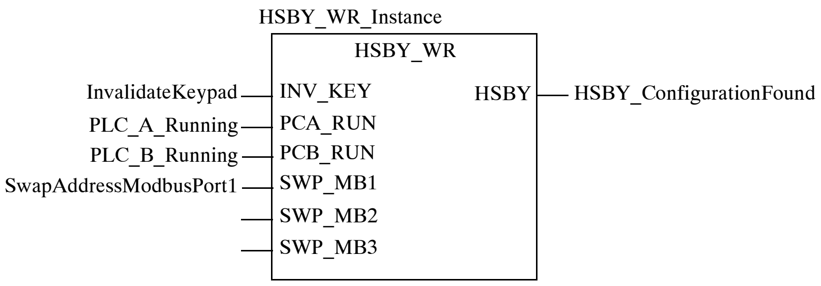
This EFB allows you to use the Hot Standby function. It searches (together with other EFBs in the `Hot Standby` family) the configuration of the respective Quantum PLC for the required components. These components always refer to hardware that is actually connected.
Therefore the correct behavior of this EFB on the simulators cannot be guaranteed.
The EFB `HSBY_WR` is used to set different Hot Standby Modes permitted for Hot Standby. Setting the respective modes means a change in the Hot Standby command register (`%SW60`), which is carried out automatically by the function block.
If there is no Hot Standby configuration, the `HSBY_ConfigurationFound` output is set to "0", otherwise it is set to "1".

Note: This function only affects the primary CPU.

`EN` and `ENO` can be configured as additional parameters.

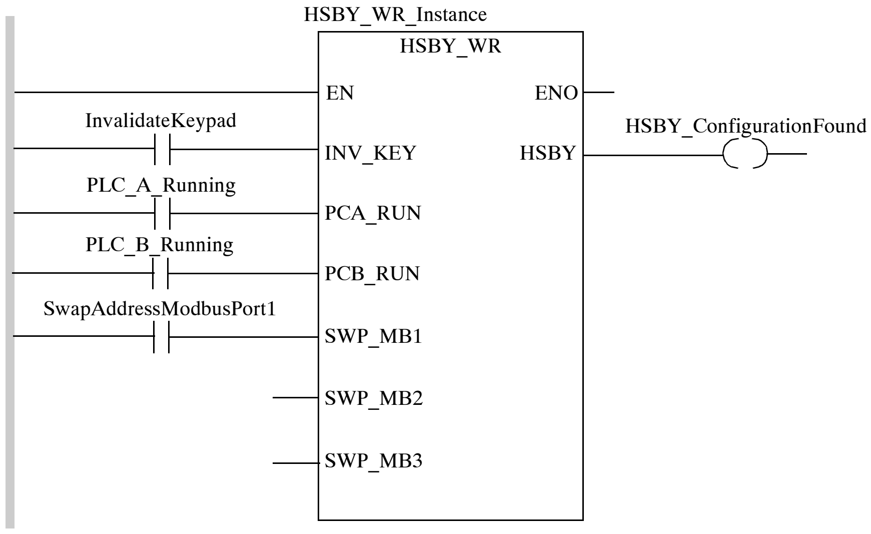
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL HSBY_WR_Instance (INV_KEY:=InvalidateKeypad,
         PCA_RUN:=PLC_A_Running, PCB_RUN:=PLC_B_Running,
         SWP_MB1:=SwapAddressModbusPort1,
         HSBY=>HSBY_ConfigurationFound)
```

Representation in ST

Representation:

```
HSBY_WR_Instance (INV_KEY:=InvalidateKeypad,
         PCA_RUN:=PLC_A_Running, PCB_RUN:=PLC_B_Running,
         SWP_MB1:=SwapAddressModbusPort1,
         HSBY=>HSBY_ConfigurationFound);
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
`INV_KEY`	`BOOL`	In the submenu for the Hot Standby PLC button "1" = Changes are disabled. "0" = Changes are allowed.
`PCA_RUN`	`BOOL`	"1 -> 0" = The Hot Standby CPU with function "A" on the local rack is forced into OFFLINE mode. "0 -> 1" = The Hot Standby CPU with function "A" is forced into RUN mode if its own button mode is in RUN mode.
`PCB_RUN`	`BOOL`	"1 -> 0" = The Hot Standby CPU with function "B" on the local rack is forced into OFFLINE mode. "0 -> 1" = The Hot Standby CPU with the function "B" is forced into RUN mode if its own button mode is in RUN mode.
`SWP MB1`	`BOOL`	"0" and a switchover has occurred: The Modbus address on port 1 of the NEW primary PLC changes. ● new primary PLC address = old primary address ● new standby PLC address = old address + 128.
		"1" and a switchover has occurred: The Modbus address at Port 1 of the NEW primary PLC changes. ● new primary PLC address = old primary address ● new standby PLC address = old primary address
`SWP_MB2`	`BOOL`	Not used. Reserved
`SWP MB3`	`BOOL`	Not used. Reserved

Description of the output parameters:

Parameter	Data type	Meaning
`HSBY`	`BOOL`	"1" = Hot Standby configuration found.

