

Quantum EIO

Remote I/O Modules

Installation and Configuration Guide

12/2018

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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

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

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

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

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Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, 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 a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

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

CAUTION

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

NOTICE

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

PLEASE NOTE

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

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

BEFORE YOU BEGIN

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

 WARNING
UNGUARDED EQUIPMENT
<ul style="list-style-type: none">• Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.• Do not reach into machinery during operation.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

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

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

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

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

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

START-UP AND TEST

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

WARNING

EQUIPMENT OPERATION HAZARD

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

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

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

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

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

Before energizing equipment:

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

OPERATION AND ADJUSTMENTS

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

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

About the Book



At a Glance

Document Scope

PlantStruxure is a Schneider Electric program designed to address the key challenges of many different types of users, including plant managers, operations managers, engineers, maintenance teams, and operators, by delivering a system that is scalable, flexible, integrated, and collaborative.

This document presents one of the PlantStruxure features, using Ethernet as the backbone around the Quantum PLC offer and connecting a *Quantum local rack* to Quantum and Modicon X80 *remote I/O drops* and distributed I/O devices. This feature is known as Quantum Ethernet I/O or Quantum EIO. (*NOTE: Modicon X80 is the generic name given to the M340 I/O modules when they are connected remotely to a Quantum controller or module in a PlantStruxure architecture. The M340 I/O name is still used when the module is connected to a M340 controller. The product references remains unchanged; only the range name changes.*)

This guide describes these modules and their roles in a Quantum EIO system:

- 140CRP31200: remote I/O head module on a Quantum local rack in a remote I/O main ring
- 140CRA31200: remote I/O adapter module in a Quantum remote I/O drop
- BMXCRA312•0: remote I/O adapter module in a Modicon X80 remote I/O drop

NOTE: The specific configuration settings contained in this guide are for instructional purposes only. The settings required for your specific application can be different from the examples presented in this guide.

NOTE: The architectures described in this document have been tested and validated in various scenarios. If you intend to use architectures different than the ones described in this document, test and validate them thoroughly before implementing.

Validity Note

This document is valid for the Quantum EIO system when used with EcoStruxure™ Control Expert 14.0 or later.

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

Step	Action
1	Go to the Schneider Electric home page www.schneider-electric.com .
2	In the Search box type the reference of a product or the name of a product range. <ul style="list-style-type: none">● Do not include blank spaces in the reference or product range.● To get information on grouping similar modules, use asterisks (*).

Step	Action
3	If you entered a reference, go to the Product Datasheets search results and click on the reference that interests you. If you entered the name of a product range, go to the Product Ranges search results and click on the product range that interests you.
4	If more than one reference appears in the Products search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click Download XXX product datasheet .

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

Related Documents

Title of Documentation	Reference Number
Quantum EIO, System Planning Guide	S1A48959 (English), S1A48961 (French), S1A48962 (German), S1A48964 (Italian), S1A48965 (Spanish), S1A48966 (Chinese)
Quantum EIO, Distributed Network, Installation and Configuration Guide	S1A48986 (English), S1A48987 (French), S1A48988 (German), S1A48990 (Italian), S1A48991 (Spanish), S1A48992 (Chinese)
Quantum EIO, Control Network, Installation and Configuration Guide	S1A48993 (English), S1A48994 (French), S1A48995 (German), S1A48997 (Italian), S1A48998 (Spanish), S1A48999 (Chinese)
Modicon Quantum Change Configuration on the Fly User Guide	S1A48967 (English), S1A48968 (French), S1A48969 (German), S1A48970 (Italian), S1A48972 (Spanish), S1A48976 (Chinese)

Title of Documentation	Reference Number
Quantum using EcoStruxure™ Control Expert, Hot Standby System, User Manual	35010533 (English), 35010534 (French), 35010535 (German), 35013993 (Italian), 35010536 (Spanish), 35012188 (Chinese)
Modicon X80, BMXNRP0200/0201 Fiber Converter Modules, User Guide	EIO0000001108 (English), EIO0000001109 (French), EIO0000001110 (German), EIO0000001111 (Spanish), EIO0000001112 (Italian), EIO0000001113 (Chinese)
Modicon X80, Analog Input/Output Modules, User Manual	35011978 (English), 35011979 (German), 35011980 (French), 35011981 (Spanish), 35011982 (Italian), 35011983 (Chinese)
Modicon X80, Discrete Input/Output Modules, User Manual	35012474 (English), 35012475 (German), 35012476 (French), 35012477 (Spanish), 35012478 (Italian), 35012479 (Chinese)
Modicon X80, BMXNOM0200 Serial Link Module, User Manual	EIO0000002696 (English), EIO0000002697 (French), EIO0000002698 (German), EIO0000002699 (Italian), EIO0000002700 (Spanish), EIO0000002701 (Chinese)
Modicon X80, BMXEHC0200 Counting Module, User Manual	35013355 (English), 35013356 (German), 35013357 (French), 35013358 (Spanish), 35013359 (Italian), 35013360 (Chinese)
Modicon X80, BMXERT1604T Time Stamp Module, User Guide	EIO0000001121 (English), EIO0000001122 (French), EIO0000001123 (German), EIO0000001125 (Italian), EIO0000001124 (Spanish), EIO0000001126 (Chinese)

Title of Documentation	Reference Number
EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35013361 (Italian), 35006147 (Spanish), 35013362 (Chinese)
EcoStruxure™ Control Expert, System Bits and Words, Reference Manual	EIO0000002135 (English), EIO0000002136 (French), EIO0000002137 (German), EIO0000002138 (Italian), EIO0000002139 (Spanish), EIO0000002140 (Chinese)
EcoStruxure™ Control Expert, Operating Modes	33003101 (English), 33003102 (French), 33003103 (German), 33003104 (Spanish), 33003696 (Italian), 33003697 (Chinese)
Quantum using EcoStruxure™ Control Expert, Hardware Reference Manual	35010529 (English), 35010530 (French), 35010531 (German), 35013975 (Italian), 35010532 (Spanish), 35012184 (Chinese)
EcoStruxure™ Control Expert, Installation Manual	35014792 (English), 35014793 (French), 35014794 (German), 35014795 (Spanish), 35014796 (Italian), 35012191 (Chinese)

You can download these technical publications and other technical information from our website at <https://www.schneider-electric.com/en/download>

Chapter 1

Characteristics of Ethernet Remote I/O Modules

Introduction

This chapter describes the head and adapter modules for Ethernet remote I/O communications in a Quantum EIO system. Specifically, those modules are:

- 140CRP31200: head module on a local Quantum rack
- 140CRA31200: adapter module on a Quantum remote I/O drop
- BMXCRA312•0: adapter module on a Modicon X80 remote I/O drop

This chapter includes physical characteristics, port descriptions, and agency specifications for these modules.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Quantum EIO 140CRP31200 Head Module Description	16
Quantum EIO Adapter Module Descriptions	19
Module Specifications	22
I/O Devices	24

Quantum EIO 140CRP31200 Head Module Description

Introduction

The Quantum 140CRP31200 module is the remote I/O head module on the local rack of Quantum EIO installations. This module allows the PLC to connect to an Ethernet network and control remote I/O devices.

Functionality

The main purpose of the 140CRP31200 module is to provide I/O scanning services of remote I/O devices on either a remote I/O network or a device network, which contains remote I/O and distributed I/O devices. The module is directly connected to the remote I/O network main ring, and it manages the remote I/O network through a daisy chain loop topology. This module also provides various Ethernet services, such as configuration for remote I/O devices and diagnostics.

You can use these function blocks with the 140CRP31200 module:

- IU_ERIO (*see page 103*)
- DROP
- XDROP

Only one 140CRP31200 module can be configured on the local rack. This module has interfaces for communicating with Ethernet remote I/O devices on the network.

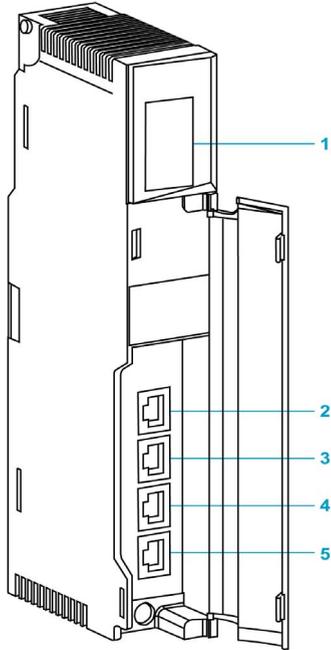
The 140CRP31200 module allows the PLC to connect to an Ethernet network and to have a deterministic I/O exchange with modules in the Ethernet remote I/O drops.

The 140CRP31200 module is dedicated to the management of remote I/O devices only. Other services of the 140CRP31200 module:

- The module uses RSTP to enable all remote I/O devices on the main ring to recover from a communication disruption within 50 ms.
- The module can configure IP parameters and the configurations for I/O modules on the drops for up to 31 remote I/O devices.
- The module provides a communication path (through an interlink) to allow distributed I/O and control network traffic to participate on the remote I/O network.
- The module supports Hot Standby functionality. The primary 140CRP31200 module and the standby 140CRP31200 module do not swap their IP addresses when a switchover occurs.

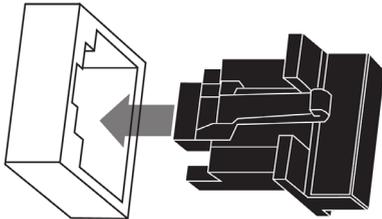
External Features

140CRP31200:



- 1 LED display
- 2 SERVICE port (ETH 1)
- 3 INTERLINK port (ETH 2)
- 4 DEVICE NETWORK port (ETH 3)
- 5 DEVICE NETWORK port (ETH 4)

NOTE: To help prevent dust from entering the unused Ethernet ports on this module, cover the port with the stopper:



External Ports

The 140CRP31200 module monitors the functionality of network links depending on which links are connected to the network. The module has 4 external ports (but a single IP address):

Port	Quantity	Description
SERVICE	1	<p>The SERVICE port allows the diagnosis of Ethernet ports and provides access to external tools and devices (Control Expert, ConneXium Network Manager, HMI, etc.). The port supports these modes:</p> <ul style="list-style-type: none"> ● access port (default): This mode supports Ethernet communications. ● port mirroring: In this mode, data traffic from one or more of the other 3 ports is copied to this port. This allows a connected tool to monitor and analyze the port traffic. ● disabled <p>NOTE:</p> <ul style="list-style-type: none"> ● You can configure the SERVICE port either on line or off line. ● In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE port. <p>NOTE:</p> <p>The maximum load the network can process from distributed I/O devices is:</p> <ul style="list-style-type: none"> ● 5 Mbps per dual-ring switch (DRS) port or service port ● 20 Mbps for distributed I/O traffic on the main ring <p>Refer to the <i>Service Port Configuration topic (see page 64)</i>.</p>
INTERLINK	1	The INTERLINK port provides connectivity to other Quantum EIO modules.
DEVICE NETWORK	2	<p>These 2 copper ports provide:</p> <ul style="list-style-type: none"> ● connections for remote I/O communications ● cable redundancy via the daisy chain loop architecture

NOTE: Do not connect a device with a speed in excess of 100 Mbps to any port. If the device is configured for a speed that exceeds 100 Mbps, the Ethernet link may not be established between the device and the module through the port.

Quantum EIO Adapter Module Descriptions

Introduction

These adapter modules are used on Ethernet remote I/O drops in 31 Quantum EIO installations:

- 140CRA31200
- BMXCRA312•0

A remote I/O drop can be connected directly to either the main ring or a remote I/O sub-ring.

NOTE: If you use a low-end CPU (140 CPU 6• 1••) (2 Mb or less), you can only install a maximum of 31 remote I/O drops. Of those 31 drops, you can only install a maximum of sixteen BMXCRA312•0 remote I/O drops. If you use a high-end CPU (140 CPU 6•• ••) (4 Mb or more), you can install a maximum of thirty-one BMXCRA312•0 or 140CRA31200 remote I/O drops.

Functionality

Adapter modules exchange data with the 140CRP31200 remote I/O head module on the local rack:

- The 140CRA31200 module is an adapter module on a Quantum remote I/O drop.
- The BMXCRA31200 and BMXCRA31210 modules are adapter modules on Modicon X80 remote I/O drops.

Features:

- The input data from the Ethernet remote I/O drop is collected and published to the remote I/O scanner.
- The output modules are updated with the data received from the remote I/O scanner.
- The protocol used for exchange is EtherNet/IP.
- The remote I/O scanner views the 140CRA31200 or BMXCRA312•0 module as a remote I/O adapter.
- The exchanges are deterministic, which means that the time it takes to resolve a remote I/O logic scan is predictable.

CAUTION

Unexpected behavior of the application.

If you use your BMXCRA in a Quantum Ethernet IO architecture, take care to update the Quantum CPU and the 140CRP31200 to the following minimum versions:

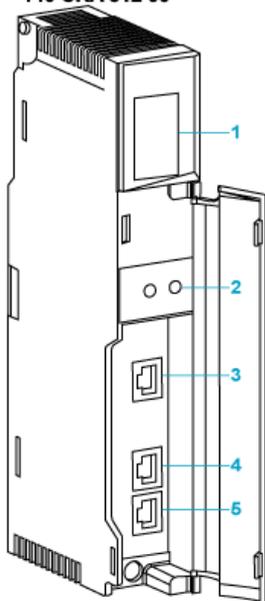
- CPU: V3.1
- CRP: V1.56

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

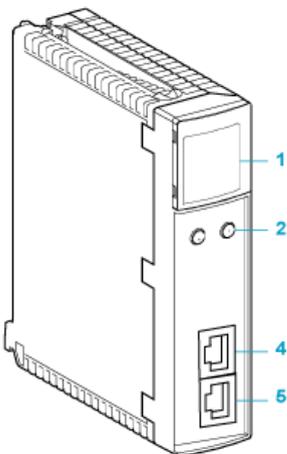
External Features

These adapter modules have the same dimensions and installation constraints as other modules in their respective product lines (Quantum or Modicon X80):

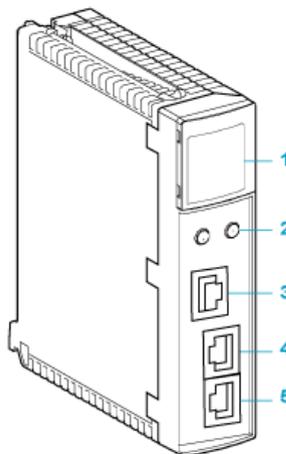
140 CRA 312 00



BMX CRA 312 00

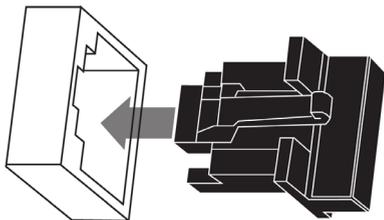


BMX CRA 312 10



- 1 LED display
- 2 rotary switches
- 3 SERVICE port (ETH 1)
- 4 DEVICE NETWORK port (ETH 2)
- 5 DEVICE NETWORK port (ETH 3)

NOTE: To help prevent dust from entering the unused Ethernet ports on these adapter modules, cover the ports with the stopper:



External Ports

Two of the Ethernet ports allow implicit I/O exchanges with a remote I/O scanner adapter. (An implicit I/O exchange has a maximum frame size of 1400 bytes.) The ports can be implemented alone or in redundant mode.

You can use a maximum of 31 adapters in a single Ethernet remote I/O network. For network topology planning, refer to the *Quantum Ethernet I/O System Planning Guide*.

These modules have up to three 10/100 Base-T Ethernet ports:

Port	Description
SERVICE	<p>The SERVICE port allows the diagnosis of Ethernet ports and provides access to external tools and devices (Control Expert, ConneXium Network Manager, HMI, etc.). The port supports these modes:</p> <ul style="list-style-type: none"> ● access port (default): This mode supports Ethernet communications. ● port mirroring: In this mode, data traffic from one of the other 3 ports is copied to this port. This allows a connected management tool to monitor and analyze the port traffic. ● disabled <p>NOTE:</p> <ul style="list-style-type: none"> ● You can configure the SERVICE port either on line or off line. ● In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE port. ● There is no SERVICE port on the BMXCRA31200 adapter module. <p>Refer to <i>Service Port Configuration (see page 64)</i>.</p>
DEVICE NETWORK	<p>The DEVICE NETWORK copper port provides:</p> <ul style="list-style-type: none"> ● connections for remote I/O communications ● cable redundancy

NOTE: Do not connect a device with a speed in excess of 100 Mbps to any port. If the device is configured for a speed that exceeds 100 Mbps, the Ethernet link may not be established between the device and the module through the port.

Cable Redundancy

Use a daisy chain network configuration that implements the RSTP service to establish redundant communications between the adapter module and a remote I/O scanner. The adapter operates normally when at least one of the 2 physical paths to the 140CRP31200 is valid. (For network topology planning, refer to the *Quantum Ethernet I/O System Planning Guide*.)

Module Specifications

Product Certification

The Quantum EIO head/adapter modules meet these standards:

UL (UL508)
CSA (CSA22.2 no. 142)
C-tick
Hazardous locations (C11 div 2)
IEC61000-4-16
EMI EN 55011
CE
EN 61131-1
IEC 61131-2 (zone B and zone C, except surges on AC: zone B only)

Quantum EIO modules conform to these product certification and marine classification authorities:

Key	Certification Body	Country
ABS	American Bureau of Shipping	United States
BV	Bureau Veritas	France
DNV	Det Norske Veritas	Norway
GOST	Gosudarstvennyy Standart	Russia
GL	Germanischer Lloyd	Germany
LR	Lloyd's Register	United Kingdom
RINA	Registro Italiano Navale	Italy

The electrical isolation within a Quantum EIO system modules complies with the 1500 Vac/2250 Vdc 60s from IEEE 802.3 2008.

Environmental Requirements

Parameter	Reference	Specification
protection	EN 61131-2	IP20
	IEC 60527	
protection class	EN 61131-2	protection class 1
over voltage class	EN 61131-2	category II
operating temperature	IEC 60068-2-1	0 ... 60° C
	Ab&Ad (cold)	
	IEC 60068-2-2	
	Bb&Bd (cold)	
storage temperature	IEC 60068-2-1	-40 ... 85° C
	Ab&Ad (cold)	
	IEC 60068-2-2	
	Bb&Bd (cold)	
sinusoidal vibration	IEC 60068-2-6fC	<ul style="list-style-type: none"> ● .5 ... 8.4 Hz at 3.5 mm constant amplitude ● 8.4 ... 150 Hz at 1g constant acceleration ● 10 cycles at sweep rate of 1 oct/min
	EN 61131-2	
operating shock	IEC 60068-2-27Ea	30 g peak, 11 ms, half-sine wave, 3 shocks in each direction (+ and -) for each of the 3 principle axes
altitude		0 ... 5000 m maximum during operation. For altitudes > 2000 m, reduce the operating temperature by 6° C for each additional 1000 m.
free fall, random (packaged)	EN 61131-2	5 random drops from 1 m onto flat surfaces
	IEC 60068-2-32	
	test ed., method 1	
free fall, flat drop (unpackaged)	EN 61131-2	<ul style="list-style-type: none"> ● 2 random drops from 1 m onto flat surfaces ● 5 drops from 0.1 m onto flat surfaces
	IEC 60068-2-32	
	test ed., method 1	
free fall, angled (unpackaged)	EN 61131-2	5 drops from 0.1 m onto each corner
	IEC 60068-2-31	
relative humidity (operating)	IEC 60068-2-78Ca	93% (+/- 2%, noncondensing) at 60° C for conformally coated modules 140CRA31200C and 140CRP31200C
relative humidity (nonoperating)	IEC 60068	93% (+/- 2%, noncondensing) at 60° C for conformally coated modules 140CRA31200C and 140CRP31200C

NOTE: The BMXCRA31210 is also available in a coated version.

I/O Devices

Introduction

This topic lists the Quantum and Modicon X80 I/O devices that can be connected to an Ethernet remote I/O network.

To add I/O modules to an Ethernet remote I/O drop in Control Expert offline mode, click and drag the modules from the **Hardware Catalog** to the remote I/O drop in the bus editor. You can also double-click the rack slot in which you want to insert the I/O module and select from the **New Device** dialog box. The available I/O modules are listed in the following tables.

Quantum Analog and Digital Modules

These analog and digital I/O modules are supported in Quantum Ethernet remote I/O drops:

Input	Output	Input/Output
Analog I/O Modules:		
140 ACI 030 00	140 ACO 020 00	140 AMM 090 00
140 ACI 040 00	140 ACO 130 00	
140 AII 330 00	140 AIO 330 00	
140 AII 330 10	140 AVO 020 00	
140 ARI 030 10		
140 ATI 030 00		
140 AVI 030 00		
Digital I/O Modules:		
140 DDI 153 10	140 DDO 153 10	140 DDM 390 00
140 DDI 353 00	140 DDO 353 00	140 DDM 690 00
140 DDI 353 10	140 DDO 353 01	140 DAM 590 00

Input	Output	Input/Output
140 DDI 364 00	140 DDO 353 10	
140 DDI 673 00	140 DDO 364 00	
140 DDI 841 00	140 DDO 843 00	
140 DDI 853 00	140 DDO 885 00	
140 DAI 340 00	140 DAO 840 00	
140 DAI 353 00	140 DAO 840 10	
140 DAI 440 00	140 DAO 842 10	
140 DAI 453 00	140 DAO 842 20	
140 DAI 540 00	140 DAO 853 00	
140 DAI 543 00	140 DRA 840 00	
140 DAI 553 00	140 DRC 830 00	
140 DAI 740 00	140 DVO 853 00	
140 DAI 753 00	140 DIO 330 00	
140 DII 330 00		
140 DSI 353 00		

Modicon X80 Analog and Digital Modules

These analog and digital I/O modules are supported in Modicon X80 Ethernet remote I/O drops:

Input	Output	Input/Output
Analog I/O Modules:		
BMX ART 0414	BMX AMO 0210	BMX AMM 0600
BMX ART 0814	BMX AMO 0410	
BMX AMI 0410	BMX AMO 0802	
BMX AMI 0800		
BMX AMI 0810		
Digital I/O Modules:		
BMX DDI 1602	BMX DDO 3202K	BMX DDM 16022
BMX DDI 1603	BMX DDO 6402K	BMX DDM 16025
BMX DDI 1604	BMX DDO 1602	BMX DDM 3202K

Input	Output	Input/Output
BMX DAI 0805	BMX DDO 1612	
BMX DAI 0814	BMX DAO 1605	
BMX DAI 1602	BMX DAO 1615	
BMX DAI 1603	BMX DRA 0804	
BMX DAI 1604	BMX DRA 0805	
BMX DAI 1614	BMX DRA 0815	
BMX DAI 1615	BMX DRA 1605	
BMX DDI 3202K	BMX DRC 0805	
BMX DDI 6402K		

NOTE: Schneider Electric recommends that you use Unity Loader to upgrade the module with the latest available version. However, a BMX ART 0414 module, V2.1 or later, can work properly behind a Modicon X80 remote I/O adapter module.

Intelligent and Special Purpose Modules

These intelligent/special purpose modules are supported in Quantum and Modicon X80 Ethernet remote I/O drops:

Type	Quantum Module	Modicon X80 Module	
		BMX CRA 312 00	BMX CRA 312 10
expert	140 ERT 854 10	—	BMX ERT 1604T
	140 ERT 854 20		
	140 ESI 062 10		
counting	140 EHC 105 00	—	BMX EHC 0200
	140 EHC 202 00	—	BMX EHC 0800
communication	140 XBE 100 00	—	BMX NOM 0200. Restrictions are described in chapter <i>BMXNOM0200 Limitation and Implementation Rules</i> (see <i>Modicon X80, BMXNOM0200 Serial Link Module, User Manual</i>).
			BMX EIA 100 (max of 1 per drop; may be combined with one BMX NOM 0200 module)
fiber cable conversion	140 NRP 312 00/01	BMX NRP 0200/01	

NOTE: Schneider Electric recommends that you use Unity Loader to upgrade the module with the latest available version. However, a BMX NOM 0200 module, V1.4 or later, can work properly behind a Modicon X80 remote I/O adapter module.

Modicon X80 Analog and Digital Module Versions

When the following modules are used in an EIO drop with a BMX CRA 312 10 adapter module, they require these versions (or later):

Module	Product Version	Hardware Release Level	Software Version
BMX AMI 0410	PV5	RL5	SV1.1
BMX AMM 0600	PV5 (PV6)	RL5 (RL6)	SV1.2
BMX AMO 0210	PV7 (PV8)	RL7 (RL8)	SV1.1
BMX ART 0414	PV5 (PV6)	RL5 (RL6)	SV2.0
	PV7	RL7	SV2.1
BMX ART 0814	PV3 (PV4)	RL3 (RL4)	SV2.0
	PV5 (PV6)	RL5 (RL6)	SV2.1
BMX EHC 0200	PV3	RL3	SV1.1
BMX EHC 0800	PV3	RL3	SV1.1

Chapter 2

Installation

Overview

This chapter describes the hardware installation of a Quantum EIO system. It includes the installation of modules in the local rack and the Ethernet remote I/O drop to which it is connected. Other discussions include the interconnections between rack-mounted modules and the hardware considerations for different PLC platforms.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
2.1	Installing Quantum EIO Modules	30
2.2	Installing the Communications Adapter on the Remote Drop	38
2.3	Remote I/O Infrastructure Cables	43

Section 2.1

Installing Quantum EIO Modules

Introduction

This section describes the installation of these Quantum EIO modules:

- 140CRP31200 remote I/O head module (on the local rack)
- 140CRA31200 remote I/O adapter module (on a Quantum remote I/O drop)
- 140CRA31908 remote I/O adapter module (for S908 applications)
- BMXCRA312•0 remote I/O adapter module (on a Modicon X80 remote I/O drop)

What Is in This Section?

This section contains the following topics:

Topic	Page
Installing the Quantum Controller	31
Mounting a Quantum EIO-Compatible Module on the Backplane	32
Quantum EIO-Compatible Module Installation Considerations	34
Remote I/O Network Cable Installation	36

Installing the Quantum Controller

Introduction

For any Quantum EIO system, install a Quantum controller on the local rack. Only processors with firmware version 3.0 or later (version 3.10 for BMXCRA312*0 support) are compatible with Quantum EIO installations.

