Modicon X80

BMENOR2200H Advanced RTU Module

User Manual

Original instructions

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www.se.com

Legal Information

Schneider Electric products and equipment should be installed, operated, serviced, and maintained only by qualified personnel.

As standards, specifications, and designs change from time to time, information contained in this guide may be subject to change without notice.

To the extent permitted by applicable law, no responsibility or liability is assumed by Schneider Electric and its subsidiaries for any errors or omissions in the informational content of this material or consequences arising out of or resulting from the use of the information contained herein.

Table of Contents

Safety Information

Important Information

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

- 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

Document Scope

This guide describes the Modicon X80 BMENOR2200H advanced RTU module and its relationship to Modicon M580 controllers and X80 remote platforms.

The BMENOR2200H module acts as a communication module on an X80 platform and conforms to the general rules and guidelines for the use of those platforms.

The module provides telemetry protocol connection availability in complex M580 configurations through the Modbus TCP communication protocol.

This guide describes the following topics:

- installation, page 33
- configuration, page 69
- diagnostics
- embedded web pages, page 109

NOTE: The specific configuration settings contained in this guide are intended to be used for instructional purposes only. The settings required for your specific configuration may differ from the examples presented in this guide.

Validity Note

This document is valid for an M580 system when used with Control Expert 15.0 HF or later.

The technical characteristics of the devices described in the present document also appear online. To access the information online, go to the Schneider Electric home page www.se.com/ww/en/download/.

The characteristics that are described 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.

Information Related to Cyber Security

Information on cyber security is provided on the Schneider Electric website: http://www2.schneider-electric.com/sites/corporate/en/support/cybersecurity/cybersecurity.page

Document available for download on cyber security support section:

Title of Documentation	Webpage Address
How can I ... Reduce Vulnerability to Cyber Attacks? System Technical Note, Cyber Security Recommendations	www.se.com/ww/en/download/document/STN v2

Related Documents

Title of documentation	Reference number
Modicon M580 Standalone System Planning Guide for Frequently Used Architectures	HRB62666 (English), HRB65318 (French), HRB65319 (German), HRB65320 (Italian), HRB65321 (Spanish), HRB65322 (Chinese)
Modicon M580 System Planning Guide for Complex Topologies	NHA58892 (English), NHA58893 (French), NHA58894 (German), NHA58895 (Italian), NHA58896 (Spanish), NHA58897 (Chinese)
Modicon M580 Hot Standby System Planning Guide for Frequently Used Architectures	NHA58880 (English), NHA58881 (French), NHA58882 (German), NHA58883 (Italian), NHA58884 (Spanish), NHA58885 (Chinese)
Modicon M580, Hardware, Reference Manual	EIO0000001578 (English), EIO0000001579 (French), EIO0000001580 (German), EIO0000001582 (Italian), EIO0000001581 (Spanish), EIO0000001583 (Chinese)
Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications	EIO0000002726 (English), EIO0000002727 (French), EIO0000002728 (German), EIO0000002730 (Italian), EIO0000002729 (Spanish), EIO0000002731 (Chinese)
Modicon M580, Change Configuration on the Fly, User Guide	EIO0000001590 (English), EIO0000001591 (French), EIO0000001592 (German), EIO0000001594 (Italian), EIO0000001593 (Spanish), EIO0000001595 (Chinese)
M580 BMENOS0300, Network Option Switch, Installation and Configuration Guide	NHA89117 (English), NHA89119 (French), NHA89120 (German), NHA89121 (Italian), NHA89122 (Spanish), NHA89123 (Chinese)
Modicon eX80, BMEAHI0812 HART Analog Input Module & BMEAHO0412 HART Analog Output Module, User Guide	EAV16400 (English), EAV28404 (French), EAV28384 (German), EAV28413 (Italian), EAV28360 (Spanish), EAV28417 (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)
Grounding and Electromagnetic Compatibility of PLC Systems, Basic Principles and Measures, User Manual	33002439 (English), 33002440 (French), 33002441 (German), 33003702 (Italian), 33002442 (Spanish), 33003703 (Chinese)
EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35013361 (Italian), 35006147 (Spanish), 35013362 (Chinese)
EcoStruxure™ Control Expert, Operating Modes	33003101 (English), 33003102 (French), 33003103 (German), 33003104 (Spanish), 33003696 (Italian), 33003697 (Chinese)
EcoStruxure™ Control Expert, Installation Manual	35014792 (English), 35014793 (French), 35014794 (German), 35014795 (Spanish), 35014796 (Italian), 35012191 (Chinese)
Modicon Controllers Platform Cyber Security, Reference Manual	EIO0000001999 (English), EIO0000002001 (French), EIO0000002000 (German), EIO0000002002 (Italian), EIO0000002003 (Spanish), EIO0000002004 (Chinese)
Modicon X80, BMXERT1604T Time Stamp Module, User Guide	EIO0000001121 (English), EIO0000001122 (French), EIO0000001123 (German), EIO0000001125 (Italian), EIO0000001124 (Spanish), EIO0000001126 (Chinese)