Description: REV_XFER

Function description

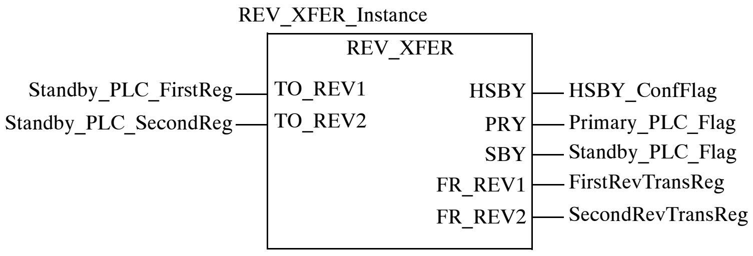
This EFB allows you to use the Hot Standby function. It searches (together with other EFBs in the `Hot Standby` family) the configuration of the respective Quantum PLC for the required components. These components always refer to hardware that is actually connected.
Therefore the correct behavior of this EFB on the simulators cannot be guaranteed.
The EFB `REV_XFER` provides the option of transferring two 16 bit words from the standby PLC to the primary PLC. The two registers transferred by this procedure are `%SW62` and `%SW63`.
`REV_XFER` must be called up absolutely in the first section of the project executed.
The parameter addresses `TO_REV1` and `TO_REV2` must be in the non-transfer area to prevent an overwriting by the Primary PLC.

Note: In the old (Concept) Hot Standby System these two registers (Reverse Transfer Registers) are the first addresses in the non-transfer area.

As additional parameters, `EN` and `ENO` are projected.

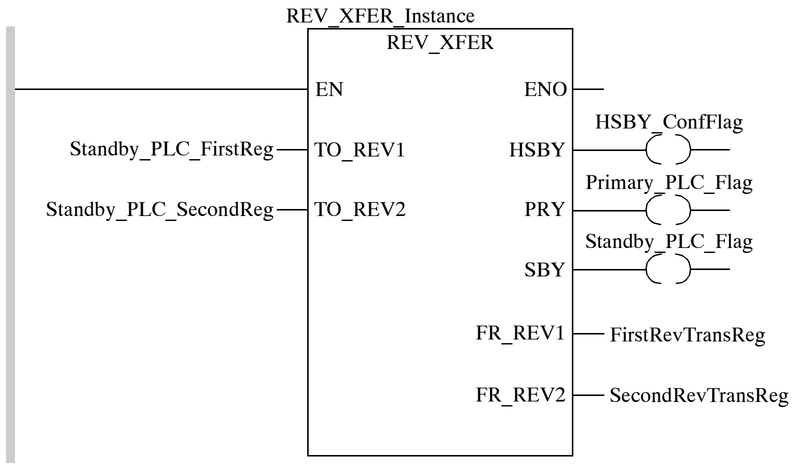
Appearance in FBD

Appearance:



Appearance in LD

Appearance:



Appearance in IL

Appearance :

```
CAL REV_XFER_Instance (TO_REV1:=Standby_PLC_FirstReg,
         TO_REV2:=Standby_PLC_SecondReg, HSBY=>HSBY_ConfFlag,
         PRY=>Primary_PLC_Flag, SBY=>Standby_PLC_Flag,
         FR_REV1=>FirstRevTransReg,
         FR_REV2=>SecondtRevTransReg)
```

Appearance in ST

Appearance:

```
REV_XFER_Instance (TO_REV1:=Standby_PLC_FirstReg,
         TO_REV2:=Standby_PLC_SecondReg, HSBY=>HSBY_ConfFlag,
         PRY=>Primary_PLC_Flag, SBY=>Standby_PLC_Flag,
         FR_REV1=>FirstRevTransReg,
         FR_REV2=>SecondtRevTransReg);
```

Parameter description

Description of input parameters:

Parameter	Data type	Description
`TO_REV1`	`INT`	Describes the first reverse transfer register if this PLC is the standby PLC.
`TO_REV2`	`INT`	Describes the second reverse transfer register if this PLC is the standby PLC.