Compatible Processors

Compatible processors:

Processor Type	Part
standalone	140 CPU 651 50
	140 CPU 651 60
	140 CPU 652 60
	140 CPU 658 60
Hot Standby	140 CPU 671 60
	140 CPU 672 60
	140 CPU 672 61
	140 CPU 678 61

NOTE: Low-end Quantum processors (140 CPU 434 12U, 140 CPU 534 14U, 140 CPU 311 10) and Quantum safety processors (140 CPU 651 60S, 140 CPU 671 60S) are not compatible with Quantum EIO systems.

Selecting a Power Supply

When installing a Quantum controller, add a power supply module that is capable of supplying power to all modules on the rack.

Mounting a Quantum EIO-Compatible Module on the Backplane

Introduction

Use these instructions to install Quantum and Modicon X80 modules that operate in a Quantum EIO system:

- 140CRP31200 remote I/O head module (on the local rack)
- remote I/O adapter module:
 - 140CRA31200 remote I/O adapter module (on a Quantum remote I/O drop)
 - BMXCRA31200 adapter module (on a Modicon X80 remote I/O drop)
 - 140CRA31908 adapter module facilitates the use of S908 hardware and applications in M580 Ethernet I/O architectures.
- 140NOC78000 distributed I/O head module (on the local rack)
- 140NOC78100 control head module (on the local rack)

Grounding Considerations

Do not apply power to a Quantum rack until connections are made at both ends of the Ethernet cable. For example, connect the cable to both the 140CRP31200 and another device (adapter module) or ConneXium dual-ring switch DRS before you turn on the power.

Refer to the *Quantum EIO System Planning Guide* for details on dual-ring switches (DRSs).

DANGER

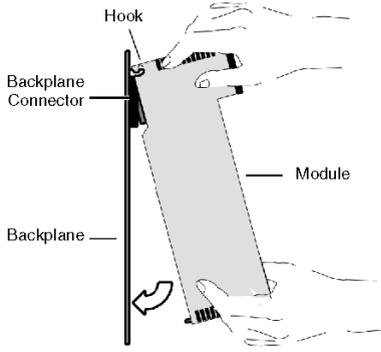
ELECTRICAL SHOCK HAZARD

- Switch off the power supply to the automation controller stations at both ends of the connection before inserting or removing an Ethernet cable.
- Use suitable insulation equipment when inserting or removing all or part of this equipment.

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

Use fiber-optic cable to establish a communications link when it is not possible to master potential between distant grounds.

Mounting a Module

Step	Action
1	<p>Hold the module at an angle and mount it on the 2 hooks near the top of the backplane. The figure shows the correct way to hold the module:</p>  <p>The diagram illustrates the first step of mounting a module. A hand is shown holding a rectangular module at an angle. The top edge of the module is being aligned with two hooks on a vertical backplane. A label 'Hook' points to the top hook. A label 'Backplane Connector' points to the connector on the backplane. A label 'Backplane' points to the vertical surface. A label 'Module' points to the rectangular object being held. The bottom of the module is held by another hand, which is also shown holding a screwdriver, indicating the next step.</p>
2	Swing the module down so the connector engages the backplane connector.
3	Use a Phillips-head screw driver to tighten the screw at the bottom of the module from 2 to 4 in-lbs or from .22 through .45 N•m of torque.

NOTE: The figure above shows a **Quantum** module being mounted from top to bottom. Modicon X80 modules mount from bottom to top.

Replacing a Module

You can replace a Quantum EIO module at any time using another module with compatible firmware. The replacement module obtains its operating parameters over the backplane connection from the CPU. The transfer occurs immediately at the next cycle to the device.

The operating parameters that the CPU sends to a replacement module do not include any parameter values that were edited in the original module using explicit messaging **SET** commands.

Quantum EIO-Compatible Module Installation Considerations

Introduction

Observe the following guidelines when you install these Quantum and Modicon X80 modules in a Quantum EIO system:

- 140CRP31200 remote I/O head module (on the local rack)
- remote I/O adapter module (on the remote I/O drop)
 - 140CRA31200 module on a Quantum drop
 - 140CRA31908 adapter module on a Quantum drop
 - BMXCRA312•0 module on a Modicon X80 drop
- 140NOC78000 distributed I/O head module (on the local rack)
- 140NOC78100 control network head module (on the local rack)

Grounding Considerations

 **DANGER**

ELECTRICAL SHOCK HAZARD

- Switch off the power supply to the automation controller stations at both ends of the connection before inserting or removing an Ethernet cable.
- Use suitable insulation equipment when inserting or removing all or part of this equipment.

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

Use fiber-optic cable to establish a communications link when it is not possible to master potential between distant grounds.

NOTE: Refer to the ground connections information in the *Grounding and Electromagnetic Compatibility of PLC Systems User Manual*.

Installation

You can apply power to the Quantum EIO controller rack after the 140CRP31200 head module or adapter module is inserted:

- Successful installation:
 - Initialization is finished.
 - Interconnections to other modules are validated (drop adapter module only).
- Unsuccessful installation:
 - Initialization does not finish.
 - Interconnections to other modules are not validated (adapter modules only).

You can see the status of the installation on the LED display.

NOTE: Because all modules on the local rack are initialized when power is applied, the 140CRP31200 remote I/O head module can only validate the interconnections with 140NOC78000 and 140NOC78100 head modules after these modules have been initialized. Therefore, the adapter module waits until its queries about the interconnected port information are answered.

NOTE: These guidelines pertain to the installation of a single head module or adapter module, not the entire network. For network power-up guidelines, refer to the *Quantum Ethernet I/O System Planning Guide*.

Remote I/O Network Cable Installation

Introduction

Your application can include:

- communications with a simple remote I/O daisy chain loop
- communications with a mix of remote I/O and distributed I/O networks

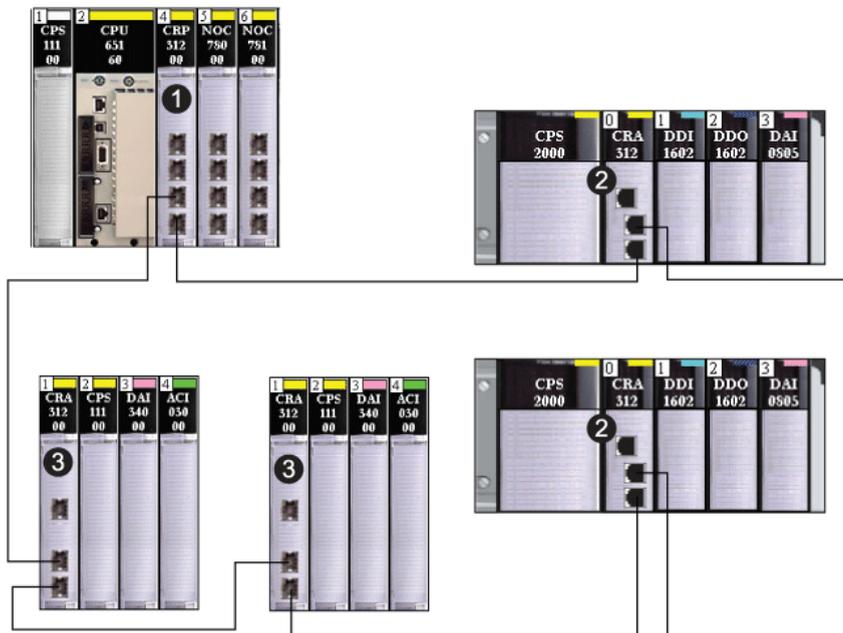
The cable connections to the 140CRP31200 remote I/O head module on the local rack are different in these scenarios. They are discussed below.

Each device network port on the 140CRP31200 module is connected to the main ring of the daisy chain. Likewise, each device network port on a 140CRA31200 or BMXCRA312•0 adapter module is connected to an Ethernet I/O device. The 140CRP31200 module and the •••CRA312•0 adapter modules do not have fiber optic ports.

The Ethernet ports are clearly labeled (*see page 15*) on the 140CRP31200 module and the •••CRA312•0 adapter modules.

Remote I/O Simple Daisy Chain Loop

The 140CRP31200 module supports communications with Ethernet remote I/O drops in daisy chain loops:



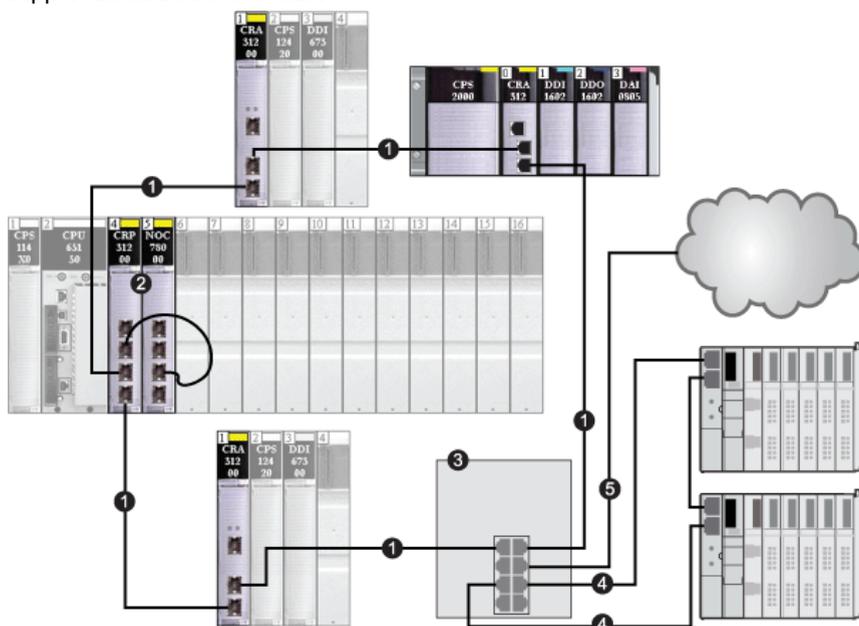
- 1 local rack with a 140CRP31200 remote I/O head module
- 2 Modicon X80 remote I/O drop with a BMXCRA312•0 adapter module
- 3 Quantum remote I/O drop with a 140CRA31200 adapter module

When you support only remote I/O, you do not have to link the 140CRP31200 module to other communication modules on the local rack.

Mix of Remote I/O Drops, Distributed I/O Devices, and Clouds

The Quantum EIO architecture allows distributed I/O devices to participate directly on the remote I/O network. This can be useful if, for example, you want to integrate a SCADA or HMI panel or other non-Quantum device into the remote I/O network.

Distributed I/O devices cannot be connected directly to the main ring of the remote I/O network, but they can be connected via a DRS. Most DRS preconfigurations enable some switch ports to support distributed I/O clouds:



- 1 main ring
- 2 140CRP31200 interlinked to 140 NO• 7•• module on the local rack
- 3 dual-ring switch (DRS)
- 4 dual-ring switch (DRS) connection to distributed I/O sub-ring
- 5 dual-ring switch (DRS) connection to distributed I/O cloud

Some dual-ring switch (DRS) preconfigurations support the connection of distributed I/O devices connected directly to a sub-ring. In these configurations, the distributed I/O devices have the advantage of cable redundancy provided by the sub-ring loop. In order for a distributed I/O device to operate on a sub-ring, use a device with 2 Ethernet ports that support RSTP.

The above figure shows two STB islands used as distributed I/O devices on a sub-ring. The network interface module installed in each island is an STB NIP 2311 NIM, which has dual Ethernet ports and the RSTP service.

Section 2.2

Installing the Communications Adapter on the Remote Drop

Introduction

This section describes the installation of the 140CRA31200 or BMXCRA312•0 adapter module in an Ethernet remote I/O drop.

What Is in This Section?

This section contains the following topics:

Topic	Page
Installing a Quantum EIO Adapter Module	39
Installing Ethernet Remote I/O Drops on a Remote Rack	40
Setting the Location of the Ethernet Remote I/O Drop	42

Installing a Quantum EIO Adapter Module

Locate a Backplane Slot

Install the 140CRA31200 adapter module in any slot in the remote I/O drop. Insert the BMXCRA312•0 adapter module in slot 0 only in the remote I/O drop.

Refer to the directions for installing a module on the backplane (*see page 32*).

Power Consumption

Power consumption is 1.2 A on a 5 Vdc power rail on the backplane (6 W). The adapter module supports modules on 2 racks. (Power consumption has no relation to the number of installed rack modules.)

Select a Power Supply

When configuring the PLC station, use a power supply module that can supply power to all rack modules.

NOTE: You can place a power supply module in any slot on Quantum Ethernet remote I/O drop. In Modicon X80 Ethernet remote I/O drops, you can insert the power supply only in the double-wide slot to the left of slot 0.

Select a power module that suits your unique system requirements. These modules (and their conformally coated versions) are supported:

Power Supply Type	Quantum Module	Modicon X80 Module
standalone	<ul style="list-style-type: none"> ● 140 CPS 21 00 (C) ● 140 CPS 511 00 (C) ● 140 CPS 111 00 (C) 	<ul style="list-style-type: none"> ● BMX CPS 2010 ● BMX CPS 3020 ● BMX CPS 2000 ● BMX CPS 3500 ● BMX CPS 3540 ● BMX CPS 4002
summable	<ul style="list-style-type: none"> ● 140 CPS 214 00 (C) ● 140 CPS 414 00 (C) ● 140 CPS 114 20 (C) 	–
redundant	<ul style="list-style-type: none"> ● 140 CPS 224 00 (C) ● 140 CPS 424 00 (C) ● 140 CPS 524 00 (C) ● 140 CPS 124 20 (C) 	<ul style="list-style-type: none"> ● ABL 8RED 24400 ● ABL 8REM 24030 ● ABL 8RPS 24030

Installing Ethernet Remote I/O Drops on a Remote Rack

Introduction

These guidelines apply to Ethernet remote I/O drops on remote racks.

Racks and Extensions

An Ethernet remote I/O drop can include 2 racks. In a 2-rack drop, the racks are linked with these bus extender modules and cables:

Remote Drop Type	Bus Extender Module	Cable
Quantum	140 XBE 100 00	140 XCA 717 0• (1 to 3 m)
Modicon X80	BMX XBE 1000	BMX XBC ••K (0.8 to 12 m)

Maximum Configuration

Quantum remote I/O drops can include two 16-slot racks for a maximum of 32 slots. Modicon X80 remote I/O drops with a BMXCRA312•0 adapter module can support two racks for a maximum of 24 slots.

NOTE: If you use a low-end CPU (140 CPU 6• 1••) (2 Mb or less), you can only install a maximum of 31 remote I/O drops. Of those 31 drops, you can only install a maximum of sixteen BMXCRA312•0 remote I/O drops. If you use a high-end CPU (140 CPU 6•• ••) (4 Mb or more), you can install a maximum of thirty-one BMXCRA312•0 or 140CRA31200 remote I/O drops.

The table shows the maximum number of modules of each type in remote drops:

Module Type	Quantum 140CRA31200	Modicon X80 BMXCRA312•0
remote I/O adapter (note 1)	1	1
power supply (note 2)	2	2
bus extension (note 3)	2	2
I/O	27	23

- **NOTE 1:**

- 140CRA31200: This adapter module consumes 1 slot in the main (first) rack in Quantum remote drops. The extended (second) rack in a Quantum remote I/O drop does not require an adapter.
- BMXCRA312•0: This adapter module supports a Modicon X80 remote I/O drop with 2 racks when a bus extender module is in both the main and extended racks.

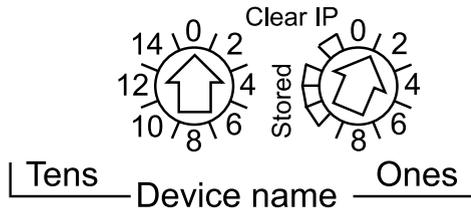
- **NOTE 2:** A power supply consumes 1 dedicated slot in each rack in Quantum and Modicon X80 remote I/O drops.
- **NOTE 3:** A bus extender module is required for each rack in remote I/O drops. In Quantum remote I/O drops, the bus extender consumes 1 rack slot. In Modicon X80 remote I/O drops, the bus extender attaches to the end of the rack and does not consume a rack slot.

Refer to the list of modules that remote I/O installations support ([see page 24](#)).

Setting the Location of the Ethernet Remote I/O Drop

Setting Rotary Switches

Set the location of the Ethernet remote I/O drop on the network with the rotary switches on the front of the 140CRA31200 or BMXCRA312•0 adapter module before you apply power to the module and before you download the application:



The values you set are applied during a power cycle. If you change the switch settings after the module has powered up, the Mod Status LED is activated and a mismatch message is logged in the module diagnostic.

Because new values on the rotary switches are implemented only at the next power cycle, we recommend that you set the value before starting the module. (Valid values: 00 ... 159)

The values on the rotary switches combine with the device prefix (for example, 140CRA_XXX or BMXCRA_XXX) to create the device name (where XXX represents the value of the rotary switches). The preceding figure shows the Tens switch set to 0 and the Ones switch set to 01, for a device name of 140CRA_001.

NOTE:

- The rotary switches can be manipulated with a small flat-tipped screwdriver.
- No software is required to configure or enable the rotary switches.
- Do not use the Stored and Clear IP settings on the Ones rotary switch. (The functionality of these settings does not apply to remote I/O installations.)

Section 2.3

Remote I/O Infrastructure Cables

What Is in This Section?

This section contains the following topics:

Topic	Page
Cable Installation	44
Duplicate IP Address Checking	46
Loss of I/O Connection	47

Cable Installation

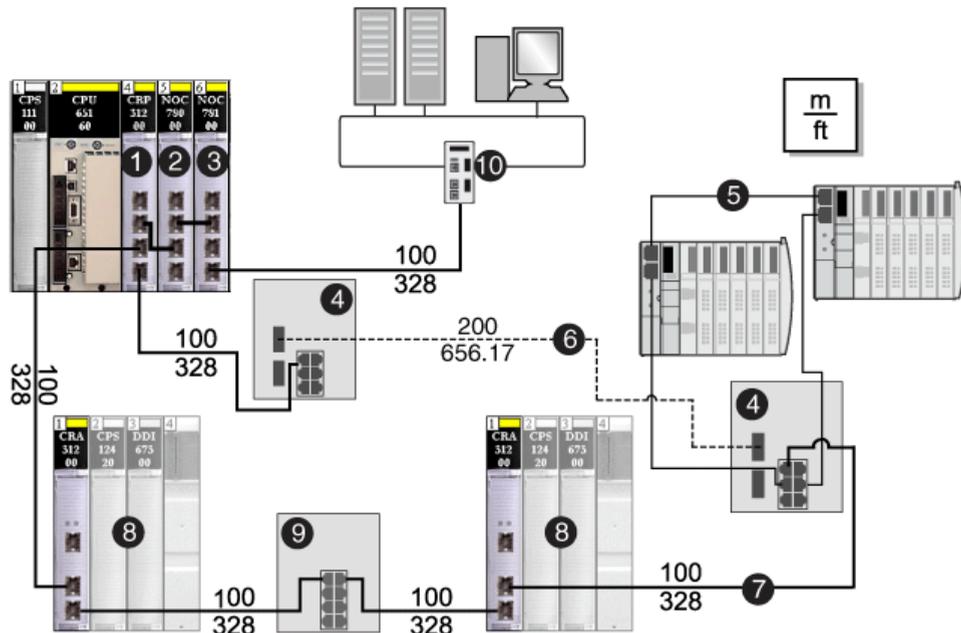
Introduction

Observe these guidelines when making cable connections between remote I/O devices on a Quantum EIO installation. (Remote I/O devices include local racks, remote I/O drops, or DRSs.)

A copper cable connection between 2 consecutive remote I/O devices cannot exceed 100 m. A fiber cable connection between 2 consecutive remote I/O devices cannot exceed 15 km (single mode) or 2.5 km (multi-mode).

Connections Between Devices

This figure shows the distances between remote I/O devices in Quantum EIO installations:

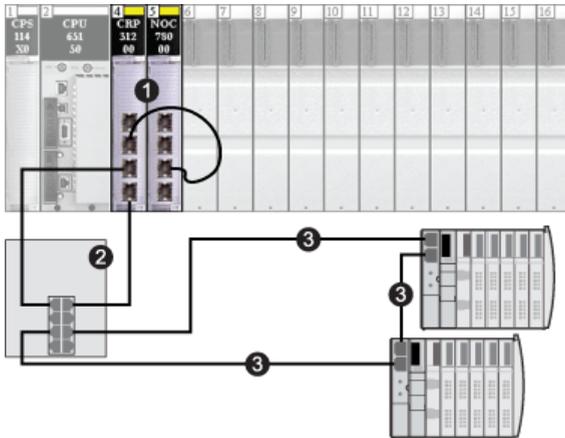


- 1 140CRP31200 remote I/O head module
- 2 140NOC78000 distributed I/O head module
- 3 140NOC78100 control head module
- 4 DRS (with copper and fiber ports): This DRS extends the distance between devices using fiber cable (up to 15 km).
- 5 distributed I/O sub-ring connected to the main ring via (4)
- 6 fiber cable portion of the main ring used to separate the DRSs beyond 15 km
- 7 copper cable (twisted pair) portion of the main ring
- 8 remote I/O drop
- 9 DRS (with copper ports only): This DRS extends the distance between devices.
- 10 control network

NOTE: We recommend the use of shielded twisted pair CAT5e (10/100 Mbps) cables, ideally ConneXium 490NT•000••.

Interlink

To support distributed I/O sub-rings in Quantum EIO installations, establish an interlink between an Ethernet communication module on the local rack and the 140CRP31200 remote I/O head module:



- 1 local rack, including a 140 NOC 780 00 distributed I/O head module that is interlinked with a 140CRP31200 remote I/O head module
- 2 DRS connected to the main ring and a distributed I/O sub-ring
- 3 distributed I/O sub-ring

NOTE: For the interlink connection, we recommend the use of shielded twisted pair CAT5e (10/100 Mbps) cables.

Duplicate IP Address Checking

Introduction

Each Quantum EIO module has a single IP address. Therefore, the address conflict detection algorithm (also called duplicate IP checking) is performed based on the status (link up, link down) of the ports.

Link Down

These conditions apply when links are lost:

Link Status	Description
A transition has occurred from 1 connected link to all links down.	When no module ports are connected to a cable (all links are down), all services are reset. For example, I/O connections, Modbus connections, and explicit EtherNet/IP connections close, but low-level network services (like RSTP or switches) are not affected. The updated Net Status LED indicates the status.
There is 1 link down and at least 1 connected link.	There is no impact on services that are running in the module.

Link Up

These conditions apply when links are added:

Link Status	Description
A transition has occurred from no connected links to 1 connected link.	A duplicate IP check is performed: <ul style="list-style-type: none"> ● <i>no duplicate</i>: All services start. ● <i>duplicate</i>: I/O services stop. The 140CRA31200 or BMXCRA312•0 adapter module gets new configuration and downloads the IP configuration again. The system goes to default IP and I/O modules are set to fallback mode.
A transition has occurred from at least 1 connected link to an additional connected link.	A duplicate IP check is performed: <ul style="list-style-type: none"> ● <i>no duplicated</i>: All services continue. ● <i>duplicate</i>: All services stop. <p>NOTE: The updated Net Status LED indicates the status.</p>

Loss of I/O Connection

Conditions

An I/O connection can be lost under these conditions:

Condition	CPU	140CRP31200	Adapter Module (140CRA31200 or BMXCRA312*0)
<ul style="list-style-type: none"> Perform a hot swap. Replace a module of the same type. 	X	X	X
There is no remote I/O cable connection.		X	X
The I/O connection is closed.*			X
*Hot swap of the CPU results in an explicit close (lost I/O connection).			

Remote Adapter Fallback

In some instances, the 140CRA31200 or BMXCRA312*0 adapter module on the remote I/O drop can lose I/O connections for a period longer than the configured hold up time. During the hold up, the adapter tries to get IP and configuration parameters from the 140CRP31200. If the adapter does not obtain those parameters, it gets these results:

- inputs*: retain last known values
- outputs*: set to fallback

NOTE: Configure the hold up time on the Control Expert **Parameter** tab ([see page 71](#)).

Chapter 3

Configuration and Programming with Control Expert

Introduction

Use Control Expert to configure your local rack and remote drops for Ethernet communications.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
3.1	Creating a Control Expert Project	50
3.2	Control Expert Configuration for Remote I/O Ethernet Modules	58
3.3	Control Expert Configuration for Ethernet Remote I/O Drops	67
3.4	Derived Data Types	77
3.5	Elementary Functions (EFs) and Function Blocks (EFBs)	89
3.6	Application Download	91

Section 3.1

Creating a Control Expert Project

Introduction

Use the instructions in this section to create a Control Expert project that allows communication between a local rack and an Ethernet remote I/O drop. Here are the basic stages of the Control Expert configuration:

1. Select a high-end Quantum processor to create a new Control Expert configuration.
2. Add a power supply to the local rack.
3. Add an Ethernet remote I/O head module (140 CRP 312 00) to the local rack.
4. Configure a rack assembly for the Ethernet remote I/O drop.

NOTE: These instructions assume that you have a working knowledge of Control Expert.

What Is in This Section?

This section contains the following topics:

Topic	Page
Configuring the Local Rack	51
Configuring the Ethernet Remote I/O Drop	53
Available Control Expert Configuration Tabs	55
NTP Configuration in Control Expert	56

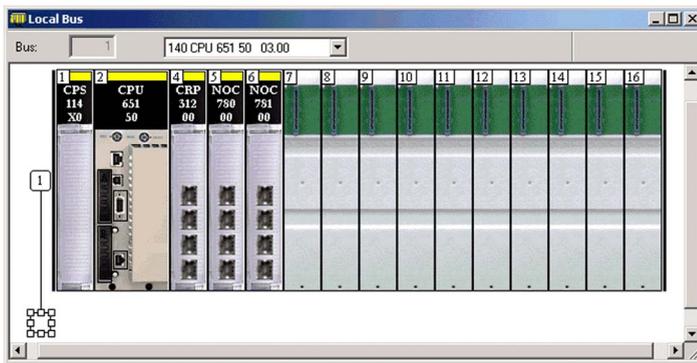
Configuring the Local Rack

Assemble a Local Rack

In Control Expert, assemble a Quantum rack:

Step	Action	Comment
1	In Control Expert, create a project.	Click File → New . Result: The New Project window appears.)
2	Add a PLC from the New Project window.	For this example, double-click the 140 CPU 651 50 module. (New Project → Quantum → 140 CPU 651 50).
3	In the Project Browser , double-click Local Bus .	Click Tools → Project Browser → Configuration → Local Bus . Result: The Local Bus window opens, and the rack includes the processor you selected.)
4	Add a power supply to the Local Bus .	Drag the module to slot 1. (Tools → Hardware catalog → Local Quantum Drop → Supply → 140 CPS 114 X0)
5	Add a 140 CRP 312 00 remote I/O head module to an available slot in the local rack.	Drag the module to slot 4. (Tools → Hardware catalog → Local Quantum Drop → Communication → 140 CRP 312 00)
6	Use the same method to add a 140 NOC 780 00 distributed I/O head module to the Local Bus .	Drag the module to slot 5. (Tools → Hardware catalog → Local Quantum Drop → Communication → 140 NOC 780 00)
7	Double-click any empty slot to add modules to the Local Bus .	This step is optional, but you can provide Ethernet transparency between the device network and the control network by adding a 140 NOC 781 00 control head module to the local rack.
8	Save the file.	Click File → Save .