NOTE: Refer also to the online help for the Maintenance Expert tool (see EcoStruxure Automation Device Maintenance, Firmware Upgrade Tool, Online Help).

You can download these technical publications, the present document and other technical information from our website www.se.com/en/download/.

Product Related Information

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise are allowed to program, install, alter, and apply this product.

REQUIRES CLEANUP
Follow all local and national safety codes and standards.

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

Introducing the Modicon X80 BMENOR2200H Advanced RTU Module

Introduction

Overview

RTU systems are designed to meet the needs of the water industry, the oil and gas sector, transportation, electrical utility and other infrastructures, where remote monitoring and telecontrol are essential to the management of a site and substations, which may be spread over a wide geographical area.

DNP3 and IEC60870-5-104 are global SCADA protocols, which are designed with various characteristics for RTU utilities (example: response event without request (unsolicited).

The Modicon X80 advanced RTU module (BMENOR2200H) is the new module on the Modicon M580 PAC platform, which provides more features than the existing RTU module (BMXNOR0200H). The advanced RTU module has enhanced cyber security features and better performance than the BMXNOR0200H module, including telemetry protocol connection availability and several Ethernet-based services.

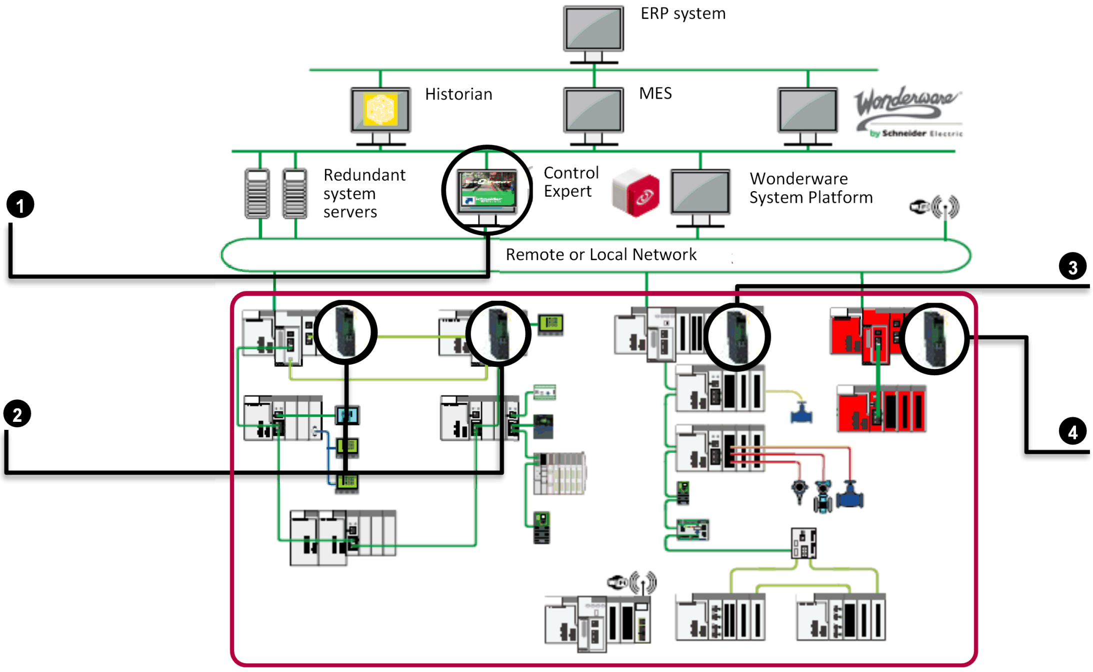
NOTICE

INOPERABLE RACK CONNECTION

- Do **not** mount the BMENOR2200H module on an BMX (X Bus-only) backplane. The module will not work.
- The module can operate properly **only** on a BME (X Bus and Ethernet) backplane.
- Refer to the rack descriptions and slot restrictions in the installation chapter in the *Modicon X80 Racks and Power Supplies, Hardware, Reference Manual* (see Modicon X80, Racks and Power Supplies, Hardware Reference Manual).

Failure to follow these instructions can result in equipment damage.

The BMENOR2200H advanced RTU module brings DNP3 and IEC 60870-5-104 communications to the Modicon M580 platform:



Telemetry & Remote Architecture

1 Software: Control Expert 15.0 HF, Automation Device Maintenance (firmware upgrade), Web Browser (cyber security settings)

2 BMENOR2200H module: M580 Hot Standby