Description of the output parameters:

Parameter	Data type	Meaning
`HSBY`	`BOOL`	1= Hot Standby configuration
`PRY`	`BOOL`	1 = This PLC is the primary PLC.
`SBY`	`BOOL`	1 = This PLC is the standby PLC.
`FR_REV1`	`INT`	Content of first reverse transfer register (`%SW62`). Output only if `HSBY` is "1".
`FR_REV2`	`INT`	Content of second reverse transfer register (`%SW63`). Output only if `HSBY` is "1".

Appendices

Appendices for Quantum Hot Standby Planning and Installation Guide

At a Glance

The appendices for the Quantum Hot Standby Planning and Installation Guide are included here.

What's in this Appendix?

The appendix contains the following chapters:

Chapter	Chapter Name	Page
A	Modicon Quantum Hot Standby with Unity Additional Information	183

Modicon Quantum Hot Standby with Unity Additional Information

A

Introduction

Overview

This chapter describes the necessary cables, design specifications, error codes.

What's in this Chapter?

This chapter contains the following topics:

Fiber Optic Cable

Schneider Electric Recommends

Recommendations

1	Use up to 2 km of 62.5/125 µm graded index, duplex, multimode glass fiber for all applications because of the relatively low loss of signal and signal distortion. Note: Most 62.5/125 µm cables are rated at 3.5 dB loss per km.
2	Use a 3 mm diameter cable for your Modicon Quantum Hot Standby with Unity system. Note: The fiber cable clasps used to maneuver the cable into the ports are designed to be used with 3 mm cable.
3	Select the cable that meets the demands of your application.
4	Wherever possible, use a multiconductor cable since the cable is inexpensive and provides a backup in case the cable is cut in the process of pulling.

Cables Available

From Schneider Electric

Part Number	**Maximum Length**
490 NOR 000 03	3 meters
490 NOR 000 05	5 meters
490 NOR 000 15	15 meters

140 CPU 671 60 Specifications for Modicon Quantum Hot Standby with Unity

Module Specifications

Component	Description
Communication ports	1 Modbus (RS-232/RS-485) 1 Modbus Plus (RS-485) 1 USB 1 Ethernet (used as HSBY port)
Bus current required	1800 mA
Max. number of NOM, NOE, CRP 811 and MMS modules supported (any combination)	6
Key switch	Yes
Keypad	Yes

Processor

Feature	Description
Model	Pentium
Clock speed	266 MHz
Coprocessor	Yes, Built-in Ethernet
Watchdog timer	250 ms S/W adjustable

Memory

RAM	Description
768 kbytes	memory for on board program and unlocated data, extensible to 7,168 Mb by PCMCIA
128 kbytes	max memory for configuration
64 kwords	memory for located data (state RAM)
8.192 kbytes	PCMCIA extension for data storage

Reference Capacity

Discrete (bits)	64 k (any combination)
Registers (words)	64 k max.

Remote I/O

Max. I/O words/drop	64 in / 64 out*
Max. number of remote drops	31
* This information can be a mix of discrete or register I/O. For each word of configured I/O, one of the I/O words must be subtracted from the total available.	

Battery and Clock

Battery type	3 V Lithium
Service life	1200 mAh
Shelf life	10 years with 0.5% loss of capacity/year
Battery load current @ power-off	typical: 14 µA
	max. 420 µA
TOD clock	+/-8.0 s/day @ 0 ... 60 °C

Diagnostic

Power-up	RAM RAM address Executive Checksum User Logic Check Processor
Run Time	RAM RAM address Executive Checksum User Logic Check

CRP Remote I/O Head Processor Error Patterns

Error Patterns

The following table displays both
- number of times the Com Act indicator blinks for each type of error
- possible codes for each type of blink

All codes are in hex.

Number of blinks on Com Act Indicator	Code in hex	Error
Slow (steady)	0000	requested kernel mode
2	6820	hcb frame pattern error
	6822	head control block diag error
	6823	mod personality diag error
	682A	fatal start IO error
	682B	bad read IO pers request
	682C	bad execute diag request
	6840	ASCII input xfer state
	6841	ASCII output xfer state
	6842	IO input comm state
	6843	IO output comm state
	6844	ASCII abort comm state
	6845	ASCII pause comm state
	6846	ASCII input comm state
	6847	ASCII output comm state
	6849	building 10 byte packet
	684A	building 12 byte packet
	684B	building 16 byte packet
	684C	illegal IO drop number
3	6729	984 interface bus ack stuck high
4	6616	coax cable initialization error
	6617	coax cable dma xfer error
	6619	coax cable dumped data error
	681A	coax cable DRQ line hung
	681C	coax cable DRQ hung
5	6503	RAM address test error
6	6402	RAM data test error
7	6300	PROM checksum error (exec not loaded)
	6301	PROM checksum error
8	8001	kernel PROM checksum error
	8002	flash prog / erase error
	8003	unexpected executive return