The local rack in your Control Expert configuration should look like this:



Note that the **Local Bus** contains these modules:

- power supply (140 CPS 114 •0)
- CPU (140 CPU 651 50)
- remote I/O head module (140 CRP 312 00)
- distributed I/O head module (140 NOC 780 00)
- control head module (140 NOC 781 00)

Rack Parameters

Double-click the 140 CRP 312 00 module in the **Local Bus** window to access these configuration parameters for the local rack:

- IP Config (*see page 59*)
- RSTP (*see page 61*)
- SNMP (*see page 62*)
- NTP (*see page 56*)
- Service port (*see page 64*)
- Device DDT (*see page 74*)

NOTE: You can accept the automatically assigned IP address or change the IP address in the Control Expert **IP Config** tab.

Rack Considerations

Remember:

- The copy/cut/paste commands are not available for the 140CRP31200 module.
- You can cut or copy other devices in the local rack or the drop and paste them in any rack of the same type. You can perform these actions (cut, copy, paste) only in the same device editor. You cannot move objects from the local rack to the drop or vice-versa.
- The number of the first slot in a rack is 1. Therefore, a 4-slot rack has slot numbers 1, 2, 3, 4.

NOTE: If you use a low-end CPU (140 CPU 6• 1••) (2 Mb or less), you can only install a maximum of 31 remote I/O drops. Of those 31 drops, you can only install a maximum of sixteen BMXCRA312•0 remote I/O drops. If you use a high-end CPU (140 CPU 6•• ••) (4 Mb or more), you can install a maximum of thirty-one BMXCRA312•0 or 140CRA31200 remote I/O drops.

Configuring the Ethernet Remote I/O Drop

Instructions

In the previous topic, you added a 140CRP31200 module to the local rack in a Control Expert project (*see page 51*). The 140CRP31200 remote I/O head module supports communication with an Ethernet remote I/O rack.

When you insert a 140CRP31200 module in the local rack, Control Expert automatically creates an **EIO Bus**, which has the same capabilities as an existing S908 legacy remote I/O bus.

In the **EIO Bus**, you can select a Quantum drop or an Modicon X80 drop.

Within an Modicon X80 drop, the BMXCRA31200 adapter module is inserted by default. This module supports only standard digital and analog modules. Insert a BMXCRA31210 module from the **Drop end communicator** field if you require more functionality, such as the following:

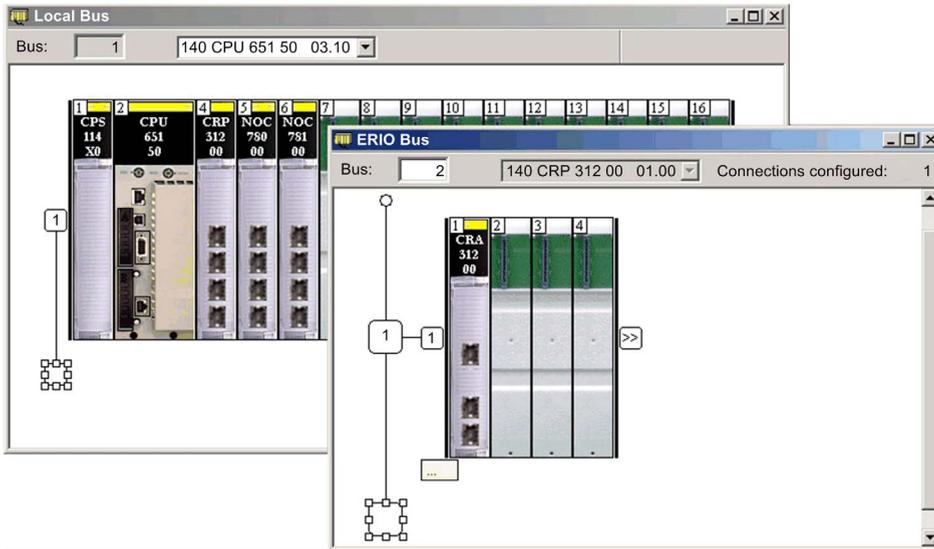
- service port (*see page 21*)
- expert modules
- time stamping (*see page 56*)
- CCOTF

NOTE: If you use a low-end CPU (140 CPU 6• 1••) (2 Mb or less), you can only install a maximum of 31 remote I/O drops. Of those 31 drops, you can only install a maximum of sixteen BMXCRA312•0 remote I/O drops. If you use a high-end CPU (140 CPU 6•• ••) (4 Mb or more), you can install a maximum of thirty-one BMXCRA312•0 or 140CRA31200 remote I/O drops.

Use these instructions to configure a remote rack (**EIO Bus**) that includes a 140CRA31200 or BMXCRA312•0 adapter module in slot 1:

Step	Action	Comment
1	In the Project Browser , double-click EIO Bus to see the (empty) drop.	(Tools → Project Browser → Structural view → Project → Configuration → EIO Bus)
2	In the EIO Bus window, double-click the square link connector to access the available racks.	The New Device window appears.
3	Select a rack for a Quantum Ethernet I/O drop or a Modicon X80 Ethernet I/O drop. NOTE: If you select a Modicon X80 drop, also choose a BMXCRA31200 or BMXCRA31210 adapter module in the Drop end communicator field of the New Device window.	This example uses the 4-slot 140 XBP 004 00 rack: New Device → Part Number → EIO Quantum Drop → Rack → 140 XBP 004 00 . Select the device and press OK .
4	Double-click any empty slot to add modules to the EIO Bus .	For this example, this step is optional.
5	Save the file.	Click File → Save .

The Control Expert configuration now includes the remote rack window (**EIO Bus**). Because the Ethernet remote I/O drop requires a module for communication with the local rack, Control Expert automatically adds an adapter module in slot 1.



Rack Parameters

The adapter module is now installed as the communications adapter module of your Ethernet remote I/O drop. Double-click the adapter to see its configuration tabs:

- RSTP (*see page 61*)
- SNMP (*see page 62*)
- Service port (*see page 64*)

Rack Considerations

Remember these points:

- You can insert 2 racks on a Modicon X80 Ethernet remote I/O drop with a BMXCRA31210. You can only insert 1 rack with a 140CRA31200 module.
- Control Expert automatically inserts BMXCRA312*0 adapter modules in slot 0. You cannot delete or move these modules.
- The number of the first slot in a Quantum rack is 1. The number of the first slot in a Modicon X80 rack is 0. Therefore, a 4-slot Quantum rack includes slot numbers 1, 2, 3, 4, and a 4-slot Modicon X80 rack includes slot numbers 0, 1, 2, 3.
- You can cut or copy other devices in the remote drop and paste them in any rack of the same type. You can perform these actions (cut, copy, paste) only in the same device editor. You cannot move objects from the local rack to the drop or vice-versa.

Available Control Expert Configuration Tabs

About the Parameters

The Control Expert configuration tabs are available after you have configured these:

- local rack (including a 140CRP31200 remote I/O head module) (*see page 51*)
- Ethernet remote I/O drop (including a 140CRA31200 or BMXCRA312•0 remote I/O adapter module) (*see page 53*)

Control Expert Configuration Tabs

This table indicates the available Control Expert configuration tabs for the local rack's 140 CRP 312 00 head module and the remote I/O drop's adapter module:

Control Expert Tab	140CRP31200 Head Module (Local Rack)	•••CRA312•0 Adapter Module (Remote I/O Drop)
IP Config (<i>see page 59</i>)	X	(See note.)
RSTP (<i>see page 61</i>)	X	X
SNMP (<i>see page 62</i>)	X	X
Service port (<i>see page 64</i>)	X	X
Device DDT (<i>see page 77</i>)	X	X
Time Stamping (<i>see page 56</i>)	X	X (BMXCRA31210 only)
NOTE: The adapter module (140CRA31200 or BMXCRA312•0) automatically receives an IP address. To maintain unique addressing on the network, keeping and using the auto-assigned IP addresses is generally considered a good practice.		

NTP Configuration in Control Expert

Introduction

This topic describes the Control Expert NTP (time stamp) parameters for the BMXCRA31210 module. To access these parameters on the Control Expert **NTP** tab, double-click the communication module in the local rack (*see page 51*).

Access the NTP Tab

To access the **NTP** tab, open the **Bus Editor**, double click on the **CRP** module and then select the **NTP** tab:

Field	Parameter	Value	Comment
NTP server configuration for adapter modules	IP address of Primary NTP Server	a.b.c.d (0.0.0.0)	entered value
	IP address of Secondary NTP Server		
	Polling period	1, 120 (5)	
online behavior	—	—	disabled in connected mode
NOTE: For time zones that support daylight saving time (DST), the default value is enabled (checked). It is disabled (unchecked) for all time zones that don't support DST.			

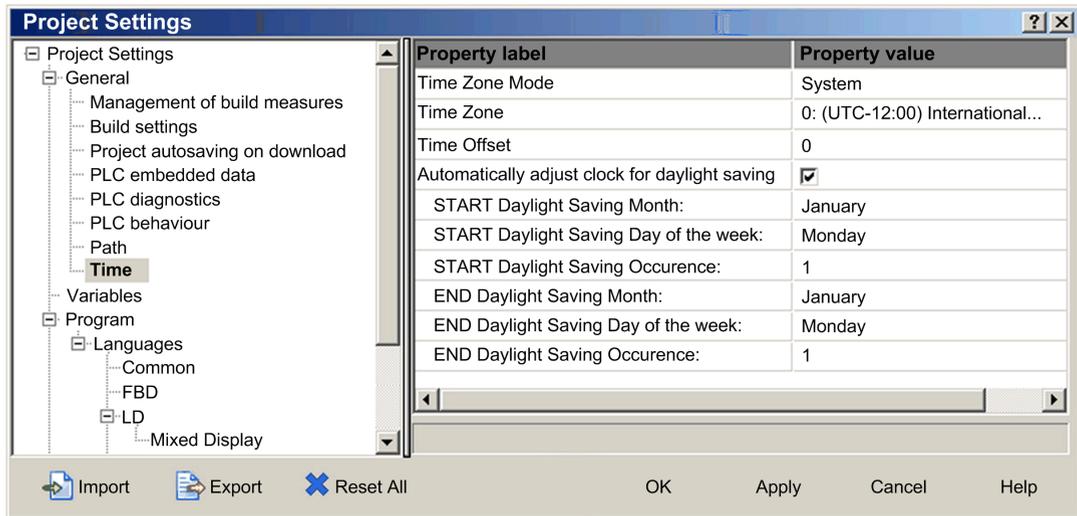
Valid IP addresses for NTP servers:

- 1.0.0.0 ... 126.255.255.255
- 128.0.0.0 ... 223.255.255.255

For any other IP address, a detected error is reported. Addresses 224.0.0.0 and higher are experimental multicast addresses. Addresses starting at 127 are loopback addresses.

Setting the Time Zone

Set the time zone in the **Project Settings** window:



Set the time zone:

Step	Action
1	In Control Expert, select Tools → Project Settings .
2	Expand the General menu in the Projects Settings window, and select the Time setting.
3	Select the appropriate values for each time zone property.
4	Click Apply to save changes, or click OK to save changes and close window.

Section 3.2

Control Expert Configuration for Remote I/O Ethernet Modules

Overview

This section describes the module configuration tabs in Control Expert. Use the parameters on these tabs to configure services for the 140CRP31200 module in the local rack and the adapter module (140CRA31200 or BMXCRA312•0) in Ethernet remote I/O drops.

What Is in This Section?

This section contains the following topics:

Topic	Page
IP Configuration	59
RSTP Bridge Configuration	61
SNMP Agent Configuration	62
Service Port Configuration	64

IP Configuration

Access the IP Config Tab

The Control Expert IP configuration parameters apply to the 140CRP31200 head module in the local rack. To access the **IP Config** tab, double-click on the 140CRP31200 module (*see page 51*):

The screenshot shows the IPConfig window with the following fields and table:

IP address configuration

- IP address A: 192.168.10.1
- IP address B: 0.0.0.0 (used for Hot Standby)
- Subnetwork mask: 255.255.255.255
- Gateway address: 0.0.0.0

CRA IP address configuration

Drop No	Device Name	IP Address
1	140CRA_001	192.168.10.2

IP Config Parameters

Configure the IP parameters for the 140CRP31200 head module in the **IP address configuration** field on the **IP Config** tab:

Parameter	Description	Default Value
IP address A	The address corresponds to the 140CRP31200 module.	192.168.10.1
IP address B	This address is used for Hot Standby configurations. NOTE: If you change IP address A, the system may recalculate all IP addresses (including those of the drops) to keep all devices in the same subnet.	IP address A + 1
Subnetwork mask	This bit mask identifies or determines the IP address bits that correspond to the network address and the subnet portion of the address. (The value can be changed to any valid value in the subnetwork.)	255.255.0.0
Gateway address	This is the IP address of the default gateway to which messages for other networks are transmitted.	0.0.0.0 (when not used)

Configure the IP parameters for the adapter module (in the remote drop) in the **CRA IP address configuration** field on the **IP Config** tab:

Parameter	Description	Default Value
Drop No.	drop number	—
Device Name	device name (140CRA31200 or BMXCRA312*0 adapter)	—
IP Address	When an Ethernet remote I/O drop is added, the adapter module is automatically assigned an IP address. (You can change this IP address in the IP Address column, but we recommend that you accept the automatically assigned IP address.)	—

RSTP Bridge Configuration

About RSTP

Use RSTP to design a network with redundant cabling so that remote I/O communications automatically find an alternate path if a communication disruption occurs (for example, a cable breaks or a device becomes inoperable). This method does not require you to manually enable or disable communication paths.

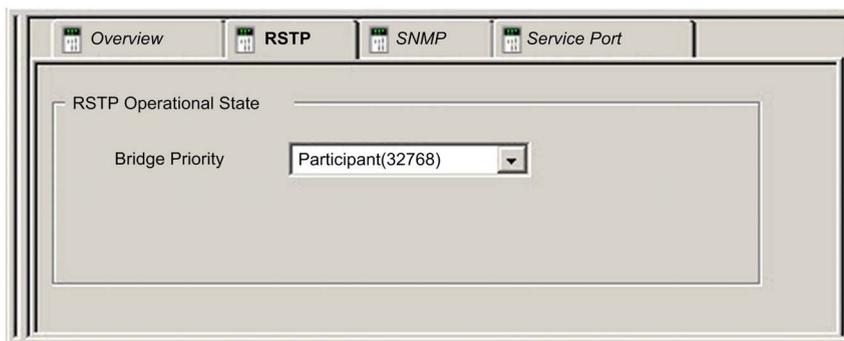
Changing these parameters can affect sub-ring diagnostics, I/O determinism, and network recovery times.

Access the RSTP Tab

You can access the **RSTP** parameters in Control Expert by double-clicking these modules in the Control Expert rack view:

- head module on the local rack (140CRP31200)
- adapter module on the remote drop (140CRA31200 or BMXCRA312•0)

The **RSTP** tab appears:



Parameters

This table shows the **Bridge priority** parameters for the **RSTP Operational State** on the Control Expert **RSTP** tab:

Bridge Priority	Value	140CRP31200	Adapter Module
Root	0	default	—
Backup Root	4096	for Hot Standby (automatic)	—
Participant	32768	—	default

NOTE: In Hot Standby systems, the RSTP bridge priority is applied to the 140CRP31200 module in rack A.

SNMP Agent Configuration

About SNMP

Use the **SNMP** tab in Control Expert to configure SNMP parameters for these Quantum Ethernet I/O modules:

- head module on the local rack (140CRP31200)
- adapter module on the remote drop (140CRA31200 or BMXCRA312•0)

An SNMP v1 agent is a software component of the SNMP service that runs on these modules to allow access to diagnostic and management information for the modules. You can use SNMP browsers, network management software, and other tools to access this data. In addition, the SNMP agent can be configured with the IP addresses of 1 or 2 devices (typically PCs that run network management software) to be the targets of event-driven trap messages. Such messages inform the management device of events like cold starts and the inability of the software to authenticate a device.

Access the SNMP Tab

Double-click these modules in the Control Expert configuration to access their **SNMP** tabs:

- 140CRP31200 head module (local rack)
- 140CRA31200 or BMXCRA312•0 adapter module (remote drop)

The **SNMP** tab appears:

Use the **SNMP** tab to configure the SNMP agents for the communication modules in the local rack and remote drop. The SNMP agent can connect to and communicate with 1 or 2 SNMP managers as part of an SNMP service. The SNMP service includes:

- authentication checking, by the Ethernet communication module, of any SNMP manager that sends SNMP requests
- management of events or traps

SNMP Parameters

These parameters are found on the Control Expert **SNMP** tab:

Field	Parameter	Description	Value
IP Address managers	IP Address manager 1	The address of the first SNMP manager to which the SNMP agent sends notices of traps.	0.0.0.0 ... 255.255.255.255
	IP Address manager 2	The address of the second SNMP manager to which the SNMP agent sends notices of traps.	
Agent	Location (SysLocation)	device location	31 characters (maximum)
	Contact (SysContact)	description of the person to contact for device maintenance	
	Enable SNMP manager	unchecked (default): You can edit the Location and Contact parameters. checked: You cannot edit the Location and Contact parameters.	checked/unchecked
Community names	Set	password that the SNMP agent requires to read commands from an SNMP manager (default = Public)	15 characters (maximum)
	Get		
	Trap		
Security	Enable "Authentication failure" trap	unchecked (default): not enabled. checked (enabled): The SNMP agent sends a trap notice to the SNMP manager if an unauthorized manager sends a Get or Set command to the agent.	checked/unchecked

Online Behavior

Tests are done to verify that the IP addresses of the managers are not:

- multicast
- loopback
- broadcast

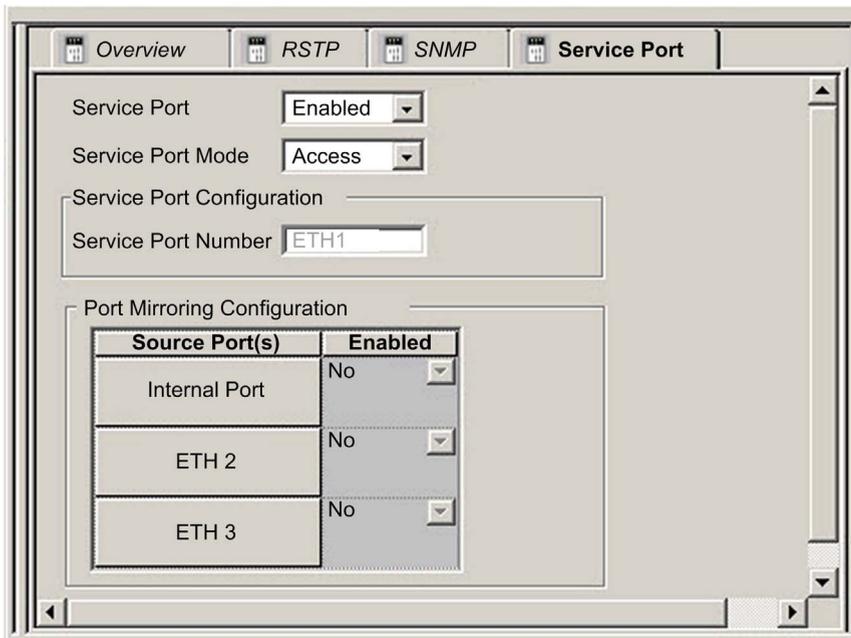
Service Port Configuration

Access the Service Port Tab

Double-click these modules in the Control Expert rack view to access the Control Expert **Service Port** tab:

- head module on the local rack (140CRP31200)
- adapter module on the remote drop (140CRA31200 or BMXCRA31210)

The **Service Port** tab appears:



Service Port Parameters

These parameters are on the Control Expert **Service Port** tab:

Field	Parameter	Value	Comment
Service Port	Enabled	—	Enable port and edit port parameters.
	Disabled	—	Disable port parameters.
Service Port Mode	Access (default)	—	This mode supports Ethernet communications.
	Mirroring	—	In port mirroring mode, data traffic from one or more of the other ports is copied to this port. A connected tool can monitor and analyze port traffic. NOTE: In this mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE port.
Access Port Configuration	Service Port Number	ETH1	You cannot edit the value in the Service Port Number field.
Port Mirroring Configuration	Source Port(s)	Internal Port	all Ethernet traffic for the module
		ETH2	140CRP31200: all INTERLINK port traffic
			adapter modules: Ethernet traffic through the first remote I/O port
		ETH3	140CRP31200: Ethernet traffic through the first remote I/O port
			adapter modules: Ethernet traffic through the second remote I/O port
ETH4	adapter modules: Ethernet traffic through the second remote I/O port (140CRP31200 only)		

On Line Behavior

The **Service Port** parameters are stored in the application, but you can reconfigure (change) the parameters in connected mode. Values that you reconfigure in connected mode are sent to the remote drop's adapter module or 140CRP31200 head module in explicit messages. (The changed values are not stored, so a mismatch can exist between the parameters that are being used and those that are in the stored application.) If the module does not respond to the explicit messages, a message appears.

Limitations

The SERVICE port on the 140CRP31200 head module and the adapter modules have the same limitations as the cloud port of the dual-ring switch (DRS). Therefore, the module's cloud port and the DRS's cloud port can be connected to the same equipment.

The maximum load the module can process from distributed I/O devices:

- 5 Mbps: per SERVICE port
- 20 Mbps: total distributed I/O traffic on the main ring

For more information about considerations that apply to the use of the distributed I/O cloud port and the service port on the DRS, refer to the *Predefined Configuration Files* topic in the *Quantum Ethernet I/O System Planning Guide*.

Section 3.3

Control Expert Configuration for Ethernet Remote I/O Drops

Introduction

This section discusses the use of Control Expert to configure the Ethernet remote I/O drop and its adapter module. It includes descriptions of the parameters on the **Configuration**, **Parameter**, and **Device DDT** tabs in Control Expert.

NOTE: These instructions assume that you have already added a remote I/O drop to your Control Expert project (*see page 40*).

What Is in This Section?

This section contains the following topics:

Topic	Page
Configuring the Size and Location of Data	68
Configuring the Parameters	70
Device DDT Parameters	74
Time Stamping	76

Configuring the Size and Location of Data

Introduction

Use the Control Expert **Configuration** tab to configure the size and location of data for an Ethernet remote I/O drop that includes a 140CRA31200 or BMXCRA312•0 remote I/O adapter module.

NOTE: These instructions assume that you have already added a drop to your Control Expert project (*see page 53*).

Access the Configuration Tab

Access the **Configuration** parameters in Control Expert:

Step	Action	Comment
1	Expand (+) the EIO Bus in the Control Expert Project Browser .	(Project Browser → EIO Bus → EIO Quantum Drop/EIO Modicon X80 Drop)
2	Double-click the Quantum EIO drop.	The EIO drop window appears. It contains the parameter tabs from the Ethernet remote I/O drop.
3	Select the Configuration tab.	The Configuration tab is available for the Quantum EIO drop only.

The **Configuration** tab shows the **Parameter Name** and the corresponding **Value**:

Parameter Name	Value
Starting address status table	0
Ending address status table	0
In Bytes	0
Out Bytes	0

Configuration Parameters

On the Control Expert **Configuration** tab, configure these parameters for the Ethernet remote I/O Quantum drop:

Parameter Name	Value
Starting address status table	the first register in the status table (configured)
Ending address status table	the starting address + the maximum number of addresses for the configured rack size
In Bytes	the total number of bytes for input modules in the remote I/O drop
Out Bytes	the total number of bytes for output modules in the remote I/O drop

NOTE: These parameters do not apply to Modicon X80 drops.

Configuring the Parameters

Parameter Tab (Remote I/O Drop)

This topic describes the Control Expert **Parameter** tab for an Ethernet remote I/O drop that includes a 140CRA31200 or BMXCRA312•0 adapter module.

NOTE: These instructions assume that you have already added a drop to your Control Expert project (*see page 53*).

Access the Parameter Tab

Access the **Parameter** tab in Control Expert:

Step	Action	Comment
1	Expand (+) EIO Bus in the Control Expert Project Browser .	Path: Project Browser → EIO Bus → EIO Quantum Drop/EIO Modicon X80 Drop
2	Double-click the EIO drop (Quantum or Modicon X80).	The EIO drop window appears. It contains the parameter tabs for the remote I/O drop.
3	Select the Parameter tab.	

The **Parameter** tab appears:

Parameter

Address information

Device Name: 140CRA_001 Tens: 0 Ones: 1

IP Address: 192 . 168 . 10 . 2

Sub Network: 255 . 255 . 255 . 0

Hold up time

Hold up time: 1,000 ms

Connection parameter

Custom RPI (see help for information)

CRA -> CRP RPI: 62 ms Application trigger

CRP -> CRA RPI: 62 ms

Parameter Descriptions

Use the Control Expert **Parameter** tab to configure the following parameters for the Ethernet remote I/O drop.