3 BMENOR2200H module: M580 standalone

4 BMENOR2200H module: M580 Safety standalone, M580 Safety Hot Standby, non-interfering type 1

Red line Indicates the telemetry and remote architecture

Compared with standard X80 communications and I/O modules, the BMENOR2200H module is a *long-factor* module, the same height as the CPU. (Refer to the module dimensions, page 18 topic.)

Install the module on a local Ethernet backplane in a Modicon M580 system. The module provides access to an Modicon M580 network through the external ports of the CPU and communication modules that may be installed on the local rack.

Main Features and Functionality

Improved Performance

The BMENOR2200H module offers these improvements over the BMXNOR0200H module:

- Compatibility with an M580 redundant system
- Occupies a single-point resource for event routing point
- Bulk configuration for RTU mapping table
- Cyber security enhancements:
  - secure boot
  - firmware signing and integrity check
  - secure firmware upgrade
  - HTTPS-based Web pages
  - RBAC
  - TLS for RTU protocols
  - password complexity

  - secure mode selection
  - DNP3 secure authentication version 2 & 5
  - secure Hot Standby communication between modules
- High data throughput capacity when the module acts as an RTU server (transmits 4,000 events/second to client devices)
- Exclusive data exchange bandwidth for each module installed on the same rack
- Maximum of 150,000 RTU events stored in module buffer

Module Features

The BMENOR2200H module addresses a wide range of telemetry requirements in an M580 system:

- RTU protocol event routing as data concentrator
- ruggedized with conformal coating for operations in extended operating temperature ranges and harsh environments
- upstream communications with SCADA client stations for polling interrogation of data, backfilling of time-stamped event data, and receiving client commands
- downstream communications with other RTU substations, server field devices and IEDs (for data collection), sending commands, and synchronizing distributed control
- remote programming and downloading of control program with Control Expert software through Ethernet or USB connections on an M580 CPU
- remote cyber security settings and diagnostic monitoring with a built-in web server

Platform Features

The module shares these characteristics and applications that are available in an M580 environment:

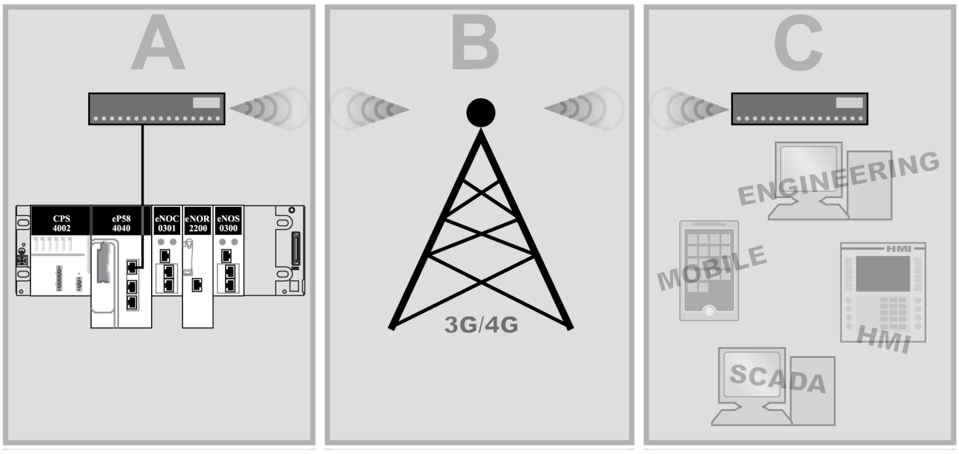
- easy connectivity with an Ethernet backplane
- specialized function blocks (AGA, flow calculations)
- expandable rack-based modular I/O configurations and remote I/O capabilities
- high-density, analog/discrete I/O and counting modules
- isolated input power supply (voltage ranges: 24 Vdc, 24/48 Vdc, 125 Vdc, 100/240 Vac)
- local and remote downloading of operating system firmware

Communication Protocols

Refer to the complete description of function and protocol support, page 45.

RTU Architecture

This sample architecture shows communications from an RTU substation that includes a BMENOR2200H module:



A A BMENOR2200H module communicates over the backplane with a CPU that is connected to a network router.

B The 3G/4G network forwards the communications.

C Communications are received by a router that connects to a control network and fieldbus devices.

BMENOR2200H and EcoStruxureTM

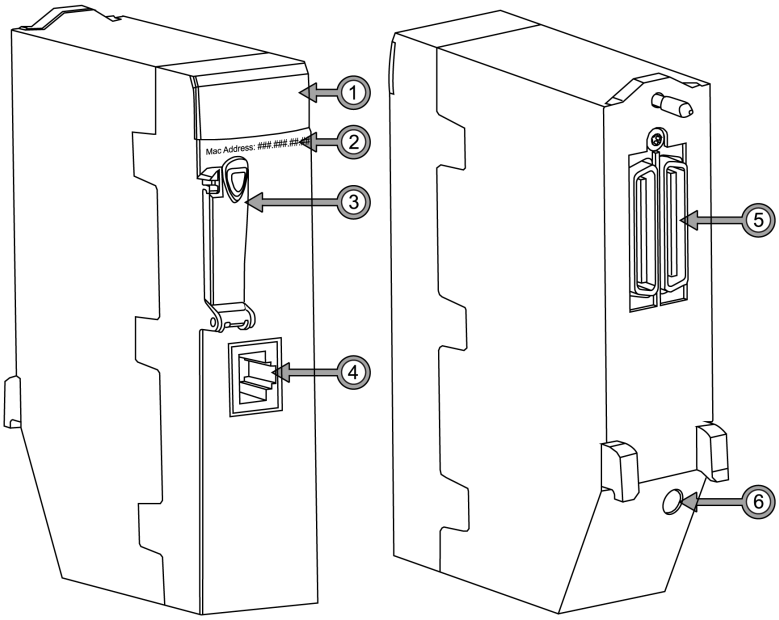
EcoStruxureTM is a Schneider Electric program designed to address the key challenges of many different types of users, including plant managers, operations managers, engineers, maintenance teams, and operators, by delivering a system that is scalable, flexible, integrated, and collaborative.

This document presents one of the EcoStruxure features, using Ethernet as the backbone around the Modicon M580 offer, in which an M580 local rack communicates with M580 RIO drops and distributed equipment in the same network.