TextIDs

TextIDs

TextIds define the warning messages written in the diagnostic buffer.
TextIDs switching from Primary to Offline

TextID	Warning message
13001	System halt
13002	Remote IO failure
13003	ETH device failure
13004	ETH communication problem
13005	Stop PLC command
13006	Offline keypad switch
13007	Offline Command register request

TextIDs switching from Standby to Offline

TextID	Warning message
13008	System halt
13009	Remote IO failure
13010	ETH device failure
13011	ETH communication problem
13012	Stop PLC command
13013	Offline keypad switch
13014	Offline Command register request

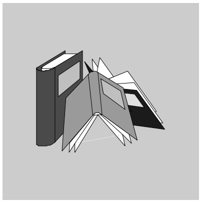
TextIDs switching from Standby to Primary

TextID	Warning message
13015	Control command over ETH
13016	Control command over RIO

TextIDs switching from Offline to Primary/Standby

TextID	Warning message
13017	Switch from Offline to Primary
13018	Switch from Offline to Standby BY

Glossary



!

%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.
%KW	According to the IEC standard, `%KW` indicates a constant word-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

ADDR_TYPE	This predefined type is used as output for ADDR function. This type is ARRAY[0..5] OF Int. You can find it in the libset, in the same family than the EFs which use it.
ANL_IN	`ANL_IN` is the abbreviation of Analog Input data type and is used when processing analog values. The `%IW` adresses for the configured analog input module, which were specified in the I/O component list, are automatically assigned data types and should therefore only be occupied with Unlocated Variables.

ANL_OUT

`ANL_OUT` is the abbreviation of Analog Output data type and is used when processing analog values. The `%MW` adresses for the configured analog input module, which were specified in the I/O component list, are automatically assigned data types and should therefore only be occupied with Unlocated Variables.

ANY

There is a hierarchy between the different types of data. In the DFB, it is sometimes possible to declare which variables can contain several types of values. Here, we use `ANY_xxx` types.
The following diagram shows the hierarchically-ordered structure:

```
ANY
  ANY_ELEMENTARY
    ANY_MAGNITUDE_OR_BIT
      ANY_MAGNITUDE
        ANY_NUM
          ANY_REAL
            REAL
          ANY_INT
            DINT, INT, UDINT, UINT
        TIME
      ANY_BIT
        DWORD, WORD, BYTE, BOOL
    ANY_STRING
      STRING
    ANY_DATE
      DATE_AND_TIME, DATE, TIME_OF_DAY
    EBOOL
  ANY_DERIVED
    ANY_ARRAY
      ANY_ARRAY_ANY_EDT
        ANY_ARRAY_ANY_MAGNITUDE
          ANY_ARRAY_ANY_NUM
            ANY_ARRAY_ANY_REAL
              ANY_ARRAY_REAL
            ANY_ARRAY_ANY_INT
              ANY_ARRAY_DINT
              ANY_ARRAY_INT
              ANY_ARRAY_UDINT
              ANNY_ARRAY_UINT
          ANY_ARRAY_TIME
        ANY_ARRAY_ANY_BIT
          ANY_ARRAY_DWORD
          ANY_ARRAY_WORD
          ANY_ARRAY_BYTE
          ANY_ARRAY_BOOL
        ANY_ARRAY_ANY_STRING
          ANY_ARRAY_STRING
        ANY_ARRAY_ANY_DATE
          ANY_ARRAY_DATE_AND_TIME
          ANY_ARRAY_DATE
          ANY_ARRAY_TIME_OF_DAY
        ANY_ARRAY_EBOOL
      ANY_ARRAY_ANY_DDT
    ANY_STRUCTURE
      ANY_DDT
      ANY_IODDT
      ANY_FFB
        ANY_EFB
        ANY_DFB
```

ARRAY

An `ARRAY` is a table of elements of the same type.
The syntax is as follows: `ARRAY [<terminals>] OF <Type>`
Example:
`ARRAY [1..2] OF BOOL` is a one-dimensional table made up of two `BOOL`-type elements.
`ARRAY [1..10, 1..20] OF INT` is a two-dimensional table made up of 10x20 `INT`-type elements.