Address information parameters:

Parameter	Comment
Device Name	<p>The device name of the device includes a fixed device prefix and a number provided by the rotary switch. Valid device names conform to this structure:</p> <ul style="list-style-type: none"> ● 140CRA_XXX ● BMXCRA_XXX <p>Remember that <i>xxx</i> equals the 3-digit value selected on the rotary switches, so the device name includes the device prefix (140CRA or BMXCRA) plus that value.</p> <p>When the device is placed on the Ethernet remote I/O drop, the number is set to the device number. The device number does not change when the device moves to a new location. Valid device numbers are unique within the application. A message like this appears when analysis reveals redundant device numbers:</p> <pre>{EIO Bus (2) 140 CRA 312 00}: Device name is not unique</pre> <p>NOTE: The device number does not change if you move the drop, but you can modify the number. However, if you modify the number, the link breaks between the device name and the drop number. Schneider Electric recommends that you allow the drop number to equal the device name, even if it can be modified.</p>
IP Address	<p>You cannot edit the IP address and Sub network (mask) fields. The IP address is editable only in the IP Configuration tab (see page 59) of the 140CRP31200 module. The value for Sub network is deduced from the 140CRP31200 sub network mask.</p>
Sub Network	

Hold up time parameter:

Parameter	Comment
Hold up time	<p>The hold up time represents the time (ms) that device outputs are maintained in their current states after a communication disruption and before taking their fallback values:</p> <ul style="list-style-type: none"> ● default value: 1000 ms ● valid value range: 50...65,530 ms

The minimum holdup time differs for standalone and Hot Standby systems. If you assign a holdup time value that is less than the recommended minimum value, you can send an I/O module to the fallback state. When communications are restored, the I/O module restarts and may not operate as anticipated.

 **WARNING**

UNINTENDED EQUIPMENT OPERATION

Do not configure a holdup time value that is less than the recommended minimum value for standalone or Hot Standby systems:

- standalone systems:
 - periodic application: 4.4 x PLC scan time
 - cyclic application: configured watchdog value
- Hot Standby systems: configured watchdog value + PLC scan time

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

Connection parameters:

Parameter	Comment
Custom RPI	Check this box to configure the CRA->CRP RPI value. NOTE: The minimum CRA->CRP RPI value is 5 ms. NOTE: Only change the CRA->CRP RPI value if you are using the IU_ERIO function block (<i>see page 103</i>).
CRA->CRP RPI	Inputs: The RPI is the input refresh rate at which the adapter module sends inputs to the 140CRP31200 module. The RPI is set in the subscribe field for the adapter on the remote I/O drop. <ul style="list-style-type: none"> ● <i>periodic mode:</i> default value = 1/2 MAST period ● <i>cyclic mode:</i> default value = 1/4 MAST watchdog timeout period ● <i>valid values:</i> 5...1500 (ms) You can configure this value when Custom RPI is checked.

Parameter	Comment
CRP->CRA RPI	<p>Outputs: Outputs are passed from the 140CRP31200 module to the adapter. Set the output refresh rate with the Application Trigger value (CRP->CRA RPI) at the end of the CPU MAST task:</p> <ul style="list-style-type: none"> ● <i>periodic mode</i>: default value = 1.1 * MAST period. The value output is sent at the end of the actual MAST period. ● <i>cyclic mode</i>: default value = 1/4 * watchdog timeout period. The value output is sent at the end of the actual MAST period. <p>NOTE: The default value for the watchdog timer is 250 ms. If the MAST task does not finish within the watchdog period, the process times out. If the watchdog is greater than 4 times the MAST period, the drops could switch to fallback while the CPU is running. For example, MAST period = 20 ms, logic execution = 90 ms, watchdog time = 100 ms.</p> <p>You cannot edit this value. All outputs are published synchronously or at the execution of the MAST task:</p> <ul style="list-style-type: none"> ● synchronously: immediately at the end of the MAST task ● execution of IU_ERIO: You can only generate outputs when you use the IU_ERIO function block (<i>see page 103</i>). (See the note below.)

NOTE:

- When the **Periodic** mode is selected for the MAST task, the **Period** value allows the complete execution of the logic. (The MAST can overrun when its execution time exceeds this value.) Valid values: 1...255 ms (increment: 1 ms).
- When **Cyclic** mode is selected for the MAST task, the outputs are sent upon the completion of the task. The **Watch Dog** value (10 ... 1500 ms, default = 250) should be greater than the execution time. Valid values: 10...1500 ms (increment: 10 ms, default = 250 ms).

Device DDT Parameters

Device DDT Parameters (Remote I/O Drop)

This topic describes the Control Expert **Device DDT** tab for an Ethernet remote I/O drop that includes a 140CRA31200 or BMXCRA312*0 adapter module. A derived data type (DDT) is a set of elements with the same type (`ARRAY`) or with different types (structure).

The device DDT instance name can be defined manually but, when adding a module, a default device DDT instance name (see *EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual*) is defined by Control Expert

NOTE:

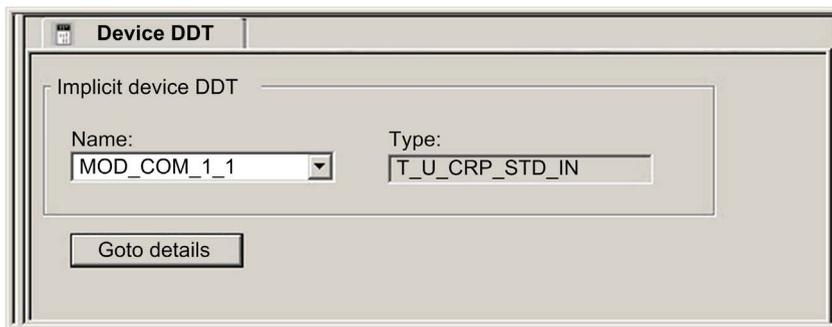
- These instructions assume that you have already added a drop to your Control Expert project (see page 53).
- Refer to the Derived Data Types chapter (see page 77) to create, update, and view derived data types.

Access the Device DDT Tab

Access the **Device DDT** parameters in Control Expert:

Step	Action	Comment
1	Expand (+) EIO Bus in the Control Expert Project Browser	Path: Project Browser → EIO Bus → EIO Quantum Drop/EIO Modicon X80 Drop
2	Double-click on the EIO drop (Quantum or Modicon X80).	The EIO drop window appears. It contains the parameter tabs for the remote I/O drop.

Example of the **Implicit device DDT** area which contains a name and a type.



Parameters

Use the Control Expert **Device DDT** tab to configure these parameters for the adapter on the remote I/O rack:

Parameter		Description
Implicit device DDT	Name	<p>A default device DDT instance name (<i>see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual</i>) is defined by Control Expert.</p> <p>NOTE:</p> <ul style="list-style-type: none"> ● There are 2 device DDT types for Ethernet remote I/O drops in a Quantum system: <ul style="list-style-type: none"> ○ 140CRA31200 adapter: T_U_DROP_STD_IN ○ BMXCRA312•0 adapter: T_M_DROP_EXT_IN ● There is 1 device DDT type for a Quantum Ethernet remote I/O drop in an M580 system: <ul style="list-style-type: none"> ○ 140CRA31200 adapter: T_Q_DROP_EXT_IN
	Type	module type (uneditable)
Goto details		link to the DDT data editor screen

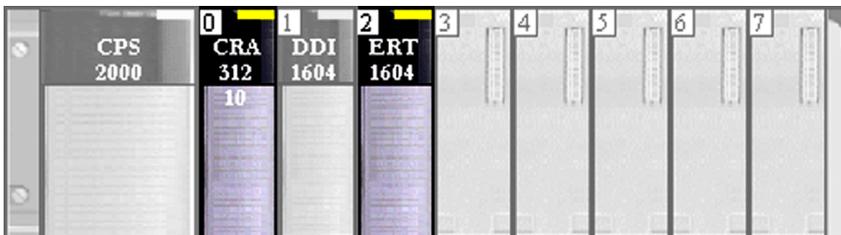
Time Stamping

Time Stamp Module

Use these modules on an Ethernet remote I/O drop:

- Modicon X80 BMXCRA31210 adapter module with a BMX ERT 1604 time stamp module
- Quantum 140CRA31200 adapter module with a 140 ERT 1604 module

This sample rack configuration in Control Expert shows a Quantum EIO drop with the required 140 ERT 1604 module:



Configuration

Double-click the BMX ERT 1604 in the remote rack to see the time stamp **Configuration** tab.

0.1: BMX ERT 1604

DIG 16I 24/125VDC TSTAMP

BMX ERT 1604

- Channel 0 - Time Stamping
- Channel 4 - Time Stamping
- Channel 8 - Time Stamping
- Channel 12 - Time Stamping

Function:
Time Stamping

Task:
MAST

Configuration

	Symbol	Symbol	Value	Unit
0	Debounce filter type		Steady state	
1	Dechatter filter		Disable	
2	Channel 4 used		Enable	
3	Channel 4 edge		Both edges	
4	Channel 4 debounce time		1	ms
5	Channel 4 chatter count		1	
6	Channel 4 chatter time		1	100 ms
7	Channel 5 used		Enable	
8	Channel 5 edge		Both edges	
9	Channel 5 debounce time		1	ms
10	Channel 5 chatter count		1	

NOTE: For more information about time stamping with the BMXCRA31210 modules, refer to the *BMXERT1604T M340 ERT Module User Manual*.

Section 3.4

Derived Data Types

Overview

This chapter describes how to complete your Control Expert project by creating, updating, and viewing derived data type (DDT) variables.

What Is in This Section?

This section contains the following topics:

Topic	Page
Device DDT Names for the Quantum EIO Remote I/O Head Module	78
Device DDT Names for Quantum EIO Remote I/O Adapter Modules	83

Device DDT Names for the Quantum EIO Remote I/O Head Module

Introduction

This topic describes the Control Expert **Device DDT** tab for a Quantum local rack that includes a 140CRP31200 remote I/O head module. A derived data type (DDT) is a set of elements with the same type (`ARRAY`) or with different types (structure).

The device DDT instance name can be defined manually but, when adding a module, a default device DDT instance name (*see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual*) is defined by Control Expert

Modifying a Device DDT name

In Control Expert a Device DDT name can be easily modified:

Step	Action	Comment
1	Open Data Editor in the Control Expert Project Browser .	Path: Tools → Data Editor
2	Right click on the device DDT and use the Copy/Paste .	A new default name is proposed by default.
3	Expand Local Bus in the Control Expert Project Browser .	Path: Tools → Project Browser → Project → Configuration → Local Bus
4	Double-click the 140CRP31200 module.	The parameter tabs appear.
5	Select the Device DDT tab.	select the new DDT name (eg : My_CRP312) as the name of Device DDT.

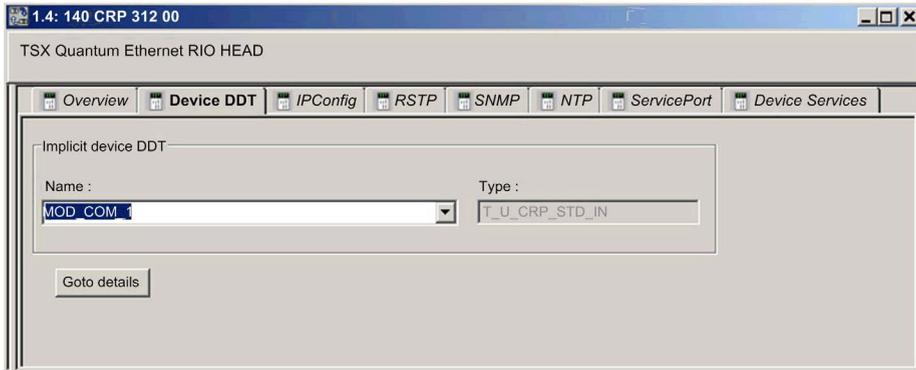
The **Implicit device DDT** field contains a default name and type.

Access the Device DDT Tab

In Control Expert:

Step	Action	Comment
1	Expand Local Bus in the Control Expert Project Browser .	Path: Tools → Project Browser → Project → Configuration → Local Bus
2	Double-click the 140CRP31200 module.	The parameter tabs appear.
3	Select the Device DDT tab.	

Example of the **Implicit device DDT** area which contains a name and a type.



Parameters

Use the Control Expert **Device DDT** tab to configure parameters for the 140CRP31200 module on the local rack:

Parameter		Description
Implicit device DDT	Name	a default device DDT instance name (<i>see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual</i>) is defined by Control Expert.
	Type	module type (uneditable)
Goto details		link to the DDT data editor screen

Implicit Device DDT Types

The 140CRP31200 module implements the implicit device DDT type in accordance with the CPU configuration:

- **T_U_CRP_HSBY_IN**: Hot Standby configurations
- **T_U_CRP_STD_IN**: standalone configurations

Hot Standby Configurations

This table describes the fields in the T_U_CRP_HSBY_IN implicit device DDT type that is used with the 140CRP31200 module in Hot Standby configurations:

Field	Type	Access	Description
LOCAL_PLC	T_U_CRP_STD_IN	R	140CRP31200 status (local PLC)
REMOTE_PLC	T_U_CRP_STD_IN	R	140CRP31200 status (remote/peer PLC)

Standalone and Hot Standby Configurations

This table describes the fields in the T_U_CRP_STD_IN implicit device DDT type that is used with the 140CRP31200 module in standalone and Hot Standby configurations.

ETH_STATUS (BYTE):

Name	Type	Rank	Bit	Description
PORT1_LINK	BOOL	0	0	0 = Port 1 link is down.
				1 = Port 1 link is up.
PORT2_LINK	BOOL	1	1	0 = Port 2 link is down.
				1 = Port 2 link is up.
PORT3_LINK	BOOL	2	2	0 = Port 3 link is down.
				1 = Port 3 link is up.
PORT4_LINK	BOOL	3	3	0 = Port 4 link is down.
				1 = Port 4 link is up.
CRP_LINK	BOOL	4	4	0 = CRP link is down.
				1 = CRP link is up.
REDUNDANCY_STATUS	BOOL	5	5	0 = Redundant owner is not present.
				1 = Redundant owner is present.
<p>NOTE: In Hot Standby systems, if this bit is set to 1 either in the local or remote 140CRP31200 DDT then the main physical ring is OK. If this bit is set to 0 in both the local and remote 140CRP31200 DDTs, the main physical ring is broken.</p>				
SCANNER_OK	BOOL	6	6	0 = Scanner is not present.
				1 = Scanner is present.
GLOBAL_STATUS	BOOL	7	7	0 = At least 1 service is not operating normally.
				1 = All services are operating normally.

NOTE: You can monitor breaks in the remote I/O main ring by diagnosing the REDUNDANCY_STATUS bits in the 140CRP31200 module DDT. The system detects and reports in this bit a main ring cable break that persists for at least 5 seconds.

Within the REDUNDANCY_STATUS bit:

- 0: The cable is broken or the device is stopped.
- 1: The loop is present and healthy.

In a Hot Standby system, perform a BITWISE OR operation of the REDUNDANCY_STATUS bit in the DDTs for both the primary and standby 140CRP31200 modules to determine whether a cable break has occurred. As indicated above, a value of 0 indicates a cable break; a value of 1 indicates no cable break.

SERVICE_STATUS (BYTE):

Name	Type	Rank	Bit	Description
RSTP_SERVICE	BOOL	0	0	0 = RSTP service is not operating normally. 1 = RSTP service is operating normally or disabled.
PORT502_SERVICE	BOOL	2	2	0 = Port 502 service is not operating normally. 1 = Port 502 service is operating normally or disabled.
SNMP_SERVICE	BOOL	3	3	0 = SNMP service is not operating normally. 1 = SNMP service is operating normally or disabled.
IP_ADDRESS_STATUS	BOOL	4	4	0 = IP address is a duplicate or unassigned. 1 = Assigned IP address is not a duplicate.
(reserved bits)	—	5...7	5...7	—

ETH_PORT_STATUS:

Name	Rank	Bit	Description
These combined 2-bit values indicate the conditions (WORD)	—	1/0	Ethernet port 1 function
	—	3/2	Ethernet port 1 RSTP role
	—	5/4	Ethernet port 2 function
	—	7/6	Ethernet port 2 RSTP role
	—	9/8	Ethernet port 3 function
	—	11/10	Ethernet port 3 RSTP role
	—	12/13	Ethernet port 4 function
	—	14/15	Ethernet port 4 RSTP role
port function	—	0	disabled
	—	1	access port
	—	2	port mirror
	—	3	remote I/O network port
RSTP role	—	0	unknown
	—	1	alternate/backup
	—	2	root
	—	3	designated

IN_BYTES:

Type	Rank	Bit	Description
UINT	4/5	—	number of bytes (octets) received on interface

IN_ERRORS:

Type	Rank	Bit	Description
UINT	6/7	—	number of inbound packets that contain detected errors

OUT_BYTES:

Type	Rank	Bit	Description
UINT	8/9	—	number of bytes (octets) sent on interface

OUT_ERRORS:

Type	Rank	Bit	Description
UINT	10/11	—	number of outbound packets that contain detected errors

Device DDT Names for Quantum EIO Remote I/O Adapter Modules

Introduction

This topic describes the Control Expert **Device DDT** tab for an Ethernet remote I/O drop that includes a •••CRA312•0 adapter module.

The I/O structure type for the Quantum remote I/O drop is T_U_DROP_STD_IN. The I/O structure type for the Modicon X80 remote I/O drop is T_M_DROP_EXT_IN. In addition, when a remote I/O drop with a Quantum 140CRA31200 module is placed into an M580 system, the I/O structure type is T_Q_DROP_EXT_IN.

The device DDT instance name can be defined manually but, when adding a module, a default device DDT instance name (*see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual*) is defined by Control Expert

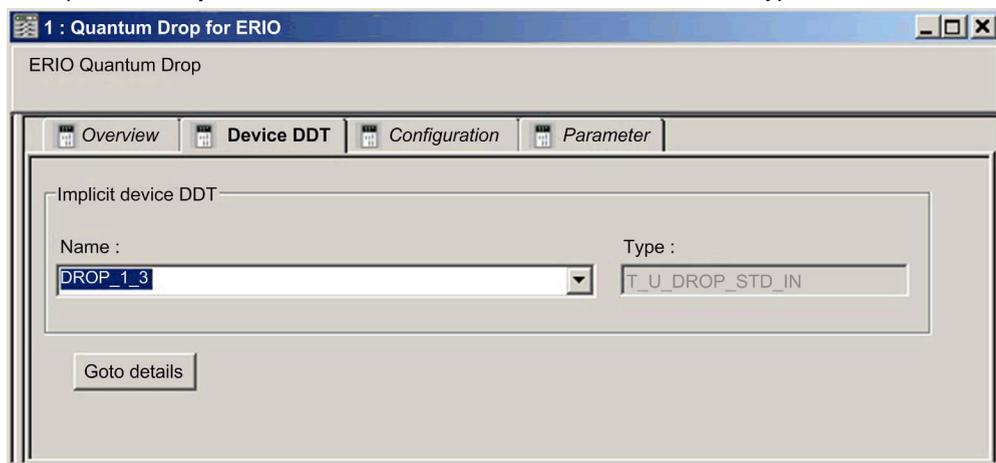
NOTE: These instructions assume that you have already added a drop to your Control Expert project (*see page 40*).

Access the Device DDT Tab

In Control Expert:

Step	Action	Comment
1	Expand EIO Bus in the Control Expert Project Browser to display the EIO drop (Quantum)	Path: Tools → Project Browser → Project → Configuration → EIO Bus → EIO Quantum Drop
2	Double-click the EIO drop.	The EIO drop window appears.
3	Select the Device DDT tab.	

Example of the **Implicit device DDT** area which contains a name and a type.



Drop Parameters

Use the Control Expert **Device DDT** tab to configure these parameters for the Ethernet remote I/O drop:

Parameter		Description
Implicit device DDT	Name	A default device DDT instance name (<i>see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual</i>) is defined by Control Expert.
	Type	module type (uneditable)
Goto details		link to the DDT data editor screen

Diagnostic Parameters

This table contains the `DROP` diagnostic parameters for the Ethernet remote I/O drop module:

Name	Type	Bit	Description	
IO_HEALTH_RACK1 only for T_Q_DROP_EXT_IN	WORD	—	Health bits of rack 1: slots 1 to 16	
IO_HEALTH_RACK2 only for T_Q_DROP_EXT_IN	WORD	—	Health bits of rack 2: slots 1 to 16	
DEVICE_NAME	string[16]	—	device name of the remote I/O drop (<i>see page 71</i>)	
VERSION	WORD	—	firmware version (Maj, Min) (4 digits coded in BCD)	
ROTARY_SWITCHES	BYTE	—	rotary switch value at power up	
CRA_STATE		—	1: CRA module is idle.	
			2: CRA module is stopped.	
			3: CRA module is running.	
CRA_DIAGNOSTIC [WORD]	GLOBAL_IO_HEALTH	BOOL	0	0: At least one I/O module in the drop reports bad health.
	CCOTF_IN_PROGRESS	BOOL	1	CCOTF is in progress.
	CCOTF_INVALID_CONF	BOOL	2	CCOTF configuration is not valid.
	IOPL_MISMATCH	BOOL	3	There is an output data mismatch. The modules in the rack are not the same as the modules configured in the PLC.
	SWITCH_CHANGE	BOOL	4	The rotary switches settings have changed since the last power up.
	DROP_COM_HEALTH	BOOL	5	This bit shows the drop communication health (set to 1 in remote I/O drop).

Name		Type	Bit	Description
CYCLE_CURR_TIME		UINT	—	This word indicates the execution time of the last CRA cycle. It has values between [0,65535] with a resolution of 0.01 ms, therefore, the last cycle time is between [0,655] ms.
CYCLE_MAX_TIME		UINT	—	This word indicates the longest CRA cycle execution time since the last start. It has values between [0,65535] with a resolution of 0.01 ms, therefore, the longest cycle time is between [0,655] ms.
CYCLE_MIN_TIME		UINT	—	This word indicates the shortest CRA cycle execution time since the last start. It has values between [0,65535] with a resolution of 0.01 ms, therefore, the shortest cycle time is between [0,655] ms.
TIME_STAMP_RECORDS (Not used for 140CRA31200 applications.)		UINT	—	This word contains the number of Time Stamp records available in the drop local buffer.
TS_DIAGNOSTIC_FLAGS (WORD) (BMXCRA312•0 only)	TIME_VALID	BOOL	0	The time is valid and synchronized.
	CLOCK_FAILURE	BOOL	1	The time source of the sending device is not validated. The time stamp value is ignored.
	CLOCK_NOT_SYNC	BOOL	2	The time source of the sending device is not synchronized with the external UTC time.
	BUFF_FULL	BOOL	3	The buffer is full.
	SOE_UNCERTAIN	BOOL	7	The SOE (sequence of events) in the buffer is not known. The SOE is reset when the sequence of events is OK.
TS_BUF_FILLED_PCTAGE (BMXCRA312•0 only)		BYTE	—	This byte reports the percentage of the buffer filled (0...100).
TS_EVENTS_STATE (BMXCRA312•0 only)		BYTE	—	The byte reports the main state of TS events.

Name		Type	Bit	Description
ETH_STATUS (BYTE)	PORT1_LINK	BOOL	0	0 = Port 1 link is down.
				1 = Port 1 link is up.
	PORT2_LINK	BOOL	1	0 = Port 2 link is down.
				1 = Port 2 link is up.
	PORT3_LINK	BOOL	2	0 = Port 3 link is down.
				1 = Port 3 link is up.
	(reserved bit)	—	3	—
RPI_CHANGE	BOOL	4	RPI change: EtherNet/IP RPI change is in progress (during CCOTF).	
REDUNDANCY_OWNER	BOOL	6	0 = Redundant owner is not present.	
			1 = Redundant owner is present.	
GLOBAL_STATUS	BOOL	7	0 = At least 1 service is not operating normally.	
			1 = All services are operating normally.	
SERVICE_STATUS (BYTE)	RSTP_SERVICE	BOOL	8	0 = RSTP service is not operating normally.
				1 = RSTP service is operating normally or disabled.
	SNTP_SERVICE (reserved)	BOOL	9	0 = SNTP service is not operating normally.
				1 = SNTP service is operating normally or disabled.
	PORT502_SERVICE	BOOL	10	0 = Port 502 service is not operating normally.
				1 = Port 502 service is operating normally or disabled.
SNMP_SERVICE	BOOL	11	0 = SNMP service is not operating normally.	
			1 = SNMP service is operating normally or disabled.	
(reserved bits)	—	4..7	—	

Name		Type	Bit	Description
ETH_PORT_STATUS (BYTE)	These combined 2-bit values indicate the conditions	WORD	1/0	Ethernet port 1 function
			3/2	Ethernet port 1 RSTP role
			5/4	Ethernet port 2 function
			7/6	Ethernet port 2 RSTP role
			9/8	Ethernet port 3 function
			11/10	Ethernet port 3 RSTP role
			12/13	Ethernet port 4 function
			14/15	Ethernet port 4 RSTP role
	port function	—	0	disabled
		1	access port	
		2	port mirror	
		3	remote I/O network port	
	RSTP role	—	0	alternate
		1	backup	
2		designated		
3		root		
NTP_UPDATE (reserved)		UINT	—	elapsed time (100 ms) since last update from NTP server
MAX_PACKET_INTERVAL		UINT	—	maximum packet interval (ms) for output packets
IN_BYTES		UINT	—	number of bytes (octets) received on interface
IN_ERRORS		UINT	—	number of inbound packets that contain detected errors (In Errors)
OUT_BYTES		UINT	—	number of bytes (octets) sent on interface
OUT_ERRORS		UINT	—	number of outbound packets that contain detected errors (In Errors)
SOE_UNCERTAIN		BOOL	—	The SOE (sequence of events) in the buffer is not known. The SOE is reset when the sequence of events is OK.