Physical Description

External Features

The BMENOR2200H module has the same form factor as other M580 advanced communication modules. This figure shows the specific external features of this module:



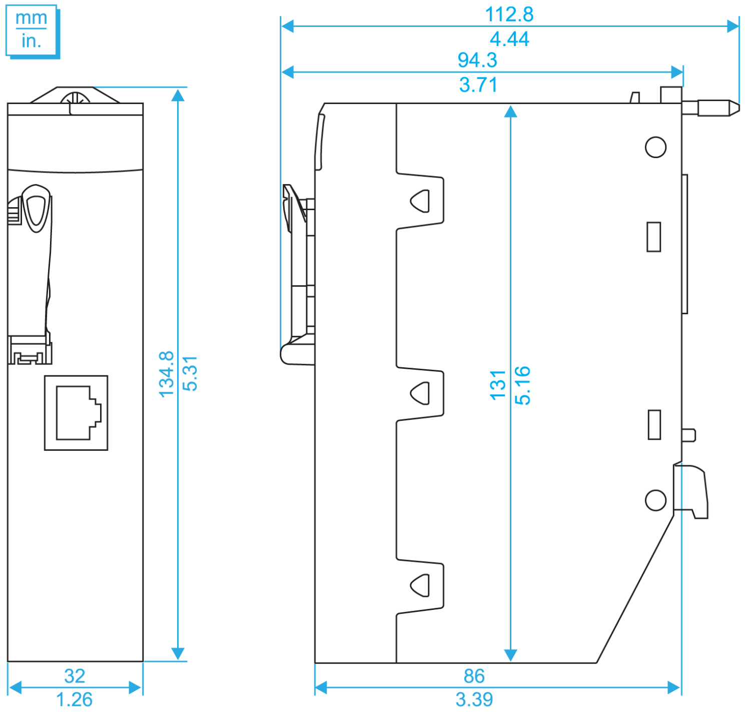
Legend:

Item	Description	Function
1	LED array, page 19	Observe the LED display to diagnose the module.
2	MAC address	This manufacturer-defined address is unique for each individual module.
3	memory card slot	Store datalogging files (.csv) to the SD card. **NOTE:** This feature is reserved for future use.
4	serial port	This port is an isolated RS232/RS485 serial connector. Use a TCSXCN3M4F3S4 cable (serial link) to connect the module's serial (RS232) RJ45 port to a communication port on a modem. The supports all pins on the modem's nine-pin D-sub connector except for the ring indicator (RI) signal pin (sold separately).
5	dual-bus backplane connector, page 17	This connection to the Modicon M580 rack supports Ethernet and X Bus communications.
6	rotary switch, page 22	Use this switch to set the cyber security level for the module.

NOTE: A ferule placed on the end of the serial port reduces the pinching of the cable by the removable cover. This reduces the risk of degrading the quality of the link by decreasing the likelihood of achieving the maximum bending radius of the cable.

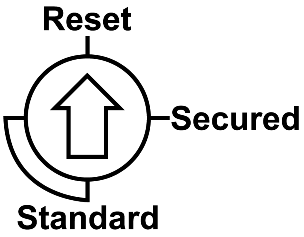
Dimensions

The BMENOR2200H module conforms to the height of an M580 CPU and the width of a standard single-slot M580 communications module that has an SD card slot:



Rotary Switch

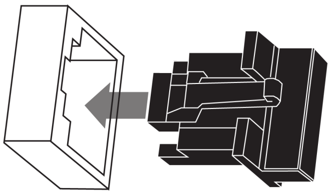
A three-position rotary switch is located on the back of the module. Set this switch to configure a cyber security operating mode for the module:



Refer to the detailed description of the rotary switch configuration, page 22.

Accessories

These additional hardware accessories are available:

Description	Comment
dust cover	Cover the module's unused RJ45 ports with this stopper:  The dust cover reduces the port's exposure to atmospheric dust.
screwdriver	Use only the small, plastic screwdriver that was delivered with the module to set the rotary switch, page 22.