B

Base 10 literals

A literal value in base 10 is used to represent a decimal integer value. This value can be preceded by the signs "+" and "-". If the character "_" is employed in this literal value, it is not significant.
Example:
`-12`, `0`, `123_456`, `+986`

Base 16 Literals

An literal value in base 16 is used to represent an integer in hexadecimal. The base is determined by the number "16" and the sign "#". The signs "+" and "-" are not allowed. For greater clarity when reading, you can use the sign "_" between bits.
Example:
`16#F_F` or `16#FF` (in decimal 255)
`16#F_F` or `16#FF` (in decimal 224)

Base 2 Literals

A literal value in base 2 is used to represent a binary integer. The base is determined by the number "2" and the sign "#". The signs "+" and "-" are not allowed. For greater clarity when reading, you can use the sign "_" between bits.
Example:
`2#1111_1111` or `2#11111111` (in decimal 255)
`2#1110_0000` or `2#11100000` (in decimal 224)

Base 8 Literals

A literal value in base 8 is used to represent an octal integer. The base is determined by the number "8" and the sign "#". The signs "+" and "-" are not allowed. For greater clarity when reading, you can use the sign "_" between bits.
Example:
`8#3_77` or `8#377` (in decimal 255)
`8#34_0` or `8#340` (in decimal 224)

BCD

BCD is the abbreviation of Binary Coded Decimal format
BCD is used to represent decimal numbers between 0 and 9 using a group of four bits (half-byte).
In this format, the four bits used to code the decimal numbers have a range of unused combinations.
Example of BCD coding:
- the number `2450`
- is coded: `0010 0100 0101 0000`

BOOL

`BOOL` is the abbreviation of Boolean type. This is the elementary data item in computing. A `BOOL` type variable has a value of either: 0 (`FALSE`) or 1 (`TRUE`).
A `BOOL` type word extract bit, for example: `%MW10.4`.

BYTE

When 8 bits are put together, this is callad a `BYTE`. A `BYTE` is either entered in binary, or in base 8.
The `BYTE` type is coded in an 8 bit format, which, in hexadecimal, ranges from `16#00` to `16#FF`

D

DATE

The `DATE` type coded in BCD in 32 bit format contains the following information:
- the year coded in a 16-bit field,
- the month coded in an 8-bit field,
- the day coded in an 8-bit field.

The `DATE` type is entered as follows: `D#<Year>-<Month>-<Day>`
This table shows the lower/upper limits in each field:

Field	Limits	Comment
Year	[1990,2099]	Year
Month	[01,12]	The left 0 is always displayed, but can be omitted at the time of entry
Day	[01,31]	For the months 01\03\05\07\08\10\12
	[01,30]	For the months 04\06\09\11
	[01,29]	For the month 02 (leap years)
	[01,28]	For the month 02 (non leap years)

DATE_AND_ TIME

see `DT`

DBCD

Representation of a Double BCD-format double integer.
The Binary Coded Decimal (BCD) format is used to represent decimal numbers between 0 and 9 using a group of four bits.
In this format, the four bits used to code the decimal numbers have a range of unused combinations.
Example of DBCD coding:

- the number `78993016`
- is coded: `0111 1000 1001 1001 0011 0000 0001 0110`

DDT

DDT is the abbreviation of Derived Data Type.
A derived data type is a set of elements of the same type (`ARRAY`) or of various types (structure)

DFB

DFB is the abbrevation of Derived Function Block.
DFB types are function blocks that can be programmed by the user ST, IL, LD or FBD.
By using DFB types in an application, it is possible to:

- simplify the design and input of the program,
- increase the legibility of the program,
- facilitate the debugging of the program,
- reduce the volume of the generated code.

DINT

`DINT` is the abbrevation of Double Integer format (coded on 32 bits).
The lower and upper limits are as follows: -(2 to the power of 31) to (2 to the power of 31) - 1.
Example:
`-2147483648`, `2147483647`, `16#FFFFFFFF`.

DT

DT is the abbreviation of Date and Time.
The DT type coded in BCD in 64 bit format contains the following information:

- The year coded in a 16-bit field,
- the month coded in an 8-bit field,
- the day coded in an 8-bit field,
- the hour coded in a 8-bit field,
- the minutes coded in an 8-bit field,
- the seconds coded in an 8-bit field.

Note: The 8 least significant bits are unused.