Device DDT Types for I/O Modules

Refer to the following user guides for specific I/O module device DDT types:

I/O Module	User Guide Reference
Modicon X80 discrete input/output	<i>Modicon M340 Using EcoStruxure™ Control Expert Discrete Input/Output Modules User Manual</i>
Modicon X80 analog input/output	<i>Modicon M340 with EcoStruxure™ Control Expert Analog Input/Output Modules User Manual</i>
BMX EHC 0800	<i>Modicon M340 with EcoStruxure™ Control Expert Counting Module BMX EHC 0800 User Manual</i>
BMX EHC 0200	<i>Modicon M340 with EcoStruxure™ Control Expert Counting Module BMX EHC 0200 User Manual</i>
BMX NOM 0200	<i>Modicon M340 with EcoStruxure™ Control Expert Serial Link User Manual</i>
BMX ERT 1604T	<i>BMX ERT 1604T M340 ERT Module User Manual</i>

Section 3.5

Elementary Functions (EFs) and Function Blocks (EFBs)

Using Quantum Function Blocks in M580 Systems

Supporting Quantum Configurations

M580 PLCs use these elementary functions (EFs) and elementary function blocks (EFBs) to support Quantum I/O configurations:

Function Block	Quantum Family	Description
ACI030	I/O management	EFBs: Manage the I/O for Quantum ERIO modules.
ACI040	I/O management	
ACO020	I/O management	
ACO130	I/O management	
AI1330	I/O management	
AI133010	I/O management	
AIO330	I/O management	
AMM090	I/O management	
ARI030	I/O management	
ATI030	I/O management	
AVI030	I/O management	
AVO020	I/O management	
ERT_854_10	I/O management	
ERT_854_20	I/O management	
ERT_854_30	I/O management	
I_NORM_WARN	analog I/O scaling	EFBs: Scale analog values from Quantum analog modules.
I_PHYS_WARN	analog I/O scaling	
I_SCALE_WARN	analog I/O scaling	
I_SET	analog I/O scaling	

Function Block	Quantum Family	Description
I_RAW	analog I/O scaling	EFs: Scale analog values from Quantum analog modules.
I_RAWSIM	analog I/O scaling	
I_NORM	analog I/O scaling	
I_PHYS	analog I/O scaling	
I_SCALE	analog I/O scaling	
I_FILTER	analog I/O scaling	
O_NORM_WARN	analog I/O scaling	EFBs: Scale analog values from Quantum analog modules.
O_PHYS_WARN	analog I/O scaling	
O_SCALE_WARN	analog I/O scaling	
O_SET	analog I/O scaling	
O_RAW	analog I/O scaling	EFs: Scale analog values from Quantum analog modules.
O_NORM	analog I/O scaling	
O_PHYS	analog I/O scaling	
O_SCALE	analog I/O scaling	
O_FILTER	analog I/O scaling	
DROP	I/O configuration	EFBs: I/O configuration blocks for building data blocks for analog or ERT modules.
XDROP	I/O configuration	

Section 3.6

Application Download

Downloading the Application to the PLC

Downloading the Application to the PLC

Download the Control Expert application to the PLC through one of its ports or through a connection to an Ethernet communication module:

Method	Connection
USB port	If the PLC and the PC that is running Control Expert both have USB ports, you can download the application to the PLC directly through the USB ports.
Modbus Plus port	If the PLC and the PC that is running Control Expert both have Modbus Plus ports, you can download the application to the PLC directly through the Modbus Plus ports.
serial port	If the PLC and the PC that is running Control Expert both have serial ports, you can download the application to the PLC directly through the serial ports.
Ethernet port	If the PLC and the PC that is running Control Expert both have Ethernet ports, you can download the application to the PLC directly through the Ethernet ports.
communication module	You can download the application to the PLC by connecting Control Expert to the IP address of the communication module.
NOTE: You cannot download the application to the PLC with the 140CRP31200 module.	

Chapter 4

Explicit Messaging

Overview

EtherNet/IP uses the TCP/IP and UDP/IP protocols to implement both explicit and implicit messaging.

This chapter explains the 140CRP31200 remote I/O head module and its use of explicit messaging for request-and-reply communications for non-real-time information (like configuration and diagnostic data). A network node that receives a TCP/IP-encapsulated explicit message processes the message and generates a response.

NOTE: The 140CRP31200 module can process 16 MBP_MSTR blocks per MAST cycle.

NOTE: If you receive a detected error message — stating that the 140CRP31200 module does not have a link (has no cable), MSTR functionality may not be available. If this happens, check that your cables are connected properly.

This chapter describes how to use both Control Expert function block logic and the Control Expert interface to send explicit messages.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
4.1	EtherNet/IP Explicit Messaging Using MBP_MSTR	94
4.2	Explicit Messaging via the Control Expert GUI	100
4.3	Immediate I/O Access (IU_ERIO)	103

Section 4.1

EtherNet/IP Explicit Messaging Using MBP_MSTR

Introduction

This section shows you how to configure the MBP_MSTR function block for explicit messages.

NOTE: Use the 140CRP31200 module to send MBP_MSTR commands to diagnose the status of sub-rings. For other operations (get remote statistics, read data, etc.), we recommend that you send an MBP_MSTR command from a 140 NO• 7•• •• module.

What Is in This Section?

This section contains the following topics:

Topic	Page
Supported MBP_MSTR Function Codes	95
EtherNet/IP Explicit Messaging Services	96
Configuring the CONTROL and DATABUF Parameters	98

Supported MBP_MSTR Function Codes

Function Codes

We recommend using these MBP_MSTR function codes with the 140 CRP 312 00 module to diagnose sub-rings:

MBP_MSTR Control Code	Description	140 CRP 312 00 Support
0x00 0x0E	EIP explicit message (connected)	X (<i>see page 96</i>)
0x01 0x0E	EIP explicit message (unconnected)	X

NOTE: The 140 CRP 312 00 module supports **only** 16 MBP_MSTR codes per CPU cycle.

EtherNet/IP Explicit Messaging Services

Overview

Communication protocols:

- *EtherNet/IP*: The 140 CRP 312 00 module uses the EtherNet/IP protocol for all exchanges of I/O data.
- *Modbus*: The 140 CRP 312 00 module uses the Modbus/TCP protocol for reading diagnostics and for MBP_MSTR.

Every EtherNet/IP explicit message performs a service. Each service is associated with a service code (or number). You will need to identify the explicit messaging service by its name, decimal number, or hexadecimal number.

You can execute EtherNet/IP explicit messages using either a Control Expert MBP_MSTR function block or the Control Expert Ethernet Configuration Tool's **EtherNet/IP Explicit Message Window**. (Refer to Explicit Messaging via the Control Expert GUI (*see page 100*.)

NOTE: Configuration edits made to an Ethernet communication module from the Control Expert Ethernet Configuration Tool's EtherNet/IP Explicit Message Window are not saved to the operating parameters stored in the CPU and, therefore, are not sent by the CPU to the module on startup.

You can use Control Expert to construct a request that executes any service supported by the target device that is compliant with the EtherNet/IP protocol.

Services

The services supported by Control Expert include these standard explicit messaging services:

Service Code		Description	Available in...	
Hex	Dec		MBP_MSTR block	Control Expert GUI
1	1	Get_Attributes_All	X	X
2	2	Set_Attributes_All	X	X
3	3	Get_Attribute_List	X	—
4	4	Set_Attribute_List	X	—
5	5	Reset	X	X
6	6	Start	X	X
7	7	Stop	X	X
8	8	Create	X	X
9	9	Delete	X	X
A	10	Multiple_Service_Packet	X	—
D	13	Apply_Attributes	X	X
<i>x</i> (available service) — (service not available)				

Service Code		Description	Available in...	
Hex	Dec		MBP_MSTR block	Control Expert GUI
E	14	Get_Attribute_Single	X	X
10	16	Set_Attribute_Single	X	X
11	17	Find_Next_Object_Instance	X	X
14	20	Error Response (DeviceNet only)	—	—
15	21	Restore	X	X
16	22	Save	X	X
17	23	No Operation (NOP)	X	X
18	24	Get_Member	X	X
19	25	Set_Member	X	X
1A	26	Insert_Member	X	X
1B	27	Remove_Member	X	X
1C	28	GroupSync	X	—
<i>x</i> (available service) — (service not available)				

Configuring the CONTROL and DATABUF Parameters

Overview

The CONTROL and DATABUF output parameters define the operations of the MBP_MSTR function block. For the EtherNet/IP protocol, the structure of the CONTROL and DATABUF output parameters remains the same for all explicit messaging services.

Configuring the Control Parameter

Use MSTR operation 14 or 270 to send generic Modbus requests on the network. (These operation codes are not available on the Modbus Plus port or embedded Ethernet port on the CPU.)

The CONTROL parameter register contains these consecutive words:

Register	Function	Description
CONTROL [0]	operation	<ul style="list-style-type: none"> ● 14 = unconnected ● 270 = connected
CONTROL [1]	detected error status	Holds the event code (read-only).
CONTROL [2]	data buffer length	Data buffer length, in words
CONTROL [3]	response offset	Offset for the beginning of the response in the data buffer, in 16-bit words Note: To avoid overwriting the request, make the response offset value greater than the request length CONTROL [10].
CONTROL [4]	routing register	Specify a network destination node during data transfer: <ul style="list-style-type: none"> ● MSB: The most significant byte contains the source node address (for example, the slot number of the 140 NOE 771 •• or 140CRP31200 module). Exception: The value of the integrated Ethernet port on the CPU is 254 (FE h) regardless of the CPU slot number. Note: Only 1 Ethernet 140CRP31200 module can be used. ● LSB: The least significant byte contains the destination node address (for example, MBP on the Ethernet Transporter (MET) mapping index for the 140 NOE 771 •• or the drop number for the 140CRP31200).
CONTROL [5] ¹	IP address	Each address contains 1 byte of the 32-bit IP address: <ul style="list-style-type: none"> ● high byte = byte 4 of the IP address (MSB) ● low byte = byte 3 of the IP address ● high byte = byte 2 of the IP address ● low byte = byte 1 of the IP address (LSB)
CONTROL [6] ¹		
CONTROL [7]	request length	length of the CIP request, in bytes
CONTROL [8]	response length	length of the response received, in bytes read only—set after completion

1. For example, the Control parameter handles the IP address 192.168.1.6 in the following order: Byte 4 = 192, Byte 3 = 168, Byte 2 = 1, Byte 1 = 6.

Configuring the Data Buffer

The `DATABUF` varies in size. It consists of contiguous registers that include—in sequence—both the CIP request and the CIP response. To avoid overwriting the request, confirm that the data buffer is large enough to contain both the request and response data.

Data Buffer: Variable size: set in <code>CONTROL[2]</code>	CIP Request: Request size: set in <code>CONTROL[7]</code>
	CIP Response: Starting position: set in <code>CONTROL[3]</code> Response size: reported in <code>CONTROL[8]</code> NOTE: If the response offset is smaller than the request size, response data overwrites part of the request.

The formats of the data buffer's CIP request and CIP response are described in this table. (Both the request and response are structured in little endian order.)

Request			
Byte offset	Field	Data Type	Description
0	Service	Byte	Service of the explicit message
1	Request_Path_Size	Byte	The number of words in the Request_Path field
2	Request_Path	Padded EPATH	This byte array describes the path of the request (including class ID, instance ID, etc.) for this transaction.
...	Request_Data	Byte array	Service-specific data in the explicit message request delivery (if none, this field is empty)
Response			
Byte offset	Field	Data Type	Description
0	Reply Service	Byte	Service of the explicit message + 16#80
1	Reserved	Byte	0
2	General Status	Byte	EtherNet/IP General Status
3	Size of Additional Status	Byte	Additional Status array size—in words
4	Additional Status	Word array	Additional status
...	Response Data	Byte array	Response data from request, or additional detected error data if General Status indicates a detected error

Section 4.2

Explicit Messaging via the Control Expert GUI

Sending Explicit Messages to EtherNet/IP Devices

Introduction

The 140 CRP 312 00 module uses explicit messages from Control Expert to obtain diagnostics information from an EtherNet/IP module or device on the network.

Access the EtherNet/IP Explicit Message Window

Step	Action	Comment
1	Access the 140 CRP 312 00 module for Online Action.	Refer to the Devices Services tab (<i>see page 171</i>).
2	Double-click the 140 CRP 312 00 module in the Control Expert rack view.	The EtherNet/IP Explicit Message tab appears.

The EtherNet/IP Explicit Message Tab

The **EtherNet/IP Explicit Message** window shows an example of the configuration of an EtherNet/IP explicit message and the response to the message. The explicit message is addressed to a DRS to obtain diagnostic information:

Parameters

Features of the **EtherNet/IP Explicit Message** screen:

Field	Parameter (Value)	Description
Address NOTE: Refer to your EtherNet/IP device user manual for the values in the Address field.	IP Address (<i>x.x.x.x</i>)	The IP address of the target device, used to identify the target of the explicit message. (The IP address in the example above is 192.168.1.6.)
	Class (1...65535)	The class identifier of the target device is an integer that is used to construct the message path. (The class in the example above is 4.)
	Instance (0...65535)	The class instance of the target device is an integer that is used to construct the message path. (The class instance in the above example is 100.)
	Attribute (0...65535)	The specific device attribute (or property) is the target of the explicit message. This integer is used to construct the message path. (The attribute in the above example is 3.) NOTE: Check this box to enable this optional field.

Field	Parameter (Value)	Description
Service	Number (1...127)	Number is an integer that is associated with the service that the explicit message performs. NOTE: If you select Custom Service , type in a service number. This field is read-only for all other services.
	Name	Scroll to the name of the service that you want the explicit message to perform. In the example above, Get_Attribute_Single is selected.
	Enter Path (hex)	Check this box to enable the message path field where you can manually enter the entire path to the target device. (In the example above, the box is not checked.)
Data (hex)	—	The Data field contains the data to be sent to the target device for services that send data. (The field is blank in the example above.)
Messaging	Connected	Select the type of explicit message to send: <ul style="list-style-type: none"> ● <i>unconnected</i>: An unconnected message requires path information (addressing) that identifies the destination device and (optionally) device attributes. ● <i>connected</i>: A connected explicit message contains path information and a connection identifier to the target device. NOTE: The example uses an Unconnected message.
	Unconnected	
Send to Device (button)	—	After the explicit message is configured, press Send to Device .
Response (hex)	—	Response contains the (hexadecimal) data sent to the configuration by the target device when you press Send to Device .
Status	—	After you press Send to Device , the messages in the Status field indicate the status of the explicit message.
Repeat (500ms)	—	Check this box to send the explicit message every 500 ms. (In this example, leave this blank.)

NOTE: You can use explicit messaging to perform many different services, but every EtherNet/IP device does not support every service.

Section 4.3

Immediate I/O Access (IU_ERIO)

Description

Function Description

 WARNING
--

UNINTENDED EQUIPMENT OPERATION

Do not use the IU_ERIO function block in Quantum Hot Standby installations.

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

An IU_ERIO function block updates Ethernet remote I/O drop input and output modules with an optimal response time. The Ethernet remote I/O drop inputs and outputs are updated during the MAST task.

Call this function block in a MAST task. It can be called more than once in a task.

NOTE: To maintain system performance, we recommend that you use no more than 10 executions of the IU_ERIO block during a single MAST task.

The input and output modules are physically located on an Ethernet remote I/O drop and declared in the Ethernet configuration.

EN and ENO can be configured as additional parameters.

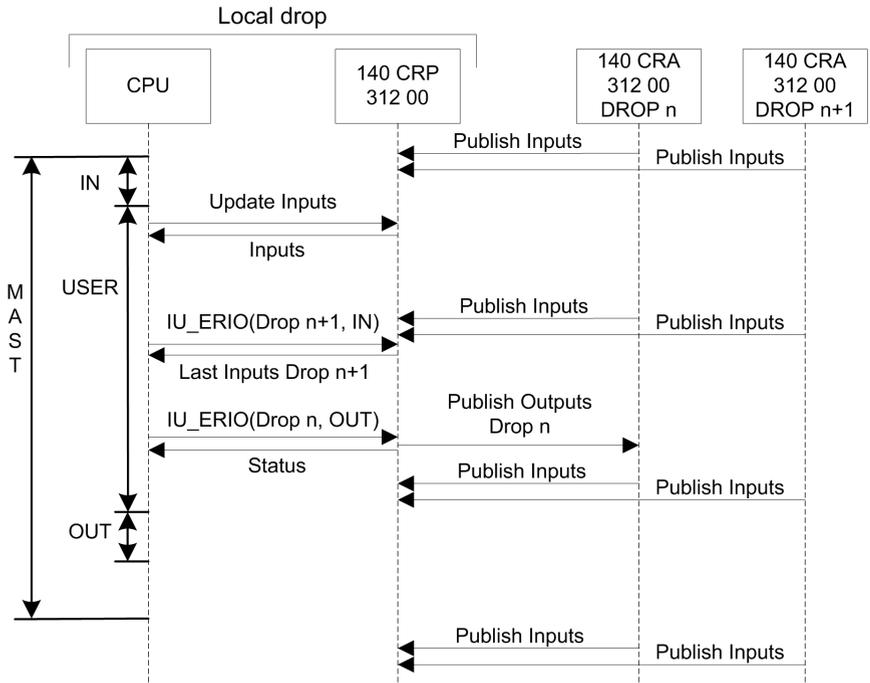
NOTE: Refer to the *Quantum EIO System Planning Guide* for calculating the ART when your application does not use an IU_ERIO function block.

IU_ERIO Mechanism

The Ethernet remote I/O drop input values are read in the 140CRP31200 module with an optimal response time.

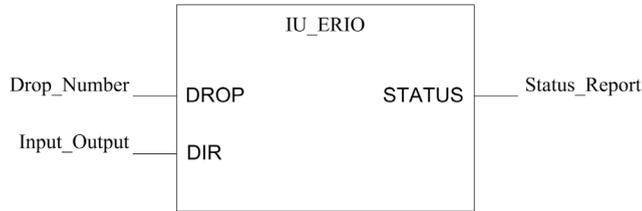
The input values read in the 140CRP31200 module represent the latest values sent in an asynchronous way by the adapter module in each drop. The maximum time shift between values read in the 140CRP31200 and actual input values depends on the adapter's publishing frequency (subscribe field **CRA-> RPI**) (see page 71).

The following diagram represents the I/O exchanges between a CPU and the Ethernet remote I/O drops:



Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

```
CAL IU_ERIO (DROP=>Drop_Number, DIR=>Input_Output, STATUS=>Status_Report);
```

Representation in ST

```
IU_ERIO (DROP=>Drop_Number, DIR=>Input_Output, STATUS=>Status_Report);
```

Parameter Description

Input parameters:

Parameter	Data type	Meaning
Drop	INT	Drop number (1...31) Drop number: <ul style="list-style-type: none"> ● 1: Drop 1 ● 2: Drop 2 ● ... ● 31: Drop 31
Dir	BOOL	Data direction: <ul style="list-style-type: none"> ● 0 = Outputs. The output values are sent immediately to the 140CRP31200 module. ● 1 = Inputs. The input values are read immediately from the 140CRP31200 module.

Output parameter:

Parameter	Data type	Meaning
Status	WORD	Status report from the 140CRP31200 module: <ul style="list-style-type: none"> ● 0002 hex: Invalid drop number ● 0003 hex: Ethernet remote I/O drop is not configured ● 0004 hex: Ethernet remote I/O drop is not connected ● 0005 hex: Retry number is exceeded ● 0007 hex: An error is detected on the 140CRP31200 module ● 0008 hex: Operation was not completed before time out ● 0009 hex: 140CRP31200 module is not present on the local drop ● 000B hex: Operation OK

NOTE: If no connection is opened with the Ethernet remote I/O drop, a detected communication error (system words %SW172 to %SW173) is returned.

Chapter 5

Implicit Messaging

The MAST Task in Implicit Exchanges

Task Management

This topic explains implicit messaging and the relationship between the MAST task configuration and the remote I/O implicit exchanges.

Implicit messaging maintains open connections for real-time communications of a predefined nature between consumers and producers. Implicit messages contain control data and a connection identifier.

EtherNet/IP uses the TCP/IP and UDP/IP protocols to implement both explicit and implicit messaging.

Access the MAST Configuration

View the **Properties of MAST**:

Step	Action
1	Go to the Properties of MAST dialog box in Control Expert (Tools → Project Browser → Project → Program → Tasks → MAST).
2	Right-click Properties .
3	Configure the parameters.

CIP Definitions

Inputs: The MAST period should be 2 times the RPI of the 140CRA31200 or BMXCRA312•0 adapter on the remote I/O drop. This provides new input values for every MAST cycle. (For example, an RPI of 25 ms provides data for a MAST period of 50 ms.)

Outputs: The CPU in the local rack of a Quantum Ethernet I/O system produces outputs to Ethernet remote I/O drops and consumes inputs from those drops (based on the producer/consumer model). A consumer (the remote drop) detects the lack of updated data through a time-out. (Possible time-out values are $N \times \text{RPI}$, where $N = 4, 8, 16 \dots$) When a time-out is triggered, the consumer assumes that the producer is absent.

Periodic and Cyclic Modes

The effect that periodic and cyclic modes have on implicit messages is explained in the description of the connection parameters (*see page 71*).

Quantum I/O Management for Implicit I/O Exchanges

Assign state RAM addresses:

Drop type	Instruction
Quantum Ethernet remote I/O	The direct state RAM address manages the Quantum I/O data. Assign the state RAM addresses for each module. (Default values are proposed by Control Expert in the module configuration windows.) You can also define symbols on the I/O variables allocated in the state RAM.
Modicon X80 Ethernet remote I/O	To assign state RAM addresses for Modicon X80 I/O data, refer to the topic Device DDT Names for Quantum EIO adapters (<i>see page 83</i>)

Chapter 6

Diagnostics

Overview

This chapter describes the diagnostics for the Quantum EIO modules. For details on diagnostics at the system level, refer to the systems diagnostics topic in the *Quantum Ethernet I/O System Planning Guide*.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
6.1	LED Indicators	110
6.2	Service Port Management	116
6.3	Diagnostics Available through the CPU	119
6.4	Diagnostics Available through Modbus/TCP	124
6.5	Diagnostics Available through EtherNet/IP CIP Objects	134
6.6	Diagnostics Available through Control Expert	170

Section 6.1

LED Indicators

What Is in This Section?

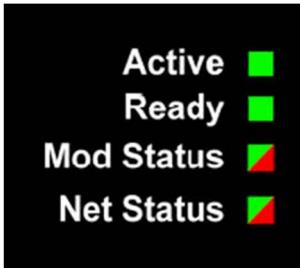
This section contains the following topics:

Topic	Page
LED Indicators on the 140 CRP 312 00 Module	111
LED Indicators on the Quantum EIO Adapter Module	114

LED Indicators on the 140 CRP 312 00 Module

Display

These LEDs are on the front of the 140CRP31200 module:



Indications

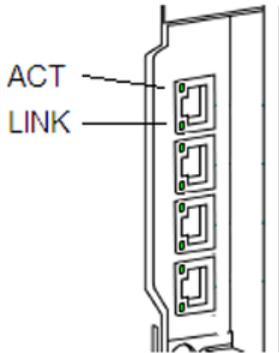
LED conditions:

Description		Active	Ready	Mod Status		Net Status	
		green	green	red	green	red	green
general	component not operating	—	off	on	off	—	—
	invalid configuration	—	off	flash	off	—	—
	not configured	—	off	off	flash	—	—
	configured	on	blink	off	on	off	on/flash
	no/default module MAC	—	blink 2	flash	off	off	off
	no/default port MAC	—	blink 2	flash	off	off	off
power-up sequence	sequence	5	6	2	1	4	3
	non-ODVA standard	blink (.25 sec on; .25 sec off)	blink (.25 sec on; .25 sec off)	—	—	—	—
	ODVA standard	—	—	blink (.25 sec on; .25 sec off)			

Description		Active	Ready	Mod Status		Net Status	
		green	green	red	green	red	green
FDR client	no Ethernet connections	—	blink 3	—	—	—	—
	duplicate IP	—	blink 4	off	on	on	off
	waiting for IP	—	blink 5	off	on	off	off
	default IP	—	blink 6	off	on	off	off
	receive or assign IP	—	on	off	on	off	flash
	invalid configuration	—	blink 7	off	on	off	off
EIP scanner	no EIP connection or all EIP connections closed	—	on	flash	off	off	flash
	one or more connections established	—	on	off	on	off	on
	one connection timeout	—	on	off	on	flash	off

NOTE: In Hot Standby systems, the Net Status LEDs on the 140 CRP 312 00 modules are solid green during normal operations. When power to the 140 CRP 312 00 module in either rack A or B is lost, the Net Status LED on the 140 CRP 312 00 module in the partner rack is unchanged (solid green).

Ethernet Port Indications



These LEDs report the status of the Ethernet port:

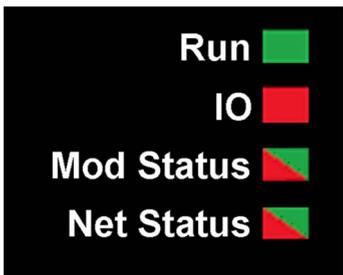
Name	Color	Status	Description
LINK	green	on	100 Mbps link detected
	yellow	on	10 Mbps link detected
	—	off	no detected link
ACT	green	blinking	active Ethernet link (transmit or receive)
	—	off	inactive Ethernet link

LED Indicators on the Quantum EIO Adapter Module

Display

The LEDs are on the front of the adapter module:

140CRA31200:



BMXCRA312•0:



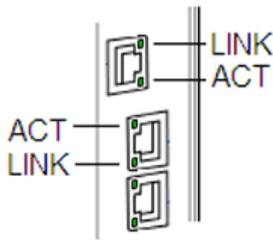
Indications

LED conditions:

Description		Run	IO	Mod Status		Net Status	
		green	red	green	red	green	red
power-up sequence	blink (.25 sec on; .25 sec off)	1	2	Green/Red/Green		Green/Red/Off	
not configured	IP address not valid	—	—	flashing	off	off	off
	<ul style="list-style-type: none"> valid IP address invalid configuration 	off	off	flashing	off	flashing	off
configured	no external error detected	flashing	off	—	—	flashing	off
	external error detected	flashing	on	—	—	flashing	off
I/O data communication established	STOP	flashing	(note 1)	on	off	on	off
	RUN	on	(note 2)	on	off	on	off

Description		Run	IO	Mod Status		Net Status	
		green	red	green	red	green	red
detected error states	recoverable error	—	—	off	flashing	—	—
	nonrecoverable error	flashing	on	off	on	—	—
	duplicate IP address	—	—	—	—	off	on
OS firmware update		flashing	off	off	on	off	on
<p>NOTE 1 (STOP state):</p> <ul style="list-style-type: none"> ● on: An input or output is a detected error that originates in a module, or a channel configuration or a channel configuration error has been detected. ● off: Operations are normal. <p>NOTE 2 (RUN state):</p> <ul style="list-style-type: none"> ● on: External error is detected. ● off: External error is not detected. 							

Ethernet Port Indications



These LEDs report the status of the Ethernet port:

Name	Color	Status	Description
LINK	green	on	100 Mbps link detected
	yellow	on	10 Mbps link detected
	—	off	no detected link
ACT	green	blinking	active Ethernet link (transmit or receive)
	—	off	inactive Ethernet link

Section 6.2

Service Port Management

What Is in This Section?