Module LED Indicators

Introduction

Refer to the LED indicators to monitor the status and performance of these items:

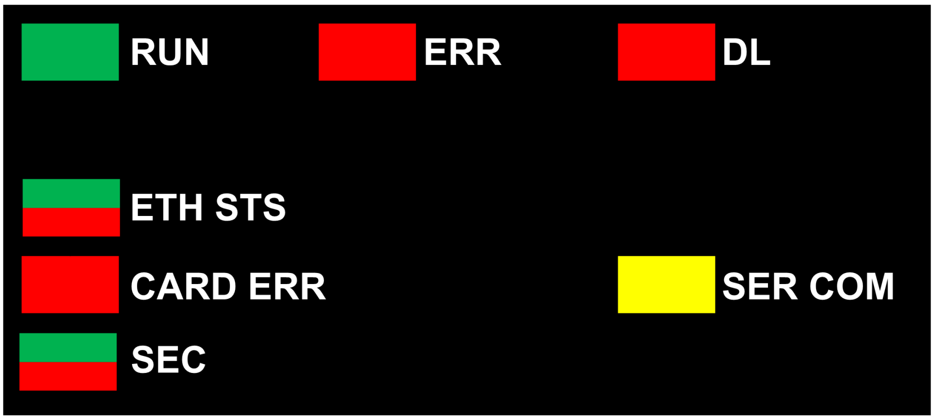
- BMENOR2200H module LEDs, page 19
- SD card LEDs

Module LED Descriptions

The module LED indicators are located on the front of the BMENOR2200H module. The LEDs provide information on:

- module status (run, error, downloading)
- serial communications
- Ethernet network communications
- SD memory card state
- cyber security status

This is the LED display on the front of the BMENOR2200H module:



The LEDs can be in these states:

- *on*: steady on
- *off*: steady off
- *flashing*: alternate (50 ms on, 50 ms off)

The module status is indicated by the color and state of the LEDs:

Label	Color	Pattern	Indication
RUN: operational state	green	on	The module is operating and configured.
		flashing	The module is blocked by a detected software error.
		off	The module is not configured. (The application is absent, invalid, or incompatible.)
ERR: detected error	red	on	• The processor, system, or configuration detected an error. • If you move the rotary switch from **Standard > Secured** (or vice versa) directly instead of moving to **Reset** in between, an error is detected.
		flashing	• The module is not configured. (The application is absent, invalid, or incompatible.) • The module is blocked by a detected software error. • A Hot Standby failure is detected.
		off	Operations are normal (no detected errors).

Label	Color	Pattern	Indication
DL: download firmware (upgrade)	red	on	A firmware upgrade or factory reset is in progress.
		off	A firmware upgrade or factory reset is not in progress.
SER COM: serial data status	yellow	flashing	A data exchange (send/receive) is in progress on the serial connection.
		off	There is no data exchange on the serial connection.
CARD ERR: memory card detected error	red	on	• The memory card is missing. • The memory card is not usable (bad format, unrecognized type).
		off	The memory card is valid and recognized.
ETH STS: Ethernet communication status	—	off	There is no link on the Ethernet backplane port.
	green	on	At least one RTU connection (client or server) established in the module.
		flashing	The module has an IP address, but there is no RTU connection.
	red	on	The module has a duplicate IP address or factory reset mode.
SEC: secure communication status	green	on	Secure communications are enabled and running fine.
	red	on	• Communications are *not* secure because a critical error in secure communications is detected. For example, there is no available security configuration, or the certificate expired when the communications stopped. • No channel security is configured through the channel name for either client or server.
		flashing	Secure communications are enabled and running, but a critical error is detected. For example, there is no available security configuration, or the certificate expired when the communications stopped.
	—	off	The module is not secure.

Typical Status and Related LED Behavior

Label	Pattern	Indication
ERR	Red on	Secure/Non-secure: The rotary switch was moved directly between non-secure mode and secure mode. A factory reset is required.
DL		
ETH STS		
Secure		

Module status	LED	Description
Factory mode	RUN: green on	
	DL: red on DL: red off	Factory reset is ongoing. Factory reset is complete.
	ETH STS: red on	
Secure mode (initial indication at first-time start-up)	ERR: red flashing	
	ETH STS: green flashing	
	SEC: red on	Module is not running; a validated cybersecure setting is required.