The DT type is entered as follows:
DT#<Year>**-**<Month>**-**<Day>**-**<Hour>**:**<Minutes>**:**<Seconds>
This table shows the lower/upper limits in each field:

Field	Limits	Comment
Year	[1990,2099]	Year
Month	[01,12]	The left 0 is always displayed, but can be omitted at the time of entry
Day	[01,31]	For the months 01\03\05\07\08\10\12
	[01,30]	For the months 04\06\09\11
	[01,29]	For the month 02 (leap years)
	[01,28]	For the month 02 (non leap years)
Hour	[00,23]	The left 0 is always displayed, but can be omitted at the time of entry
Minute	[00,59]	The left 0 is always displayed, but can be omitted at the time of entry
Second	[00,59]	The left 0 is always displayed, but can be omitted at the time of entry

DWORD

DWORD is the abbreviation of Double Word.
The DWORD type is coded in 32 bit format.
This table shows the lower/upper limits of the bases which can be used:

Base	**Lower limit**	**Upper limit**
Hexadecimal	16#0	16#FFFFFFFF
Octal	8#0	8#37777777777
Binary	2#0	2#11111111111111111111111111111111

Representation examples:

Data content	**Representation in one of the bases**
00000000000010101101110011011110	16#ADCDE
00000000000000010000000000000000	8#200000
00000000000010101011110011011110	2#10101011110011011110

E

EBOOL

EBOOL is the abbrevation of Extended Boolean type. It can be used to manage rising or falling edges, as well as forcing.
An EBOOL type variable takes up one byte of memory.

EF

Is the abbreviation of Elementary Function.
This is a block which is used in a program, and which performs a predefined software function.
A function has no internal status information. Multiple invocations of the same function using the same input parameters always supply the same output values.
Details of the graphic form of the function invocation can be found in the "[Functional block (instance)] ". In contrast to the invocation of the function blocks, function invocations only have a single unnamed output, whose name is the same as the function. In FBD each invocation is denoted by a unique [number] via the graphic block, this number is automatically generated and can not be altered.
You position and set up these functions in your program in order to carry out your application.
You can also develop other functions using the SDKC development kit.

EFB	Is the abbreviation for Elementary Function Block. This is a block which is used in a program, and which performs a predefined software function. EFBs have internal statuses and parameters. Even where the inputs are identical, the output values may be different. For example, a counter has an output which indicates that the preselection value has been reached. This output is set to 1 when the current value is equal to the preselection value.
Elementary Function	see EF
EN	EN means **EN**able, this is an optional block input. When EN is activated, an ENO output is automatically drafted. If EN = 0, the block is not activated, its internal program is not executed and ENO ist set to 0. If EN = 1, the internal program of the block is executed, and ENO is set to 1 by the system. If an error occurs, ENO is set to 0.
ENO	ENO means **E**rror **NO**tification, this is the output associated to the optional input EN. If ENO is set to 0 (caused by EN=0 or in case of an execution error), ● the outputs of function blocks remain in the status they were in for the last correct executed scanning cycle and ● the output(s) of functions and procedures are set to "0".

F

FBD	FBD is the abbreviation of Function Block Diagram. FBD is a graphic programming language that operates as a logic diagram. In addition to the simple logic blocks (AND, OR, etc.), each function or function block of the program is represented using this graphic form. For each block, the inputs are located to the left and the outputs to the right. The outputs of the blocks can be linked to the inputs of other blocks to form complex expressions.
FFB	Collective term for EF (Elementary Function), EFB (Elementary Function Block) and DFB (Derived Function block)
Function	see EF
Function Block Diagram	see FBD

G

GRAY

Gray or "reflected binary" code is used to code a numerical value being developed into a chain of binary configurations that can be differentiated by the change in status of one and only one bit.
This code can be used, for example, to avoid the following random event: in pure binary, the change of the value 0111 to 1000 can produce random numbers between 0 and 1000, as the bits do not change value altogether simultaneously.
Equivalence between decimal, BCD and Gray:

Decimal	0	1	2	3	4	5	6	7	8	9
BCD	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001
Gray	0000	0001	0011	0010	0110	0111	0101	0100	1100	1101

I

IEC 61131-3

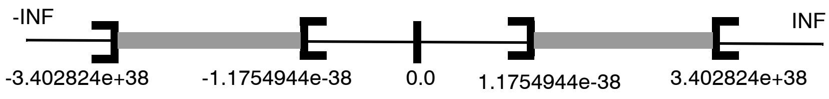
International standard: Programmable Logic Controls
Part 3: Programming languages.

IL

IL is the abbreviation of Instruction List.
This language is a series of basic instructions.
This language is very close to the assembly language used to program processors.
Each instruction is composed of an instruction code and an operand.