This section contains the following topics:

Topic	Page
Service Port Configuration	117
Service Port Configuration for Adapter Modules	118

Service Port Configuration

Introduction

The 140CRP31200 remote I/O head module and the remote I/O adapter modules (140CRA31200 and BMXCRA31210) support the configuration of the SERVICE port without requiring you to re-build or download your application.

140CRP31200

The online configuration of the SERVICE port on the 140CRP31200 module is discussed in the section about diagnostics through Control Expert (*see page 173*).

Adapter Modules

You can send explicit messages with an EtherNet/IP tool for the configuration of the SERVICE port on the 140CRA31200 or BMXCRA31210 modules. For details, refer to the discussions of EtherNet/IP CIP objects (*see page 168*) and SERVICE port configuration for adapter modules (*see page 118*).

Cycling Power

The online configuration of the SERVICE port is volatile. The following situations can arise when power is cycled to the module while the application is being applied:

- The configuration can be lost.
- The configuration in the application can be applied to the SERVICE port.

Service Port Configuration for Adapter Modules

Configuration

Follow these steps to modify the **Service Port** configuration of an online 140CRA31200 or BMXCRA312•0 adapter module:

Step	Action
1	Launch the EtherNet/IP Explicit Message window (<i>see page 100</i>).
2	Assign these Device Services parameters: <ul style="list-style-type: none"> ● Address: <ul style="list-style-type: none"> ○ IP Address: Enter the IP address of the adapter with the SERVICE port you want to configure. ○ Class: 0x400 ○ Instance: 1 ● Service: <ul style="list-style-type: none"> ○ Name: Set_Attribute_Single
3	Set the Port Control value: <ul style="list-style-type: none"> ● Attribute: Check this box. ● Attribute (field): Enter 1 (access port). ● Data (hex) (field): Enter a value that is based on the Port Control attribute definition (<i>see page 168</i>). <p>NOTE:</p> <ul style="list-style-type: none"> ● To set the UINT value of 2, set the data field to 02 00 (low byte/high byte). ● If you enter 2 (port mirroring) in Attribute, refer to the next table. ● In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE port.
4	Leave the default values for these parameters: <ul style="list-style-type: none"> ● Enter Path(hex): Leave this check box unselected. ● Repeat(500ms): Leave this check this check box unselected. ● Messaging: Select Unconnected.
5	Press Send to Device .

Port Mirroring: Use these steps only if you chose 2 (port mirroring) for the **Port Control** value (above):

Step	Action
1	Set the Port Control value: <ul style="list-style-type: none"> ● Attribute: Check this box. ● Attribute: Enter 2 (port mirroring). ● Data(hex): Enter a value that is based on the Port Control attribute definition (<i>see page 168</i>).
2	Accept the default values for other parameters (as before).
3	Press Send to Device .

Section 6.3

Diagnostics Available through the CPU

What Is in This Section?

This section contains the following topics:

Topic	Page
System Diagnostics	120
Device Data Types for the Remote I/O Modules	123

System Diagnostics

Introduction

System diagnostics are performed locally on the CPU with system bits (%S) and system words (%SW).

Local Rack Diagnostics

Local rack diagnostics are accessible for the 140CRP31200, 140 NOC 771 **, and 140 NOE 771 ** modules within the standard system bits (%SW180 to %SW339).

Ethernet Remote I/O Drop Diagnostics

Ethernet remote I/O drop diagnostics are accessible for the entire drop within system bits and words in the PLC (%S, %SW). Each drop is animated with a health bit display of the health bit status for:

- a drop node
- a module in a remote drop

The Quantum PLC on the local rack monitors remote I/O drops and module health. The 140CRA31200 or BMXCRA312*0 adapter module on the remote I/O drop transmits detected errors in drop modules to the Quantum PLC via implicit exchanges (*see page 134*). The detected errors are stored in the global diagnostic buffers of the PLC and in the diagnostic buffer of the individual drop module.

The Quantum PLC or the 140CRP31200 module on the local rack updates the detected error buffers. Health bits are updated in the PLC only if the adapter of the concerned drop communicates with the 140CRP31200 module on the local rack. If these modules cannot communicate, the concerned health bits are set to 0.

System Bits and Words

This table describes new or modified system bits and words that represent detected errors:

System Bits/Words	Symbol	Description
%S117	EIOERR	detected remote I/O error on the Ethernet I/O network
%SW101	EIO_CCOTF_COUNT	EIO CCOTF counting status register
%SW108	FORCED_DISCRETE_COUNT	forced bit counting status register
%SW109	FORCED_ANALOG_COUNT	forced bit counting status register

System Bits/Words	Symbol	Description
%SW152 ... %SW153	EIO_DROP_ERROR	detected Ethernet remote I/O drop status The bit is set to 0 if at least one I/O module in the drop as a detected error. The bit is set to 1 if all modules are operating properly. <ul style="list-style-type: none"> ● %SW152.0: drop #1 ● %SW152.1: drop #2 ● ● %SW153.14: drop #31
%SW172 ... %SW175	EIO_CONNECT_STATUS	Ethernet I/O communication health status for drops in standalone and primary systems
%SW176 ... %SW179	SDBY_EIO_CONNECT_STATUS	Ethernet I/O communication health status for drops in standby systems
%SW180 ... %SW181	IOHEALTH _{ij} (i = 1 ... 32, j = 1 ... 5)	health bits of the PLC modules (including Hot Standby and Safety Hot Standby systems)
%SW182 ... %SW183		
%SW641 ... %SW702	EIO_MOD_HEALTH	Ethernet remote I/O module health bit status

NOTE: Refer to Quantum-Specific System Words section (*see EcoStruxure™ Control Expert, System Bits and Words, Reference Manual*) for a detailed explanation.

Viewing Diagnostics in Control Expert

The bus editor in Control Expert uses color animation to display the status of each drop, rack, or module on the **EIO Bus**. The slot number of the drop/rack/module appears in red when a detected error is associated with that slot. For a module, the red display indicates the module is missing, inoperable, or improperly configured.

Drop	Status	Language Object	i	j
	drop (d)	%SW _{i,j}	$152 + [(d-1)/16]$	$(d-1)/16$
140 CRA	rack (r), drop (d)	%SW _i	$641 + [(d-1)*2] + (r-1)$	
	module (m), rack (r), drop (d)	%SW _{i,j}	$641 + [(d-1)*2] + (r-1)$	16-m
BMX CRA	rack (r), drop (d)	%SW _i	$641 + [(d-1)*2] + r$	
	module (m), rack (r), drop (d)	%SW _{i,j}	$641 + [(d-1)*2] + r$	15-m

NOTE:

Remember that the 16 slots have different numbering schemes:

- 140CRA31200 drop: slots 1...16
- BMXCRA312*0 drop: slots 0...15

NOTE:

Remember that the rack numbering scheme is also different:

- 140CRA31200 drop: 1 or 2
- BMXCRA312•0 drop: 0 or 1

Device Data Types for the Remote I/O Modules

Device Data Types

The DDT structures for these remote I/O modules are described elsewhere:

- 140CRP31200 head module (local rack)
- 140CRA31200 or BMXCRA312•0 adapter (remote drop)

These DDTs are available in the application. Refer to the Derived Data Types section (*see page 77*).

The DDT diagnostics data is mapped to default local variables. The data is updated every MAST cycle.

Section 6.4

Diagnostics Available through Modbus/TCP

Modbus Diagnostic Codes

Supported Diagnostic Codes

Modbus function code 3 provides access to a variety of diagnostic functions, including basic network diagnostics, Ethernet port diagnostics, and Modbus port 502 diagnostics.

To access the function code 3 diagnostics from the local device, set the **unit ID** to 100.

The following modules support these Modbus diagnostic codes.

- Quantum remote I/O head module (140CRP31200)
- Quantum distributed I/O head module (140NOC78000)
- Quantum control head module (140NOC78100)
- Quantum remote I/O adapter module (140CRA31200)
- M340 distributed I/O head module (BMXNOC0401)
- M340 remote I/O adapter module (BMXCRA31200)
- Quantum IEC 61850 module (140NOP85000)
- M580 communications module (BMENOC03•1)
- M580 communications module (BMENOP0300)

Modbus Function Code 3: Basic Network Diagnostics

Basic network diagnostics start at address 40001(decimal) as described in the following table.

Starting Address (Decimal)	Length (Words)	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40001	2	MS Byte 00	Byte 01	Basic network diagnostic validity
		Byte 02	LS Byte	
40003	1	MS Byte	LS Byte 03	Communication global status
40004	1	MS Byte	LS Byte	Supported communication services
40005	1	MS Byte	LS Byte	Status of communication services
40006	2	IP 1	IP 2	IP address (IP1.IP2.IP3.IP4)
		IP 3	IP 4	
40008	2	SM 1	SM 2	Subnet mask (SM1.SM2.SM3.SM4)
		SM 3	SM 4	

Starting Address (Decimal)	Length (Words)	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40010	2	GW 1	GW 2	Default gateway (GW1.GW2.GW3.GW4)
		GW 3	GW 4	
40012	3	MAC 1	MAC 2	MAC address (MAC1:MAC2:MAC3:MAC4:MAC5:MAC6.
		MAC 3	MAC 4	
		MAC 5	MAC 6	
40015	3	MS Byte 00	01	Ether frame format capability / configuration / operational
		02	03	
		04	LS Byte 05	
40018	2	C00	C01	Ethernet receive frames OK
		C02	C03	
40020	2	C00	C01	Ethernet transmit frames OK
		C02	C03	
40022	1	MS Byte	LS Byte	Number of open client connections
40023	1	MS Byte	LS Byte	Number of open server connections
40024	2	C00	C01	Number of Modbus detected error messages sent
		C02	C03	
40026	2	C00	C01	Number of Modbus messages sent
		C02	C03	
40028	2	C00	C01	Number of Modbus messages received
		C02	C03	
40030	8	Char 1	Char 2	Device name
		Char 3	Char 4	
		Char 5	Char 6	
		Char 7	Char 8	
		Char 9	Char 10	
		Char 11	Char 12	
		Char 13	Char 14	
		Char 15	Char 16	
40038	2	MS Byte 00	Byte 01	IP assignment mode capability / operational
		Byte 02	LS Byte 03	

Example: Reading Basic Network Diagnostics with Modbus Function Code 3

Here is an example of how to read registers 40018 and 40019, the *Ethernet receive frames OK* count registers. The request contains 7 bytes. The starting address, shown as a hex value in byte 2 below, is calculated as follows:

$$40018 - 40001 = 17 \text{ dec} = (11 \text{ hex})$$

The number of registers to be diagnosed (2 hex) is shown in byte 4:

Byte Number	Value
0	Function code = 03 (hex)
1	Starting Address Hi = 00 (hex)
2	Starting Address Low = 11 (hex)
3	No. of Registers Hi = 00 (hex)
4	No. of Registers Low = 2 (hex)
5	CRC high byte (inserted by the Modbus sending application)
6	CRC low byte (inserted by the Modbus sending application)

The normal response is returned in 8 bytes. In this example, the expected response is 14229 hex; this value is shown in bytes 2 through 5 of the response:

Byte Number	Value
0	Function code = 03 (hex)
1	Byte count = 4 (hex)
2	1 st register data, high byte = 00 (hex)
3	1 st register data, low byte = 01 (01 hex)
4	2 nd register data, high byte = 42 (hex)
5	2 nd register data, low byte = 29 (hex)
6	CRC high byte
7	CRC low byte

Byte Number	Value
0	Original function code + 80 hex (= 83 hex)
1	Detected error code
2	CRC high byte
3	CRC low byte

For more information on Modbus function code 3 and other function codes, refer to the *Modicon Modbus Protocol Reference Guide* (PI-MBUS-300).

Modbus Function Code 3: Ethernet Internal Port Diagnostic Data

Internal port diagnostics start at address 40040 (decimal) as described in the following table.

Starting Address (Decimal)	Length (Words)	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40040	1	MS Byte	LS Byte	Internal port Diagnostics Data Validity
40041	1	MS Byte	LS Byte	Internal port Logical/Physical Port Number
40042	1	MS Byte	LS Byte	Internal port Ethernet Control Capability
40043	1	MS Byte	LS Byte	Internal port Link Speed Capability
40044	1	MS Byte	LS Byte	Internal port Ethernet Control Configuration
40045	1	MS Byte	LS Byte	Internal port Link Speed Configuration
40046	1	MS Byte	LS Byte	Internal port Ethernet Control Operational
40047	1	MS Byte	LS Byte	Internal port Link Speed Operational
40048	3	MAC 1	MAC 2	MAC Address (MAC1:MAC2:MAC3:MAC4:MAC5:MAC6)
		MAC 3	MAC 4	
		MAC 5	MAC 6	
40051	2	MSB C00	C01	Internal port Media Counters Data Validity
		C02	LSB C03	
40053	2	MSB C00	C01	Internal port Num Frames Transmitted OK
		C02	LSB C03	
40055	2	MSB C00	C01	Internal port Num Frames Received OK
		C02	LSB C03	
40057	2	MSB C00	C01	Internal port Num Ether Collisions
		C02	LSB C03	
40059	2	MSB C00	C01	Internal port Carrier Sense Errors detected
		C02	LSB C03	
40061	2	MSB C00	C01	Internal port Num Ether Excessive Collisions
		C02	LSB C03	
40063	2	MSB C00	C01	Internal port CRC Errors detected
		C02	LSB C03	
40065	2	MSB C00	C01	Internal port FCS Errors detected
		C02	LSB C03	
40067	2	MSB C00	C01	Internal port Alignment Errors detected
		C02	LSB C03	
40069	2	MSB C00	C01	Internal port Num Internal MAC Tx Errors detected
		C02	LSB C03	

Starting Address (Decimal)	Length (Words)	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40071	2	MSB C00	C01	Internal port Late Collisions
		C02	LSB C03	
40073	2	MSB C00	C01	Internal port Num Internal MAC Rx Errors detected
		C02	LSB C03	
40075	2	MSB C00	C01	Internal port Multiple Collisions
		C02	LSB C03	
40077	2	MSB C00	C01	Internal port Single Collisions
		C02	LSB C03	
40079	2	MSB C00	C01	Internal port Deferred Transmissions
		C02	LSB C03	
40081	2	MSB C00	C01	Internal port Frames Too Long
		C02	LSB C03	
40083	2	MSB C00	C01	Internal port Frames Too Short
		C02	LSB C03	
40085	2	MSB C00	C01	Internal port SQE Test Error detected
		C02	LSB C03	
40087	1	MS Byte	LS Byte	Internal port Interface Label Length
40088	32	IL char64	IL char63	Internal port Interface Label characters
40089		IL char62	IL char61	
...		
40118		IL char04	IL char03	
40119		IL char02	IL char01	
40120	1	MS Byte	LS Byte	Internal port Interface Counters Diagnostic Validity
40121	2	MSB C00	C01	Internal port Num Octets Received
		C02	LSB C03	
40123	2	MSB C00	C01	Internal port Num Unicast Packets Received
		C02	LSB C03	
40125	2	MSB C00	C01	Internal port Num Non Unicast Packets Received
		C02	LSB C03	
40127	2	MSB C00	C01	Internal port Num Inbound Packets Discarded
		C02	LSB C03	
40129	2	MSB C00	C01	Internal port Num Inbound Packets Error detected
		C02	LSB C03	

Starting Address (Decimal)	Length (Words)	Register Byte Order		Comments
		MS BYTE	LS BYTE	
401331	2	MSB C00	C01	Internal port Num Inbound Packets Unknown
		C02	LSB C03	
40133	2	MSB C00	C01	Internal port Num Octets Sent
		C02	LSB C03	
40135	2	MSB C00	C01	Internal port Num Unicast Packets Sent
		C02	LSB C03	
40137	2	MSB C00	C01	Internal port Num Non Unicast Packets Sent
		C02	LSB C03	
40139	2	MSB C00	C01	Internal port Num Outbound Packets Discarded
		C02	LSB C03	
40141	2	MSB C00	C01	Internal port Num Outbound Packets Error detected
		C02	LSB C03	

Modbus Function Code 3: Ethernet Port 1 Diagnostic Data

Port 1 diagnostics start at address 40143 (decimal). As described in the following table, port 1 diagnostic data fields are the same as for the internal port, with the appropriate starting address offset.

Starting Address	Length	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40143	1	MS Byte	LS Byte	Port 1 Port Diagnostics Data Validity
...
40244	2	MSB C00	C01	Port 1 Num Outbound Packets Error detected
		C02	LSB C02	

Modbus Function Code 3: Ethernet Backplane Port Diagnostic Data

Backplane port diagnostics start at address 40246 (decimal). As described in the following table, backplane port diagnostic data fields are the same as for the internal port and port 1, with the appropriate starting address offset.

Starting Address	Length	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40246	1	MS Byte	LS Byte	Backplane Port Diagnostics Data Validity
...
40347	2	MSB C00	C01	Backplane Port Num Outbound Packets Error detected
		C02	LSB C02	

Modbus Function Code 3: Ethernet Port 3 Diagnostic Data

Port 3 diagnostics start at address 40349 (decimal). As described in the following table, port 3 diagnostic data fields are the same as for the internal port and ports 1 and 2, with the appropriate starting address offset.

Starting Address	Length	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40349	1	MS Byte	LS Byte	Port 3 Port Diagnostics Data Validity
...
40450	2	MSB C00	C01	Port 3 Num Outbound Packets Error detected
		C02	LSB C03	

Modbus Function Code 3: Ethernet Port 4 Diagnostic Data

Port 4 diagnostics start at address 40452 (decimal). As described in the following table, port 4 diagnostic data fields are the same as for the internal port and ports 1-3, with the appropriate starting address offset.

Starting Address	Length	Register Byte Order		Comments
		MS BYTE	LS BYTE	
40452	1	MS Byte	LS Byte	Port 4 Port Diagnostics Data Validity
...
40553	2	MSB C00	C01	Port 4 Num Outbound Packets Error detected
		C02	LSB C03	

Ethernet Port Not Present

If an Ethernet port is not physically present on the device, the relevant Modbus registers will return data = 0.

Modbus Function Code 3: Modbus TCP Port 502 Diagnostic Data

Modbus TCP port 502 diagnostics start at address 40555 (decimal) as described in the following table.

Starting Address	Length	Register Byte Order		Comments	
		MS BYTE	LS BYTE		
40555	2	MS Byte 00	Byte 01	Modbus TCP/Port 502 Diagnostic Data Validity	
		Byte 02	LS Byte 03		
40557	1	MS Byte	LS Byte	Port 502 Status	
40558	1	MS Byte	LS Byte	Num Open Connections	
40559	2	MSB C00	C01	Num MB Messages Sent	
		C02	LSB C03		
40561	2	MSB C00	C01	Num MB Messages Received	
		C02	LSB C03		
40563	1	MS Byte	LS Byte	Num MB Open Client Connections	
40564	1	MS Byte	LS Byte	Num MB Open Server Connections	
40565	1	MS Byte	LS Byte	Max Num Connections	
40566	1	MS Byte	LS Byte	Max Num Client Connections	
40567	1	MS Byte	LS Byte	Max Num Server Connections	
40568	2	MSB C00	C01	Num MB Detected Error Messages Sent	
		C02	LSB C03		
40570	1	MS Byte	LS Byte	Num Open Priority Connections	
40571	1	MS Byte	LS Byte	Max Num Priority Connections	
40572	1	MS Byte	LS Byte	Num Entries in Unauthorized Table	
40573	2	MSB - IP1	IP2	Remote IP Address 1	Connection 1
		IP3	LSB - IP4		
40575	1	MS Byte	LS Byte	Num Attempts to Open Unauthorized Connection 1	
40576	2	MSB - IP1	IP2	Remote IP Address 2	Connection 2
		IP3	LSB - IP4		
40578	2	MS Byte	LS Byte	Num Attempts to Open Unauthorized Connection 2	
...	
40663	2	MSB - IP1	IP2	Remote IP Address 31	Connection 31
		IP3	LSB - IP4		
40665	1	MS Byte	LS Byte	Num Attempts to Open Unauthorized Connection 31	

Starting Address	Length	Register Byte Order		Comments	
		MS BYTE	LS BYTE		
40666	2	MSB - IP1	IP2	Remote IP Address 32	Connection 32
		IP3	LSB - IP4		
40668	1	MS Byte	LS Byte	Num Attempts to Open Unauthorized Connection 32	

Modbus Function Code 3: Modbus TCP Port 502 Connection Table Data

Modbus TCP port 502 connection table data starts at address 40669 (decimal) as described in the following table.

Starting Address	Length	Register Byte Order		Comments	
		MS BYTE	LS BYTE		
40669	1	MS Byte	LS Byte	Connection Table Validity	
40670	1	MS Byte	LS Byte	Number of Entries	
40671	1	MS Byte	LS Byte	Starting Entry Index	
40672	1	MS Byte	LS Byte	Connection 1 Index	Connection 1
40673	2	IP1	IP2	Connection 1 Remote IP Address	
		IP3	IP4		
40675	1	MS Byte	LS Byte	Connection 1 Remote Port Number	
40676	1	MS Byte	LS Byte	Connection 1 Local Port Number	
40677	1	MS Byte	LS Byte	Num MB Messages Sent on Connection 1	
40678	1	MS Byte	LS Byte	Num MB Messages Received on Connection 1	
40679	1	MS Byte	LS Byte	Num MB Detected Error Messages Sent on Connection 1	
40680	1	MS Byte	LS Byte	Connection 2 Index	Connection 2
40681	2	IP1	IP2	Connection 2 Remote IP Address	
		IP3	IP4		
40683	1	MS Byte	LS Byte	Connection 2 Remote Port Number	
40684	1	MS Byte	LS Byte	Connection 2 Local Port Number	
40685	1	MS Byte	LS Byte	Num MB Messages Sent on Connection 2	
40686	1	MS Byte	LS Byte	Num MB Messages Received on Connection 2	
40687	1	MS Byte	LS Byte	Num MB Detected Error Messages Sent on Connection 2	

Starting Address	Length	Register Byte Order		Comments	
		MS BYTE	LS BYTE		
...	
41168	1	MS Byte	LS Byte	Connection 63 Index	Connection 63*
41169	2	IP1	IP2	Connection 63 Remote IP Address	
		IP3	IP4		
41171	1	MS Byte	LS Byte	Connection 63 Remote Port Number	
41172	1	MS Byte	LS Byte	Connection 63 Local Port Number	
41173	1	MS Byte	LS Byte	Num MB Messages Sent on Connection 63	
41174	1	MS Byte	LS Byte	Num MB Messages Received on Connection 63	
41175	1	MS Byte	LS Byte	Num MB Detected Error Messages Sent on Connection 63	
41176	1	MS Byte	LS Byte	Connection 64 Index	Connection 64*
41177	2	IP1	IP2	Connection 64 Remote IP Address	
		IP3	IP4		
415179	1	MS Byte	LS Byte	Connection 64 Remote Port Number	
41180	1	MS Byte	LS Byte	Connection 64 Local Port Number	
41181	1	MS Byte	LS Byte	Num MB Messages Sent on Connection 64	
41182	1	MS Byte	LS Byte	Num MB Messages Received on Connection 64	
41183	1	MS Byte	LS Byte	Num MB Detected Error Messages Sent on Connection 64	
*140 CRA 312 10 and BMX CRA 312 •0 RIO adapter modules support a maximum of 8 connections.					

Section 6.5

Diagnostics Available through EtherNet/IP CIP Objects

Introduction

Quantum Ethernet I/O applications use CIP within a producer/consumer model to provide communication services in an industrial environment. This section describes the available CIP objects for Quantum EIO modules.

What Is in This Section?

This section contains the following topics:

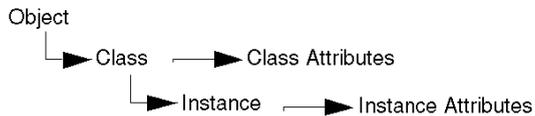
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About CIP Objects

Overview

The Ethernet communication module can access CIP data and services located in connected devices. The CIP objects and their content depend on the design of each device.

CIP object data and content are exposed—and accessed—hierarchically in the following nested levels:



NOTE:

You can use explicit messaging to access these items:

- Access a collection of instance attributes by including only the class and instance values for the object in the explicit message.
- Access a single attribute by adding a specific attribute value to the explicit message with the class and instance values for the object.

This chapter describes the CIP objects that the Ethernet communication module exposes to remote devices.

Identity Object

Overview

The Identity object presents the instances, attributes and services described below.

Class ID

01

Instance IDs

The Identity object presents two instances:

- 0: class
- 1: instance

Attributes

Identity object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID		Description	Type	GET	SET
hex	dec				
01	01	Vendor ID	UINT	X	—
02	02	Device Type	UINT	X	—
03	03	Product Code	UINT	X	—
04	04	Revision	STRUCT	X	—
		Major	USINT		
		Minor	USINT		
X = supported — = not supported					

Attribute ID		Description	Type	GET	SET
hex	dec				
05	05	Status bit 2: 0x01=the module is configured bits 4-7: 0x03=no I/O connections established 0x06=at least 1 I/O connection in run mode 0x07=at least 1 I/O connection established, all in IDLE mode	Word	X	—
06	06	Serial Number	UDINT	X	—
07	07	Product Name	STRING	X	—
18	24	Modbus Identity	STRUCT	X	—
X = supported — = not supported					

Services

The Identity object performs the following services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns: <ul style="list-style-type: none"> all class attributes (instance = 0) instance attributes 1 to 7 (instance = 1)
0E	14	Get_Attribute_Single	X	X	Returns the value of the specified attribute.
X = supported — = not supported					

Assembly Object

Overview

The Assembly object consists of the attributes and services described below.

NOTE: You can send an explicit message to the Assembly object only when no other connections have been established that read from or write to this object. For example, you can send an explicit message to the Assembly object if a local slave instance is enabled, but no other module is scanning that local slave.