SD Memory Card (BMXRMS004GPF)

Introduction

The slot for the secure digital (SD) memory card (BMXRMS004GPF) is on the front of the module.

⚠ WARNING

RISK OF LOST APPLICATION

- Do not remove the memory card from the module while the PLC is running.
- Remove the memory card only when the power is off.

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

Card Functionality

This table describes the functionality of the BMXRMS004GPF memory card when inserted into the module:

SD Memory Card	Data Storage	Functionality
BMXRMS004GPF	4 GB	Storage of data logging files (.csv) **NOTE:** Data logging is not available for the BMENOR2200H V2 module.

Card Services

NOTICE

INOPERABLE MEMORY CARD

- Do not format the memory card with a non-Schneider tool. The memory card needs a structure to contain program and data. Formatting with another tool destroys this structure.
- Do not use a write-protected memory card with the module. Some services do not operate properly when the memory card is write-protected.

Failure to follow these instructions can result in equipment damage.

Precautions

NOTICE

MEMORY CARD DESTRUCTION

- Do not touch the memory card connections.
- Keep the memory card away from electrostatic and electromagnetic sources as well as heat, sunlight, water, and moisture.
- Avoid impacts to the memory card.
- Check the postal service security policy before sending a memory card by postal service. In some countries, the postal service exposes mail to high levels of radiation as a security measure. These high levels of radiation may erase the contents of the memory card and render it unusable.

Failure to follow these instructions can result in equipment damage.

Without SD Memory Card

If the memory card slot is empty during the power-up, the module can operate normally without the data logging service. **NOTE**: Data logging is not available for the BMENOR2200H module.

A memory card that is inserted during module operations is not recognized. Keep the memory card in the slot at all times.

Cyber Security Rotary Switch

Introduction

A three-position rotary switch is on the back of the module. Set this switch to configure a cyber security operating mode for the module.

NOTICE

RISK OF UNINTENDED OPERATION

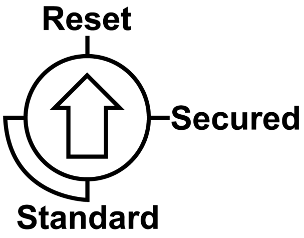
To maintain the integrity of the hardware, use only the small, plastic screwdriver that ships with the module to change the switch position.

REQUIRES CLEANUP
Do not use a metal screwdriver. The use of a metal screwdriver can damage the switch and render it inoperable.

Failure to follow these instructions can result in equipment damage.

Position Selection

This is an enlarged view of the three-position rotary switch on the back of the module:



Use the screwdriver to select a switch position that meets your cyber security requirements:

Icon	Setting	Description
Secured (default)	secure mode on	The module supports some level(s) of cyber security when a cyber security configuration is available.
Standard	standard mode on	The module does not support cyber security.
Reset	factory reset	The module implements its out-of-the-box cyber security configuration.

NOTICE

RISK OF UNINTENDED OPERATION

Set the switch only to the *exact* “clock position” that corresponds to your security configuration:

- *12 o’clock:* **Reset**
- *3 o’clock:* **Secured**
- *6 o’clock/9 o’clock:* **Standard** (To implement the **Standard** level of cyber security, set the switch to *only* the 6 o'clock or 9 o'clock positions.)

Failure to follow these instructions can result in equipment damage.

Set the Switch

Configure the cyber security mode for the module in the rack:

Step	Action
1	Remove the module from the rack by following the directions for module replacement, page 35.
2	Change the switch setting to **Reset**.
3	Re-insert the module in the rack to power it up in **Reset** mode. **Result**: The module performs a factory reset and is properly powered when the RUN LED is steady green.
4	Remove the module from the rack again.
5	Change the switch setting to **Secured** or **Standard**.
6	Re-insert the module in the rack to power it up in the selected (**Secured** or **Standard**) mode. **Result**: The module is properly powered when the LED is steady green for both secured and standard modes.