INF

Used to indicate that a number overruns the allowed limits.
For a number of Integers, the value ranges (shown in gray) are as follows:



When a calculation result is:
- less than -3.402824e+38, the symbol `-INF` (for -infinite) is displayed,
- greater than +3.402824e+38, the symbol `INF` (for +infinite) is displayed.

INT	`INT` is the abbreviation of single integer format (coded on 16 bits). The lower and upper 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`.
Integer Literals	Integer literal are used to enter integer values in the decimal system. The values can have a preceding sign (+/-). Individual underlines (_) between numbers are not significant. Example: `-12`, `0`, `123_456`, `+986`
IODDT	IODDT is the abbreviation of Input/Output Derived Data Type. The term IODDT designates a structured data type representing a module or a channel of a PLC module. Each application expert module possesses its own IODDTs.

K

Keyword	A keyword is a unique combination of characters used as a syntactical programming language element (See annex B definition of the IEC standard 61131-3. All the key words used in Unity Pro and of this standard are listed in annex C of the IEC standard 61131-3. These keywords cannot be used as identifiers in your program (names of variables, sections, DFB types, etc.)).

L

LD	LD is the abbreviation of Ladder Diagram. LD is a programming language, representing the instructions to be carried out in the form of graphic diagrams very close to a schematic electrical diagram (contacts, coils, etc.).
Located variables	A located variable is a variable for which it is possible to know its position in the PLC memory. For example, the variable `Water_pressure`, is associated with`%MW102`. `Water_pressure` is said to be localized.

M

Multiple Token	Operating mode of an SFC. In multitoken mode, the SFC may possess several active steps at the same time.

N

Naming conventions (Identifier)	An identifier is a sequence of letters, numbers and underlines beginning with a letter or underline (e.g. name of a function block type, an instance, a variable or a section). Letters from national character sets (e.g: ö,ü, é, õ) can be used except in project and DFB names. Underlines are significant in identifiers; e.g. `A_BCD` and `AB_CD` are interpreted as different identifiers. Multiple leading underlines and consecutive underlines are invalid. Identifiers cannot contain spaces. Not case sensitive; e.g. `ABCD` and `abcd` are interpreted as the same identifier. According to IEC 61131-3 leading digits are not allowed in identifiers. Nevertheless, you can use them if you activate in dialog **Tools** → **Project settings** in tab **Language extensions** the ceck box **Leading digits**. Identifiers cannot be keywords.
NAN	Used to indicate that a result of an operation is not a number (NAN = Not A Number). Example: calculating the square root of a negative number.

Note: The IEC 559 standard defines two classes of NAN: quiet `NAN` (`QNAN`) and signaling `NaN` (`SNaN`) `QNAN` is a `NAN` with the most significant fraction bit set and a `SNAN` is a `NAN` with the most significant fraction bit clear (Bit number 22). `QNAN`s are allowed to propagate through most arithmetic operations without signaling an exception. `SNAN` generally signal an invalid-operation exception whenever they appear as operands in arithmetic operations (See %SW17 and %S18).

Network

There are two meanings for Network.

- In LD:
  A network is a set of interconnected graphic elements. The scope of a network is local to the program organization unit (section) in which the network is located.
- With communication expert modules:
  A network is a group of stations which communicate among one another. The term network is also used to define a group of interconnected graphic elements. This group forms then a part of a program which may be composed of a group of networks.

P

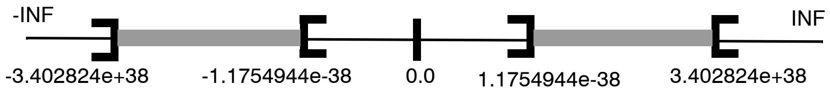
Procedure

Procedures are functions view technically. The only difference to elementary functions is that procedures can take up more than one output and they support data type `VAR_IN_OUT`. To the eye, procedures are no different than elementary functions.
Procedures are a supplement to IEC 61131-3.

R

REAL

Real type is a coded type in 32 bits.
The ranges of possible values are illustrated in gray in the following diagram:



When a calculation result is:

- between -1.175494e-38 and 1.175494e-38 it is considerd as a `DEN`,
- less than -3.402824e+38, the symbol `-INF` (for - infinite) is displayed,
- greater than +3.402824e+38, the symbol `INF` (for +infinite) is displayed,
- undefined (square root of a negative number), the symbol `NAN` or `NAN` is displayed.