Class ID

04

Instance IDs

The Assembly object presents the following instance identifiers:

- 0: class
- 101, 102, 111, 112, 121, 122: instance

Attributes

The Assembly object consists of the following attributes:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
03	Number of Instances	X	—
X = supported — = not supported			

Instance attributes:

Instance ID	Attribute ID	Description	Type	GET	SET
101	03	Local slave 1: T->O input data	Array of BYTE	X	—
102		Local slave 1: O>T	Array of BYTE	X	X
111		Local slave 2: T->O input data	Array of BYTE	X	—
112		Local slave 2: O>T	Array of BYTE	X	X
121		Local slave 3: T->O input data	Array of BYTE	X	—
122		Local slave 3: O>T	Array of BYTE	X	X
X = supported — = not supported					

Services

The CIP Assembly object performs these services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
0E	14	Get_Attribute_Single	X	X	Returns the value of the specified attribute
10	16	Set_Attribute_Single ¹	—	X	Returns these values: 0E=attribute not settable: assembly is not o->T type 0F=permission denied: assembly is being used by an active connection 13=config too small: the Set_Attribute_Single command contains partial data 15=data too big: the Set_Attribute_Single command contains too much data
X = supported — = not supported					
1. When valid, the size of the data written to the Assembly object using the Set_Attribute_Single service equals the size of the Assembly object as configured in the target module.					

Connection Manager Object

Overview

The Connection Manager object presents the instances, attributes and services described below.

Class ID

06

Instance IDs

The Connection Manager object presents two instance values:

- 0: class
- 1: instance

Attributes

Connection Manager object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID		Description	Type	GET	SET	Value
hex	dec					
01	01	Open Requests	UINT	X	X	Number of Forward Open service requests received
02	02	Open Format Rejects	UINT	X	X	Number of Forward Open service requests that were rejected due to bad format
03	03	Open Resource Rejects	UINT	X	X	Number of Forward Open service requests that were rejected due to lack of resources
X = supported — = not supported						

Attribute ID		Description	Type	GET	SET	Value
hex	dec					
04	04	Open Other Rejects	UINT	X	X	Number of Forward Open service requests that were rejected for reasons other than bad format or lack of resources
05	05	Close Requests	UINT	X	X	Number of Forward Close service requests received
06	06	Close Format Requests	UINT	X	X	Number of Forward Close service requests that were rejected due to bad format
07	07	Close Other Requests	UINT	X	X	Number of Forward Close service requests that were rejected for reasons other than bad format
08	08	Connection Timeouts	UINT	X	X	Total number of connection timeouts that occurred in connections controlled by this connections manager
09	09	Connection Entry List	STRUCT	X	—	0 (Unsupported optional item)
0B	11	CPU_Utilization	UINT	X	—	0 (Unsupported optional item)
0C	12	MaxBufSize	UDINT	X	—	0 (Unsupported optional item)
0D	13	BufSize Remaining	UDINT	X	—	0 (Unsupported optional item)
X = supported — = not supported						

Services

The Connection Manager object performs the following services on the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns the value of all attributes.
0E	14	Get_Attribute_Single	X	X	Returns the value of the specified attribute.
X = supported — = not supported					

Quality Of Service (QoS) Object

Overview

The QoS object implements Differentiated Services Code Point (DSCP or *DiffServe*) values for the purpose of providing a method of prioritizing Ethernet messages. The QoS object presents the instances, attributes and services described below.

Class ID

48 (hex), 72 (decimal)

Instance IDs

The QoS object presents two instance values:

- 0: class
- 1: instance

Attributes

The QoS object consists of the following attributes:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID	Description	Type	GET	SET	Value
04	DSCP Urgent	USINT	X	X	For CIP transport class 0/1 Urgent priority messages, default value = 55.
05	DSCP Scheduled	USINT	X	X	For CIP transport class 0/1 Urgent priority messages, default value = 47.
06	DSCP High	USINT	X	X	For CIP transport class 0/1 Urgent priority messages, default value = 43.
07	DSCP Low	USINT	X	X	For CIP transport class 0/1 Urgent priority messages, default value = 31.
08	DSCP Explicit	USINT	X	X	For CIP explicit messages (transport class 2/3 and UCMM), default value = 27.
X = supported — = not supported					

NOTE: A change in the instance attribute value takes effect on device re-start, for configurations made from flash memory.

Services

The QoS object performs the following services upon the listed object types:

Service ID		Description	Class	Instance
hex	dec			
0E	14	Get_Attribute_Single	X	X
10	16	Set_Attribute_Single	—	X
X = supported — = not supported				

TCP/IP Interface Object

Overview

The TCP/IP interface object presents the instances (per network), attributes and services described below.

Class ID

F5 (hex), 245 (decimal)

Instance IDs

The TCP/IP interface object presents 2 instance values:

- 0: class
- 1: instance

Attributes

TCP/IP interface object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID	Description	Type	GET	SET	Value
01	Status	DWORD	X	—	0x01
02	Configuration Capability	DWORD	X	—	0x01 = from BootP 0x11 = from flash 0x00 = other
03	Configuration Control	DWORD	X	X	0x01 = out-of-box default
04	Physical Link Object	STRUCT	X	—	
	Path Size	UINT			
	Path	Padded EPATH			
X = supported — = not supported					

Attribute ID	Description	Type	GET	SET	Value
05	Interface Configuration	STRUCT	X	X	0x00 = out-of-box default
	IP Address	UDINT			
	Network Mask	UDINT			
	Gateway Address	UDINT			
	Name Server	UDINT			
	Name Server 2	UDINT			
	Domain Name	STRING			
06	Host Name	STRING	X	—	
X = supported — = not supported					

Services

The TCP/IP interface object performs the following services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns the value of all attributes.
0E	14	Get_Attribute_Single	X	X	Returns the value of the specified attribute.
10	16	Set_Attribute_Single ¹	—	X	Sets the value of the specified attribute.
X = supported — = not supported					
1. The Set_Attribute_Single service can execute only when these preconditions are satisfied:					
<ul style="list-style-type: none"> ● Configure the Ethernet communication module to obtain its IP address from flash memory. ● Confirm that the PLC is in stop mode. 					

Ethernet Link Object

Overview

The Ethernet Link object consists of the instances, attributes and services described below.

Class ID

F6 (hex), 246 (decimal)

Instance IDs

The Ethernet Link object presents the following instance values:

- 0: class
- 1: port 1
- 2: port 2
- 3: port 3
- 4: port 4

Attributes

The Ethernet Link object presents the following attributes:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
03	Number of Instances	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID		Description	Type	GET	SET	Value
hex	dec					
01	01	Interface Speed	UDINT	X	—	Valid values include: 0, 10000000, 100000000
02	02	Interface Flags	DWORD	X	—	Bit 0: link status 0 = Inactive 1 = Active
						Bit 1: duplex mode 0 = half duplex 1 = full duplex
						Bits 2—4: negotiation status 3 = successfully negotiated speed and duplex 4 = forced speed and link
						Bit 5: manual setting requires reset 0 = automatic 1 = device need reset
						Bit 6: local hardware detected error 0 = no event 1 = event detected
03	03	Physical Address	ARRAY of 6 USINT	X	—	module MAC address
04	04	Interface Counters	STRUCT	X	—	
		In octets	UDINT			octets received on the interface
		In Ucast Packets	UDINT			unicast packets received on the interface
		In NUCast Packets	UDINT			non-unicast packets received on the interface
		In Discards	UDINT			inbound packets received on the interface, but discarded
		In Errors	UDINT			inbound packets with detected errors (does not include in discards)
		In Unknown Protos	UDINT			inbound packets with unknown protocol
		Out Octets	UDINT			octets sent on the interface
		Out Ucast Packets	UDINT			unicast packets sent on the interface
		Out NUCast Packets	UDINT			non-unicast packets sent on the interface
		Out Discards	UDINT			outbound packets discarded
		Out Errors	UDINT			outbound packets with detected errors
X = supported — = not supported						

Attribute ID		Description	Type	GET	SET	Value
hex	dec					
05	05	Media Counters	STRUCT	X	—	
		Alignment Errors	UDINT			frames that are not an integral number of octets in length
		FCS Errors	UDINT			bad CRC — frames received do not pass the FCS check
		Single Collisions	UDINT			successfully transmitted frames that experienced exactly 1 collision
		Multiple Collisions	UDINT			successfully transmitted frames that experienced more than 1 collision
		SQE Test Errors	UDINT			number of times the detected SQE test error is generated
		Deferred Transmissions	UDINT			frames for which first transmission attempt is delayed because the medium is busy
		Late Collisions	UDINT			number of times a collision is detected later than 512 bit times into the transmission of a packet
		Excessive Collisions	UDINT			frames that do not transmit due to excessive collisions
		MAC Transmit Errors	UDINT			frames that do not transmit due to a detected internal MAC sublayer transmit error
		Carrier Sense Errors	UDINT			times that the carrier sense condition was lost or not asserted when attempting to transmit a frame
		Frame Too Long	UDINT			frames received that exceed the maximum permitted frame size
MAC Receive Errors	UDINT			frames not received on an interface due to a detected internal MAC sublayer receive error		
X = supported — = not supported						

Attribute ID		Description	Type	GET	SET	Value
hex	dec					
06	06	Interface Control	STRUCT	X	X	API of the connection
		Control Bits	WORD			Bit 0: Auto-negotiation 0 = disabled 1 = enabled Note: When auto-negotiation is enabled, 0x0C (object state conflict) is returned when attempting to set either: <ul style="list-style-type: none"> forced interface speed or forced duplex mode
		Forced Interface Speed	UINT			Bit 1: forced duplex mode (if auto-negotiation bit = 0) 0 = half duplex 1 = full duplex Valid values include: 10000000, 100000000 Note: Attempting to set any other value returns the detected error 0x09 (invalid attribute value)
10	16	Interface Label	SHORT_STRING	X	—	A fixed textual string identifying the interface, that should include 'internal' for internal interfaces. Maximum number of characters is 64.
X = supported — = not supported						

Services

The Ethernet Link object performs the following services upon the listed object types:

Service ID		Description	Class	Instance
hex	dec			
01	01	Get_Attributes_All	X	X
10	16	Set_Attribute_Single	—	X
0E	14	Get_Attribute_Single	X	X
4C	76	Get_and_Clear	—	X
X = supported — = not supported				

EtherNet/IP Interface Diagnostics Object

Overview

The EtherNet/IP Interface Diagnostics object presents the instances, attributes and services described below.

Class ID

350 (hex), 848 (decimal)

Instance IDs

The EtherNet/IP Interface object presents two instance values:

- 0: class
- 1: instance

Attributes

EtherNet/IP Interface Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID	Description	Type	GET	SET	Value
01	Protocols Supported	UINT	X	—	
02	Connection Diagnostics	STRUCT	X	—	
	Max CIP IO Connections opened	UINT			Number of Class 1 connections opened since the last reset
	Current CIP IO Connections	UINT			Number of Class 1 connections currently opened
	Max CIP Explicit Connections opened	UINT			Number of Class 3 connections opened since the last reset
	Current CIP Explicit Connections	UINT			Number of Class 3 connections currently opened
	CIP Connections Opening Errors	UINT			Increments each time a Forward Open is not successful (Originator and Target)
	CIP Connections Timeout Errors	UINT			Increments when a connection times out (Originator and Target)
	Max EIP TCP Connections opened	UINT			Number of TCP connections (used for EIP, as client or server) opened since the last reset
	Current EIP TCP Connections	UINT			Number of TCP connections (used for EIP, as client or server) currently open
03	IO Messaging Diagnostics	STRUCT	X	X	
	IO Production Counter	UDINT			Increments each time a Class 0/1 message is sent
	IO Consumption Counter	UDINT			Increments each time a Class 0/1 message is received
	IO Production Send Errors Counter	UINT			Increments each time a Class 0/1 message is not sent
	IO Consumption Receive Errors Counter	UINT			Increments each time a consumption is received with a detected error
04	Explicit Messaging Diagnostics	STRUCT	X	X	
	Class 3 Msg Send Counter	UDINT			Increments each time a Class 3 message is sent (client and server)
	Class 3 Msg Receive Counter	UDINT			Increments each time a Class 3 message is received (client and server)
	UCMM Msg Receive Counter	UDINT			Increments each time a UCMM message is sent (client and server)
	UCMM Msg Receive Counter	UDINT			Increments each time a UCMM message is received (client and server)
X = supported — = not supported					

Services

The EtherNet/IP Interface Diagnostics object performs the following services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns the value of all attributes.
0E	14	Get_Attribute_Single	—	X	Returns the value of the specified attribute.
4C	76	Get_and_Clear	—	X	Returns and clears the values of all instance attributes.
X = supported — = not supported					

EtherNet/IP IO Scanner Diagnostics Object

Overview

The EtherNet/IP IO Scanner Diagnostics object presents the instances, attributes and services described below.

Class ID

351 (hex), 849 (decimal)

Instance IDs

The EtherNet/IP IO Scanner Diagnostics object presents two instances:

- 0: class
- 1: instance

Attributes

EtherNet/IP IO Scanner Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 (instance attributes):

Attribute ID	Description	Type	GET	SET
01	IO Status Table	STRUCT	X	—
	Size	UINT		
	Status	ARRAY of UNINT		
X = supported — = not supported				

Services

The EtherNet/IP IO Scanner Diagnostics object performs the following services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns the value of all attributes.
0E	14	Get_Attribute_Single	X	X	Returns the value of the specified attribute.

X = supported
— = not supported

IO Connection Diagnostics Object

Overview

The IO Connection Diagnostics object presents the instances, attributes and services described below.

Class ID

352 (hex), 850 (decimal)

Instance IDs

The IO Connection Diagnostics object presents two instance values:

- 0: class
- 1...256: instance (The instance number is the connection number in the configuration.)

Attributes

IO Connection Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 to 256 (instance attributes):

Attribute ID	Description	Type	GET	SET	Value
01	IO Communication Diagnostics	STRUCT	X	X	
	IO Production Counter	UDINT			Increments at each production
	IO Consumption Counter	UDINT			Increments at each consumption
	IO Production Send Errors Counter	UINT			Increments each time a production is not sent
	IO Consumption Receive Errors Counter	UINT			Increments each time a consumption is received with a detected error
	CIP Connection Timeout Errors	UINT			Increments when a connection times out
	CIP Connection Opening Errors	UINT			Increments each time a connection is unable to open
	CIP Connection State	UINT			State of the Connection Bit
	CIP Last Error General Status	UINT			General status of the last error detected on the connection
	CIP Last Error Extended Status	UINT			Extended status of the last error detected on the connection
	Input Communication Status	UINT			Communication status of the inputs (see table, below)
	Output Communication Status	UINT			Communication status of the outputs (see table, below)
X = supported — = not supported					

Attribute ID	Description	Type	GET	SET	Value
02	Connection Diagnostics	STRUCT	X	X	
	Production Connection ID	UDINT			Connection ID for production
	Consumption Connection ID	UDINT			Connection ID for consumption
	Production RPI	UDINT			RPI for production
	Production API	UDINT			API for production
	Consumption RPI	UDINT			RPI for consumption
	Consumption API	UDINT			API for consumption
	Production Connection Parameters	UDINT			Connection parameters for production
	Consumption Connection Parameters	UDINT			Connection parameters for consumption
	Local IP	UDINT			—
	Local UDP Port	UINT			—
	Remote IP	UDINT			—
	Remote UDP Port	UINT			—
	Production Multicast IP	UDINT			Multicast IP used for production (or 0)
	Consumption Multicast IP	UDINT			Multicast IP used for consumption (or 0)
	Protocols Supported	UDINT			Protocol supported on the connection: 1 = EtherNet/IP
X = supported — = not supported					

The following values describe the structure of the instance attributes: *CIP Connection State*, *Input Communication Status*, and *Output Communication Status*:

Bit Number	Description	Values
15...3	<i>Reserved</i>	0
2	Idle	0 = no idle notification 1 = idle notification
1	Consumption inhibited	0 = consumption started 1 = no consumption
0	Production inhibited	0 = production started 1 = no production

Services

The EtherNet/IP Interface Diagnostics object performs the following services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns the value of all attributes.
0E	14	Get_Attribute_Single	—	X	Returns the value of the specified attribute.
4C	76	Get_and_Clear	—	X	Returns and clears the values of all instance attributes.

X = supported
— = not supported

EtherNet/IP Explicit Connection Diagnostics Object

Overview

The EtherNet/IP Explicit Connection Diagnostics object presents the instances, attributes and services described below.

Class ID

353 (hex), 851 (decimal)

Instance IDs

The EtherNet/IP Explicit Connection Diagnostics object presents two instance values:

- 0: class
- 1...*N*: instance (*N* = maximum concurrent number of explicit connections)

Attributes

EtherNet/IP Explicit Connection Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID hex	Description	Value	GET	SET
01	Revision	1	X	—
02	Max Instance	0... <i>N</i>	X	—
X = supported — = not supported				

Instance ID = 1 to *N*(instance attributes):

Attribute ID hex	Description	Type	GET	SET	Value
01	Originator connection ID	UDINT	X	—	Originator to target connection ID
02	Originator IP	UINT	X	—	
03	Originator TCP Port	UDINT	X	—	
04	Target connection ID	UDINT	X	—	Target to originator connection ID
05	Target IP	UDINT	X	—	
06	Target TCP Port	UDINT	X	—	
07	Msg Send Counter	UDINT	X	—	Incremented each time a Class 3 CIP message is sent on the connection
08	Msg Receive counter	UDINT	X	—	Increments each time a Class 3 CIP message is received on the connection
X = supported — = not supported					

Services

The EtherNet/IP Explicit Connection Diagnostics object performs the following services upon the listed object type:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	Returns the value of all attributes.
X = supported — = not supported					

EtherNet/IP Explicit Connection Diagnostics List Object

Overview

The EtherNet/IP Explicit Connection Diagnostics List object presents the instances, attributes and services described below.

Class ID

354 (hex), 852 (decimal)

Instance IDs

The EtherNet/IP Explicit Connection Diagnostics List object presents two instance values:

- 0: class
- 1...*N*: instance

Attributes

EtherNet/IP Explicit Connection Diagnostics List object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

Attribute ID	Description	GET	SET
01	Revision	X	—
02	Max Instance	X	—
X = supported — = not supported			

Instance ID = 1 to N (instance attributes):

Attribute ID	Description	Type	GET	SET	Value
01	Number of connections	UINT	X	—	Total number of opened explicit connections
02	Explicit Messaging Connections Diagnostic List	ARRAY of STRUCT	X	—	
	Originator connection ID	UDINT			O->T connection ID
	Originator IP	UINT			—
	Originator TCP port	UDINT			—
	Target connection ID	UDINT			T->O connection ID
	Target IP	UDINT			—
	Target TCP port	UDINT			—
	Msg Send counter	UDINT			Increments each time a Class 3 CIP message is sent on the connection
Msg Receive counter	UDINT			Increments each time a Class 3 CIP message is received on the connection	
X = supported — = not supported					

Services

The EtherNet/IP Explicit Connection Diagnostics object performs the following services upon the listed object types:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	—	Returns the value of all attributes.
08	08	Create	X	—	—
09	09	Delete	—	X	—
4B	75	Explicit_Connections_Diagnostic_Read	—	X	—
X = supported — = not supported					

RSTP Diagnostics Object

Overview

The RSTP Diagnostics object presents the instances, attributes and services described below.

Class ID

355 (hex), 853 (decimal)

Instance IDs

The RSTP Diagnostics object presents these instance values:

- 0: class
- 1: instance

Attributes

RSTP Diagnostics object attributes are associated with each instance.

Instance ID = 0 (class attributes):

Attribute ID	Description	Type	GET	SET
01	Revision: This attribute specifies the current revision of the RSTP Diagnostic Object. The revision is increased by 1 at each new update of the object.	UINT	X	—
02	Max Instance: This attribute specifies the maximum number of instances that may be created for this object on a per device basis (for example, an RSTP Bridge). There is 1 instance for each RSTP port on a device.	UINT	X	—
X = supported — = not supported				

Instance ID = 1 to *N*(instance attributes):

Attribute ID	Description	Type	GET	CLEAR	Value
01	Switch Status	STRUCT	X	—	—
	Protocol Specification	UINT	X	—	Refer to RFC-4188 for attribute definitions and value range. In addition, the following value is defined: [4]: the protocol is IEEE 802.1D-2004 and IEEE 802.1W
	Bridge Priority	UDINT	X	—	Refer to RFC-4188 for attribute definitions and value range.
	Time Since Topology Change	UDINT	X	—	
	Topology Change Count	UDINT	X	—	Refer to RFC-4188 for attribute definitions and value range.
	Designated Root	String	X	—	Refer to RFC-4188 for attribute definitions and value range.
	Root Cost	UDINT	X	—	
	Root Port	UDINT	X	—	
	Max Age	UINT	X	—	
	Hello Time	UINT	X	—	
	Hold Time	UDINT	X	—	
	Forward Delay	UINT	X	—	
	Bridge Max Age	UINT	X	—	
	Bridge Hello Time	UINT	X	—	
Bridge Forward Delay	UINT	X	—		
X = supported — = not supported					

Attribute ID	Description	Type	GET	CLEAR	Value
02	Port Status	STRUCT	X	X	—
	Port	UDINT	X	X	Refer to RFC-4188 for attribute definitions and value range.
	Priority	UDINT	X	X	
	State	UINT	X	X	
	Enable	UINT	X	X	
	Path Cost	UDINT	X	X	
	Designated Root	String	X	X	
	Designated Cost	UDINT	X	X	
	Designated Bridge	String	X	X	
	Designated Port	String	X	X	
Forward Transitions Count	UDINT	X	X	Refer to RFC-4188 for attribute definitions and value range. Services: <ul style="list-style-type: none"> ● Get_and_Clear: The current value of this parameter is returned with the response message. ● other services: The current value of this parameter is returned without being cleared. 	
X = supported — = not supported					

Attribute ID	Description	Type	GET	CLEAR	Value
03	Port Mode	STRUCT	X	—	—
	Port Number	UINT	X	—	This attribute indicates the port number for a data query. The value range is configuration dependent. For a 4-port Ethernet device, as an instance, the valid range is 1...4.
	Admin Edge Port	UINT	X	—	This attribute indicates if this is a user-configured edge port: <ul style="list-style-type: none"> ● 1: true ● 2: false Other values are not valid.
	Oper Edge Port	UINT	X	—	This attribute indicates if this port is currently an edge port: <ul style="list-style-type: none"> ● 1: true ● 2: false Other values are not valid.
	Auto Edge Port	UINT	X	—	This attribute indicates if this port is a dynamically determined edge port: <ul style="list-style-type: none"> ● 1: true ● 2: false Other values are not valid.
X = supported — = not supported					

Services

The RSTP Diagnostics object performs these services:

Service ID		Description	Class	Instance	Notes
hex	dec				
01	01	Get_Attributes_All	X	X	This service returns: <ul style="list-style-type: none"> ● all attributes of the class ● all attributes of the instance of the object
02	02	Get_Attribute_Single	X	X	This service returns: <ul style="list-style-type: none"> ● the contents of a single attribute of the class ● the contents of the instance of the object as specified Specify the attribute ID in the request for this service.
32	50	Get_and_Clear	—	X	This service returns the contents of a single attribute of the instance of the object as specified. Then the relevant counter-like parameter(s) within the specified attribute are cleared. (Specify the attribute ID in the request for this service.)
X = supported — = not supported					

Service Port Control Object

Overview

The Service Port Control object is defined for port control purposes.

Class ID

400 (hex), 1024 (decimal)

Instance IDs

The Service Port Control object presents these instance Values:

- 0: class
- 1: instance

Attributes

Service Port Control object attributes are associated with each instance.

Required class attributes (instance 0):

Attribute ID	Description	Type	Get	Set
01	Revision	UINT	X	—
02	Max Instance	UINT	X	—
X = supported — = not supported				

Required instance attributes (instance 1):

Attribute ID		Description	Type	Get	Set	Value
hex	dec					
01	01	Port Control	UINT	X	X	0 (default): disabled 1: access port 2: port mirroring 3: extended port
02	02	Mirror	UINT	X	X	bit 0 (default): ETH2 port bit 1: ETH3 port bit 2: ETH4 port bit 3: internal port
X = supported — = not supported						

NOTE:

- If the SERVICE/EXTEND port is not configured for port mirroring, the mirror attribute is ignored. If the value of a parameter request is outside the valid range, the service request is ignored.
- In port mirroring mode, the SERVICE/EXTEND port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE/EXTEND port.

Services

The Service Port Control object performs these services for these object types:

Service ID		Name	Class	Instance	Description
hex	dec				
01	01	Get_Attributes_All	X	X	Get all attributes in a single message.
02	02	Set_Attributes_All	—	X	Set all attributes in a single message.
0E	14	Get_Attribute_Single	X	X	Get a single specified attribute.
10	16	Set_Attribute_Single	—	X	Set a single specified attribute.
X = supported — = not supported					

Section 6.6

Diagnostics Available through Control Expert

Introduction

The Quantum EIO modules support online actions. Use the online actions to perform these tasks:

- Display EtherNet/IP objects for the head module or a remote EtherNet/IP device.
- View and edit the service/extend port configuration parameters for the head module/
- Ping the head module or a remote EtherNet/IP or Modbus TCP device to confirm it is active on the Ethernet network.
- Connect to a remote device to perform these actions:
 - View the remote device's default parameter settings.
 - View the remote device's current parameter settings.
 - Edit and download to the remote device its editable parameter settings.

What Is in This Section?

This section contains the following topics:

Topic	Page
Device Services	171
EtherNet/IP Objects	172
Service Port Management (Online Action)	173
Pinging the 140CRP31200 Module	175
Displaying I/O Memory Consumption	177
Logging DTM Events to a Control Expert Logging Screen	178

Device Services

Access the Device Services Tab

The Control Expert IP configuration parameters apply to the 140 CRP 312 00 head module in the local rack. To access the **Device Services** tab, double-click on the 140 CRP 312 00 module (*see page 51*).