Note: The IEC 559 standard defines two classes of NAN: quiet `NAN` (`QNAN`) and signaling `NaN` (`SNaN`) `QNAN` is a `NAN` with the most significant fraction bit set and a `SNAN` is a `NAN` with the most significant fraction bit clear (Bit number 22). `QNAN`s are allowed to propagate through most arithmetic operations without signaling an exception. `SNAN` generally signal an invalid-operation exception whenever they appear as operands in arithmetic operations (See %SW17 and %S18).

Note: when an operand is a `DEN` (Denormalized number) the result is not significant.

Real Literals

An literal real value is a number expressed in one or more decimals.
Example:
`-12.0`, `0.0`, `+0.456`, `3.14159_26`

Real Literals with Exponent

An Literal decimal value can be expressed using standard scientific notation. The representation is as follows: mantissa + exponential.
Example:
`-1.34E-12` or `-1.34e-12`
`1.0E+6` or `1.0e+6`
`1.234E6` or `1.234e6`

S

SFC	SFC is the abbreviation of Sequential Function Chart. SFC enables the operation of a sequential automation device to be represented graphically and in a structured manner. This graphic description of the sequential behavior of an automation device, and the various situations which result from it, is performed using simple graphic symbols.
Single Token	Operating mode of an SFC chart for which only a single step can be active at any one time.
ST	ST is the abbreviation of Structured Text language. Structured Text language is an elaborated language close to computer programming languages. It enables you to structure series of instructions.
STRING	A variable of the type `STRING` is an ASCII standard character string. A character string has a maximum length of 65534 characters.

T

TIME	The type `TIME` expresses a duration in milliseconds. Coded in 32 bits, this type makes it possible to obtain periods from 0 to 2^{32}-1 milliseconds. The units of type `TIME` are the following: the days (`d`), the hours (`h`), the minutes (`m`), the seconds (`s`) and the milliseconds (`ms`). A literal value of the type `TIME` is represented by a combination of previous types preceded by `T#`, `t#`, `TIME#` or `time#`. Examples: `T#25h15m`, `t#14.7S`, `TIME#5d10h23m45s3ms`
Time literals	The units of type `TIME` are the following: the days (`d`), the hours (`h`), the minutes (`m`), the seconds (`s`) and the milliseconds (`ms`). A literal value of the type `TIME` is represented by a combination of previous types preceded by `T#`, `t#`, `TIME#` or `time#`. Examples: `T#25h15m`, `t#14.7S`, `TIME#5d10h23m45s3ms`
TIME_OF_DAY	see `TOD`

TOD

`TOD` is the abbreviation of Time of Day.
The `TOD` type coded in BCD in 32 bit format contains the following information:
- the hour coded in a 8-bit field,
- the minutes coded in an 8-bit field,
- the seconds coded in an 8-bit field.

Note: The 8 least significant bits are unused.

The Time of Day type is entered as follows: **`TOD#`**`<Hour>`**`:`**`<Minutes>`**`:`**`<Seconds>`
This table shows the lower/upper limits in each field:

Field	Limits	Comment
Hour	[00,23]	The left 0 is always displayed, but can be omitted at the time of entry
Minute	[00,59]	The left 0 is always displayed, but can be omitted at the time of entry
Second	[00,59]	The left 0 is always displayed, but can be omitted at the time of entry

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

Token

An active step of an SFC is known as a token.

TOPO_ADDR_TYPE

This predefined type is used as output for READ_TOPO_ADDR function. This type is an ARRAY[0..4] OF Int. You can find it in the libset, in the same family than the EFs which use it.

U

UDINT

`UDINT` is the abbreviation of Unsigned Double Integer format (coded on 32 bits) unsigned. The lower and upper limits are as follows: 0 to (2 to the power of 32) - 1.
Example:
`0, 4294967295, 2#11111111111111111111111111111111, 8#37777777777, 16#FFFFFFFF`.

UINT

`UINT` is the abbreviation of Unsigned integer format (coded on 16 bits). The lower and upper limits are as follows: 0 to (2 to the power of 16) - 1.
Example:
`0, 65535, 2#1111111111111111, 8#177777, 16#FFFF`.

Unlocated variable

An unlocated variable is a variable for which it is impossible to know its position in the PLC memory. A variable which have no address assigned is said to be unlocated.

V

Variable

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

W

WORD

The `WORD` type is coded in 16 bit format and is used to carry out processing on bit strings.
This table shows the lower/upper limits of the bases which can be used:

Base	Lower limit	Upper limit
Hexadecimal	16#0	16#FFFF
Octal	8#0	8#177777
Binary	2#0	2#1111111111111111

Representation examples

Data content	Representation in one of the bases
0000000011010011	16#D3
1010101010101010	8#125252
0000000011010011	2#11010011

Index