Device Services Parameters

These parameters are found on the Control Expert **Device Services** tab:

Field	Parameter	Description
Network Card	Card	IP address of the PC
CRP Diagnostics (See below.)	<ul style="list-style-type: none"> ● Connect ● Disconnect 	connection to the 140 CRP 312 00
	<ul style="list-style-type: none"> ● Online Action ● EtherNet/IP Explicit Message 	
	Apply	apply configuration

Access Online Action

In the **CRP Diagnostics** field, select **Connect** to connect to the PLC and press **Apply** to access the configuration tabs for **Online Action** or **EtherNet/IP Explicit Message**:

- **Online Action** configuration tabs:
 - EtherNet/IP Objects (*see page 172*)
 - Service Port (*see page 173*)
 - Ping (*see page 175*)
- EtherNet/IP Explicit Message (*see page 100*)

EtherNet/IP Objects

View Parameters

Use the **EtherNet/IP Objects** tab to view available EtherNet/IP parameters:

Step	Action	Comment
1	In Control Expert, access the module for Online Action.	Refer to Online Action (<i>see page 171</i>).
2	Double-click on the 140 CRP 312 00 module in the Control Expert rack view.	
3	Select the EtherNet/IP Objects tab.	View these parameters: <ul style="list-style-type: none">● Group/Parameters● Value● Unit
4	Press Refresh .	This action updates the screen with current parameters.

Service Port Management (Online Action)

Introduction

Configure the SERVICE port for the 140CRP31200 module on the Control Expert **Service Port** tab.

Access the Service Port Tab

Step	Action
1	In Control Expert, access the module for Online Action. Refer to Online Action (<i>see page 171</i>).
2	Double-click the 140CRP31200 module in the Control Expert rack view.
3	Select the Service Port tab.

Service Port Parameters

Field	Parameter	Value		Comment
Service Port Mode	Access (default)	ETH1		You cannot edit the value in the Service Port Number field.
	Mirroring	ETH1		
Access Port Configuration	Service Port Number	ETH1		Service Port Mode = Mirroring (see note)
		ETH1		Service Port Mode = any available source port
Port Mirroring Configuration	Source Port(s)	Internal Port	Yes	Ethernet traffic destined for the module
			No	
		ETH2	Yes	traffic through the 140CRP31200 INTERLINK port
			No	
		ETH3	Yes	Ethernet traffic through the first remote I/O port
			No	
		ETH4	Yes	Ethernet traffic through the second remote I/O port
			No	
Description	—	—	—	description of the source port

NOTE: In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE port.

Buttons on the **Service Port** tab:

Button	Description
Update	After you change Service Port parameters, press this button so that the module can use the new configuration.
Refresh	This button reads the latest Service Port configuration from the module.

On Line Behavior

The **Service Port** parameters are stored in the application, but you can reconfigure (change) the parameters in connected mode. Values that you reconfigure in connected mode are sent to the 140CRP31200 module through explicit messages. (The changed values are not stored, so a mismatch can exist between the parameters that are being used and those in the stored application.) If the module does not respond to the explicit messages, a message appears.

Limitations

The SERVICE port on the 140CRP31200 module has the same limitations as the cloud port of the dual-ring switch (DRS). Therefore, the cloud port on the module and the cloud port on the DRS can be connected to the same equipment.

For more information about considerations that apply to the use of the distributed I/O cloud port on the DRS, refer to the topic ***Predefined Configuration Files topic*** in the *Quantum Ethernet I/O System Planning Guide*.

Pinging the 140CRP31200 Module

Introduction

Use the Control Expert ping function to send an ICMP echo request to the 140CRP31200 head module. The request determines if the target device is present. If the target device is present, the request determines the time elapsed until an echo response from the target device is received.

Access the Ping Tab

Open the Control Expert **Ping** tab:

Step	Action
1	In Control Expert, access the 140CRP31200 head module for Online Action <i>(see page 171)</i> .
2	Double-click on the 140CRP31200 head module in the Control Expert rack view.
3	Select the Ping tab.

Ping Tab

This illustration shows the **Ping** tab and its parameters:

The screenshot shows the 'Ping' tab selected in a software interface. The interface has three tabs at the top: 'Module Information', 'Port Configuration', and 'Ping'. The 'Ping' tab is active. Below the tabs, there are two main sections. The first section is labeled 'Address' and contains a text box for 'IP Address' with the value '192.168.1.6'. The second section is labeled 'Ping' and contains a 'Ping' button, two checkboxes labeled 'Repeat (100ms)' and 'Stop on Error', and a 'Clear' button. To the right of these controls is a large text area labeled 'Ping Result' which is currently empty.

Ping parameters:

Field	Parameter	Value	Comment
Address	IP Address	—	IP address of the target module.
Ping	Repeat (100ms)	checked	Ping once.
		unchecked	Ping every 100 ms.
	Stop on Error	checked	Stop pinging when a detected communication error is displayed.
		unchecked	Continue pinging when a detected communication error is displayed.
	Ping (button)	—	Start pinging. (Click again to stop repeated pinging when no detected error is displayed.)
	Ping Result	—	This box reports the response to the ping.
	Clear (button)	—	Click this button to clear (empty) Ping Result .

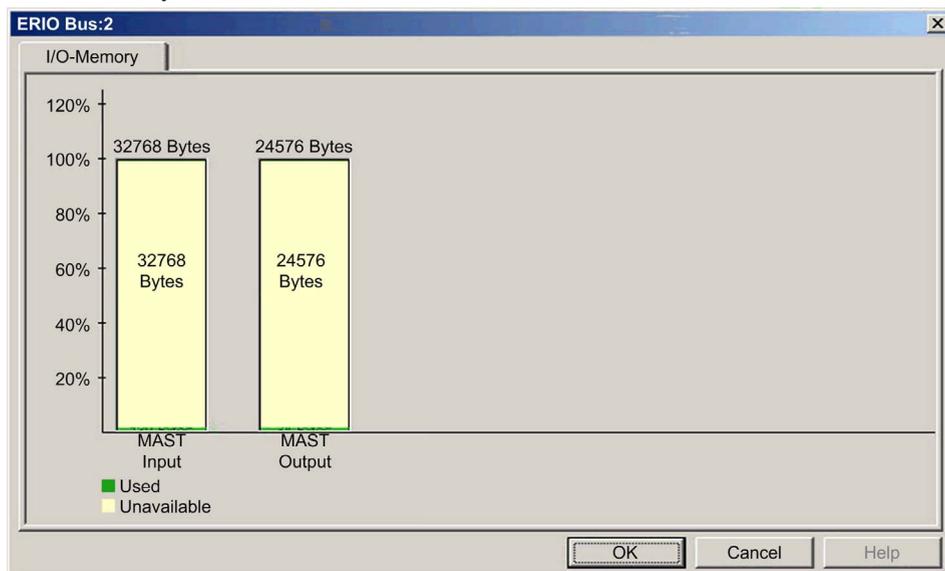
Displaying I/O Memory Consumption

Displaying Memory Consumption

In Control Expert you can monitor the I/O memory consumption by viewing the bus properties. Use one of these methods:

- In the **Project Browser**, right-click **Project** → **Configuration** → **EIO Bus** → **Properties**
- In the **Project Browser**, right-click **Project** → **Configuration** → **EIO [Quantum or Modicon X80] Drop** → **Properties**
- In background of the **EIO Bus** window, right-click **Bus properties**.
- In the **Edit** menu, scroll to **Bus properties**.

The **IO-Memory** screen looks like this:



Exceeding EIO Limitations

Control Expert displays a detected error in the log window if one of these events occurs:

- The size of the EIO memory exceeds 1400 input bytes or 1400 output bytes.
- The size of the EIO network exceeds 32768 input bytes or 24576 output bytes.
- The size of the EIO network exceeds 80% of the 32768 input bytes or 80% of the 24576 output bytes.

Logging DTM Events to a Control Expert Logging Screen

Description

Control Expert maintains a log of events for:

- the Control Expert embedded FDT container
- each Ethernet communication module DTM
- each EtherNet/IP remote device DTM

Events relating to the Control Expert FDT container are displayed in the **FDT log event** page of the **Output Window**.

Events relating to a communication module or remote EtherNet/IP device are displayed:

- in configuration mode: in the **Device Editor**, by selecting the **Logging** node in the left pane
- in diagnostic mode: in the **Diagnostics** window, by selecting the **Logging** node in the left pane

Logging Attributes

The **Logging** window displays the result of an operation or function performed by Control Expert. Each log entry includes the following attributes:

Attribute	Description	
Date/Time	The time the event occurred, displayed in the format: yyyy-mm--dd hh:mm:ss	
Log Level	The level of event importance. Values include:	
	Information	A successfully completed operation.
	Warning	An operation that Control Expert completed, but which may lead to a subsequent error.
	Error	An operation that Control Expert was unable to complete.
Message	A brief description of the core meaning of the event.	
Detail Message	A more detailed description of the event, which may include parameter names, location paths, etc.	

Accessing the Logging Screen

In Control Expert:

Step	Action
1	Open a project that includes a BME NOC 03•1 Ethernet communication module.
2	Click Tools → DTM Browser to open the DTM Browser .
3	In the DTM Browser , double-click the BME NOC 03•1 (or right-click Open) to open the configuration window.
4	Select Logging in the navigation tree in the left pane of the window.

Chapter 7

Firmware Upgrade

Introduction

This chapter describes the steps for upgrading the firmware for your 140CRP31200 head module and the 140CRA31200 or BMXCRA312*0 adapter module.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
140CRP31200 Firmware Upgrade	180
Adapter Firmware Upgrade	182

140CRP31200 Firmware Upgrade

OS

Use the Control Expert OS Loader to upgrade the firmware on the 140CRP31200 module. OS Loader was installed on your PC when you installed Control Expert. (The minimum required version of OS Loader is V6.0. The compatible version is included with your copy of Control Expert.)

A complete firmware upgrade includes the installation of these discrete files:

- kernel
- exec

The kernel and exec files are installed independently. Therefore, perform the firmware upgrade process two times (once for each file).

The name of the firmware file indicates the upgrade type (kernel or exec). Examples:

- kernel file name: CCS1_Noc_Kerl_OSLoader.bin
- exec file name: CCS1_Noc_Exec_OSLoader.bin

NOTE: These instructions assume that you are familiar with Control Expert. For more information about the OS Loader, refer to the chapter *OSLoader Screens (see EcoStruxure™ Control Expert, OS Loader, User Manual)*.

Upgrade Procedure

Follow these steps to upgrade either the firmware kernel or the firmware exec.

NOTE:

- We recommend that you update the kernel before you upgrade the exec. Both firmware upgrade files are installed in the same manner. The only difference is the name of the file you select.
- Confirm that there is no interruption to power or communications during the firmware upgrade process. Otherwise, the 140CRP31200 module can be damaged.
- During the firmware upgrade, the I/O communications with the adapter on the remote drop are interrupted. After the Hold up time (*see page 71*) expires, the I/O modules return to their fallback state.

Step	Action	Comment
1	Connect the PC that is running the Control Expert OS Loader directly to one of the module ports.	Available ports: <ul style="list-style-type: none"> ● SERVICE port: <ul style="list-style-type: none"> ○ 140CRP31200 head module ○ 140CRA31200 adapter (Quantum remote drop) ○ BMXCRA31210 adapter (Modicon X80 remote drop) ● INTERLINK port (140CRP31200) ● DRS port that is configured for a distributed I/O cloud

Step	Action	Comment
2	Launch OS Loader.	Start → Programs → EcoStruxure Control Expert → OS Loader .
3	Click Next to continue.	Go directly to the first installation step.
4	Select the FTP communication driver and press Next to continue.	The next screen displays a list of devices discovered by OS Loader. It also displays the FTP address for each discovered device.
5	In the Target Address area, type in the FTP Address of the 140CRP31200 module that is the target of the upgrade.	—
6	Click Next to continue. Perform these tasks at the next installation screen: a Select Download OS to device . b Click the Browse button to navigate to and select the desired firmware upgrade file.	—
7	Click Next . Perform these tasks at the next installation screen: a Compare the selected firmware File against the firmware already loaded in the Device . b Confirm that the Hardware ID for both the file and the device are the same	—
8	Click Next . On the summary page, click Download .	The OS Loader displays the progress of the FTP session. The download is complete when it displays the word SUCCESS .
9	Click Close .	The firmware download is finished.

The upgrade process takes approximately 2 minutes:

- 1 minute for firmware upgrade
- 1 minute to reboot and reestablish I/O connections

Hot Standby

Use these steps to upgrade the 140CRP31200 firmware in Hot Standby configurations:

Step	Action
1	Use the preceding instructions to upgrade the firmware for the 140CRP31200 in the standby rack. NOTE: During the firmware upgrade, the I/O communications with the remote drop's adapter and the 140CRP31200 module in the primary rack are not interrupted. However, the standby I/O communications with the adapter are interrupted.
2	When the firmware on the 140CRP31200 in the standby rack is upgraded, perform a manual switch-over that gives the newly upgraded standby rack the role of primary rack.
3	Upgrade the firmware for the adapter in the (new) standby rack to facilitate future Hot Standby switch-overs.

Adapter Firmware Upgrade

Overview

Use these procedures to upgrade the firmware for the 140CRA31200 or BMXCRA312•0 remote I/O adapter:

Stage	Description
1	Download and install Unity Loader software.
2	Configure and store IP parameters (optional).
3	Connect your configuration PC to the remote I/O adapter.
4	Transfer the firmware upgrade to the remote I/O adapter.

The minimum required version of Unity Loader is V2.2. (V2.3 is required for the BMXCRA312•0 adapter module and I/O modules in a Modicon X80 Ethernet remote I/O drop.)

Downloading and Installing Unity Loader

Download the Unity Loader software to your PC:

Step	Action
1	Enter the web address for Schneider Electric (www.schneider-electric.com) in an Internet browser.
2	In the Search from input field , enter the phrase Unity Loader and press Enter .
3	Examine the search results and select the appropriate entry for the Unity Loader software. NOTE: You can select the Download → Softwares menu command to filter the results.
4	Follow the on-screen instructions to download both the Unity Loader installation software and any necessary installation instructions.
5	Run the Unity Loader setup file and follow the instructions (on the screen and in the downloaded documentation) to install Unity Loader.

Default Address Configurations

If you wish, you can configure and store IP parameters for the remote drop's communications adapter when these conditions are met:

- The rotary switch setting is **Stored**.
- You have not configured and stored valid IP parameters

The adapter uses these default address configurations:

Parameter	Description
Default IP Address	The default IP address starts with 10.10 and uses the last 2 bytes of the MAC address. As an example, a device with the MAC address of 00:00:54:10:8A:05 has a default IP address of 10.10.138.5 (0x8A=138, 0x05=5).
Default Sub-Network Mask	The default mask is 255.0.0.0 (a class A mask).
Default Gateway Address	The default gateway address is identical to the default IP address.

The default address is based on the adapter's MAC address. This makes it possible for several Schneider Electric devices to use their default network configurations on the same network.

To use a specific set of IP parameters, store them in the adapter module. Set the rotary switches to the **Stored** position.

You can send an EtherNet/IP explicit message (*see page 93*) to the TCP/IP interface object (*see page 144*) of the module to store the configured IP parameters.

NOTE: The adapter uses the stored IP parameters only after a power cycle.

Connect the Configuration PC to the Remote I/O Adapter

Connect your configuration PC (that is running Unity Loader) directly to the 140CRA31200 or BMXCRA31210 adapter module. These ports are available:

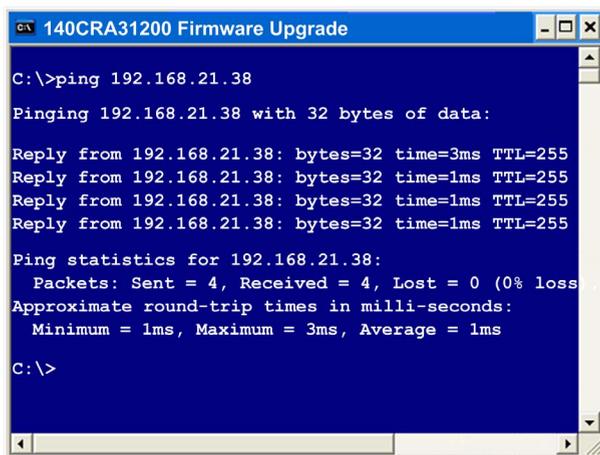
- SERVICE port
- DRS port that is configured for a distributed I/O cloud

NOTE: There is no SERVICE port on the BMXCRA31200 adapter.

Verify that communications are established between the PC and the adapter by issuing a Ping command from the PC:

Step	Action	Comment
1	Open a command window on the PC.	Start → Run.
2	In the Run dialog, type in cmd .	
3	Click OK .	
4	At the command prompt, type in the ping command and the device IP address.	Example: C:\>ping 192.168.21.38:

The command window verifies that a connection is established:



```

C:\>ping 192.168.21.38
Pinging 192.168.21.38 with 32 bytes of data:

Reply from 192.168.21.38: bytes=32 time=3ms TTL=255
Reply from 192.168.21.38: bytes=32 time=1ms TTL=255
Reply from 192.168.21.38: bytes=32 time=1ms TTL=255
Reply from 192.168.21.38: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.21.38:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
    Approximate round-trip times in milli-seconds:
        Minimum = 1ms, Maximum = 3ms, Average = 1ms

C:\>

```

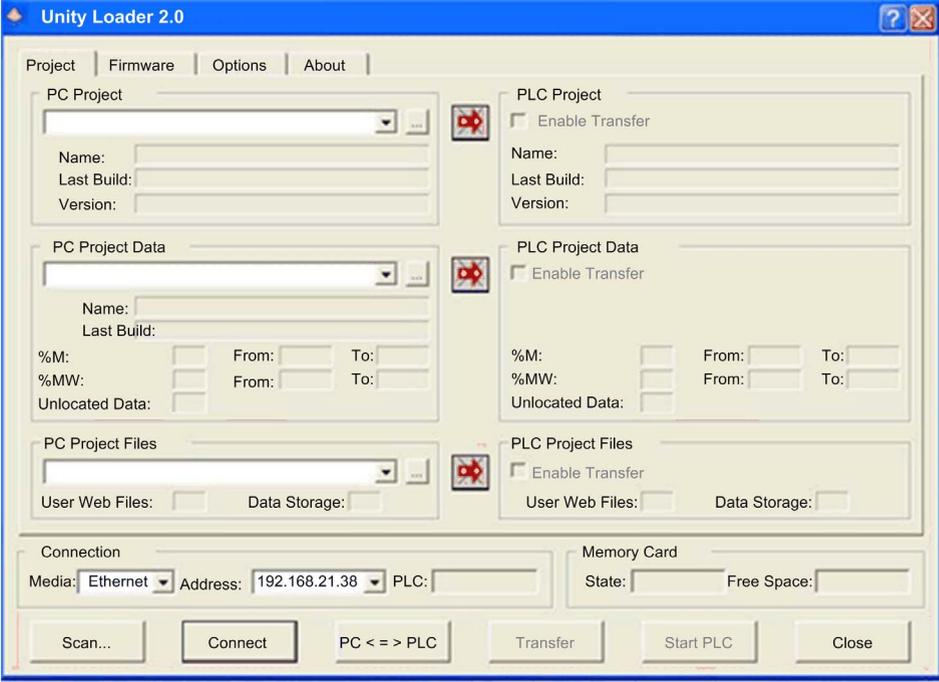
Upgrade Procedure

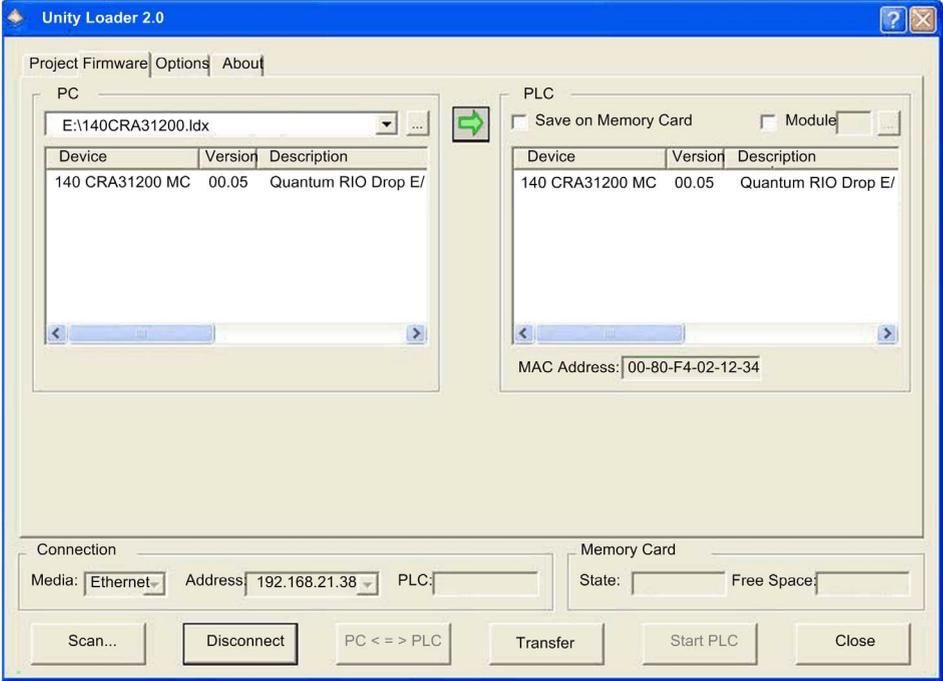
Do not interrupt the firmware download process:

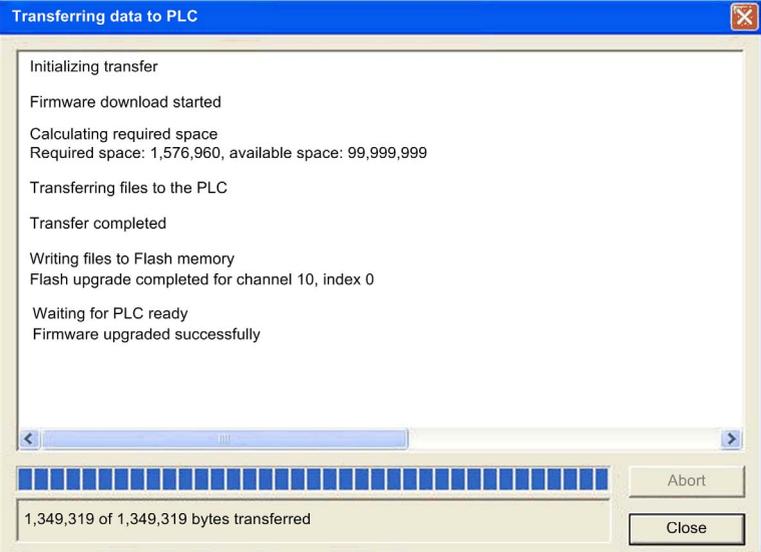
- Do not allow an interruption to the power or the communications during the firmware upgrade process.
- Do not shut down the Unity Loader software during the upgrade.

If the firmware download process is interrupted, the new firmware is not installed and the adapter continues to use the old firmware. If an interruption occurs, restart the process.

Open Unity Loader on your PC and update the firmware for the remote I/O adapter:

Step	Action
1	<p>Open Unity Loader on your PC. (Start → Programs → Schneider Electric → Unity Loader) Unity Loader opens and displays the Project tabM</p> 

Step	Action
2	<p>In the Connection area of the Project page, connect to the module:</p> <ul style="list-style-type: none"> ● In the Media list, select Ethernet. ● In the Address field, type in the IP address of the adapter, which is either: <ul style="list-style-type: none"> ○ <i>configured</i>: The adapter is already communicating on the network and the IP address for the module is configured in the application (<i>see page 59</i>). ○ <i>default</i>: The adapter's rotary switch position is Stored and you did not already store valid IP parameters. ● Click Connect.
3	<p>After Unity Loader has connected to the module, click the Firmware tab:</p>
4	<p>In the PC area, click the ellipsis (...) button to open a dialog where you can navigate to and select the firmware file for the network connectivity module. The firmware is contained in a Unity Loader file (.Idx extension).</p> <p>After you select the firmware file and close the dialog, the selected revision of this firmware is displayed in the list on the left, and the current version of the firmware is displayed in the list on the right.</p> 
5	<p>When the arrow in the middle of the screen (above) is green, click Transfer.</p> <p>NOTE: Only click Transfer if the arrow is green. A yellow arrow indicates that the firmware file on your computer is the same version or newer than the file selected for transfer; a red arrow indicates that the firmware on the computer is not compatible with the remote I/O adapter.</p>

Step	Action
6	<p>Click yes on the 2 dialogs that appear. A third dialog appears (below), which indicates the transfer status with the blue bars at the bottom of the screen. After the transfer is complete, click Close.</p>  <p>NOTE: If you are upgrading firmware for more than one remote I/O adapter, additional dialogs will appear. Click yes to close each dialog.</p>
7	In the Unity Loader software, click Disconnect and close the window.
8	Reboot the module to finalize the firmware update.

The upgrade process takes approximately 2 minutes:

- firmware upgrade (1 minute)
- reboot, reestablish I/O connections (1 minute)

During the firmware upgrade, the I/O communications with the adapter module may be interrupted. After the Hold up time (*see page 71*) expires, the I/O modules return to their fallback state.



A

adapter

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

ART

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

B

broadcast

A message sent to devices in the subnet.

C

CCOTF

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

CIP™

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

control network

An Ethernet-based network containing PLCs, SCADA systems, an NTP server, PCs, AMS, switches, etc. Two kinds of topologies are supported:

- flat — Devices in this network belong to the same subnet.
- 2 levels — The network is split into an operation network and an inter-controller network. These 2 networks can be physically independent, but are generally linked by a routing device.

D**DDT**

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

determinism

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

device network

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

distributed I/O device

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

distributed I/O network

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

DRS

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

DRSs require a firmware version 6.0 or later.

DTM

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

See *FDT*.

E

Ethernet

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

EtherNet/IP™

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

explicit messaging

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

F

FBD

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

FDT

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

G

gateway

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

H

Hot Standby

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

I

I/O scanning

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

implicit messaging

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

interlink port

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

IP address

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

L

local rack

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

M

MAST

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

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

multicast

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

P**PLC**

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

port mirroring

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

NOTE: In port mirroring mode, the SERVICE port acts like a read-only port. That is, you cannot access devices (ping, connection to Control Expert, etc.) through the SERVICE port on the module.

R**remote I/O drop**

One of the 3 types of remote I/O devices in an Ethernet remote I/O network. A remote I/O drop is a Quantum or an X80 rack of I/O modules that are connected to an Ethernet remote I/O network and managed by an Ethernet remote adapter module. A drop can be a single rack or a rack with an extension rack.

remote I/O main ring

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

remote I/O network

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

RPI

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

RSTP

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

S

S908 legacy remote I/O

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

service port

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

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

SNMP

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

T

TCP/IP

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

trap

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

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

U

UDP

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



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