NOTE:

- Do not switch from the non-secure configuration (**Standard**) directly to the secure configuration (**Secured**) or vice-versa.
  - Always power up the module with the rotary switch in the **Reset** position when you transition between the **Standard** and **Secured** modes to implement normal operations.
  - You can also use the **Management** dialog on the **Setup** web page to move the rotary switch to clean all cybersecurity configuration. Click the **Reset** button to restore the factory default cyber security settings for the module. A module restart is required.
- The changes associated with the switch settings take effect after the module is re-inserted in the rack and powered up.

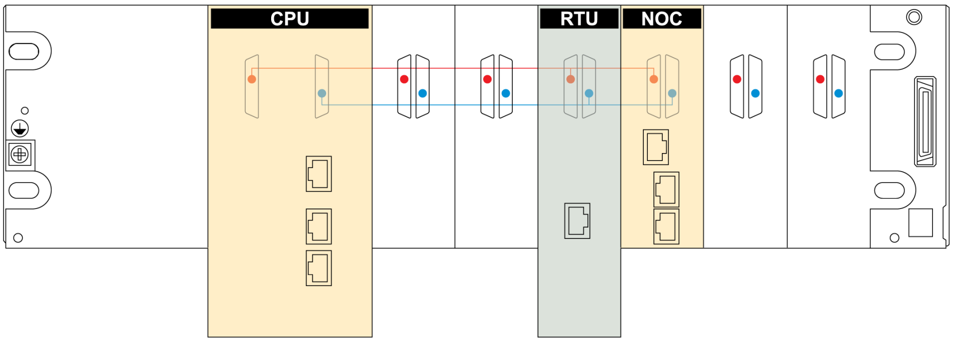
Backplane Connector

About Dual-Bus Backplanes

The dual-bus interface, page 17 on the back of the BMENOR2200H module connects to the X Bus and Ethernet bus connectors across the backplane when you mount the module in the rack.

BMEXBP••0• backplanes are compatible with Modicon X80 modules in an M580 system.

Communications across the dual-bus backplane of this sample local rack (which includes an M580 CPU) implement both the Ethernet (red line) and X-Bus (blue line) protocols:



Red The red dot/line indicates Ethernet.

Blue The blue dot/line indicates X Bus.

NOTE:

- BMXXPB••00 X Bus backplanes do not have connections that support eX80 modules.
- Ethernet racks are described in detail in the *Modicon M580, Hardware, Reference Manual*.

Connection Protocols

The module supports communications over a BMEXBP••0• backplane using these protocols:

Bus	Description
X Bus	The module uses X Bus communications to obtain and exchange the following through the CPU: • configuration data for the module • application and diagnostic data • variable data exchange between the module and the CPU • time synchronization messages to the CPU and other modules on the backplane
Ethernet	**NOTE:** The Ethernet backplane port is always enabled for the RTU module. Confirm your network topology design to help avoid network loop issues. The module uses Ethernet communications to provide an access path to the RTU module for the following: • External devices can talk with the RTU module when accessing one of the following: ◦ CPU ◦ BMENOC03•• communication module ◦ BMENOS0300 network option switch module ◦ BM•CRA312•• adapter ◦ other Ethernet modules with similar capabilities • The module communicates with Ethernet communication modules on the local rack.

The data exchange uses implicit messaging to facilitate memory sharing between the module and the CPU. For each CPU scan cycle, the CPU publishes all data at the same time to share the most current information with the RTU.

I/O Data Exchange with the CPU

Observe these maximum input and output sizes when the module exchanges I/O data with the CPU:

<table>
<tr><th>Protocol</th><th colspan="2">Characteristics</th></tr>
<tr><td rowspan="2">IEC 60870-5-104 / DNP3 NET client</td><td colspan="2">up to 64 servers (one session for each server)</td></tr>
<tr><td colspan="2">Memory consumption:
• *input data size:* 8 Kb of data includes user-configurable data and 4K words of overhead. The overhead includes module diagnostic data, data object headers, and the number of headers depending on the user configuration. As a result, the maximum user-configurable input data size is approximately 7.55Kb (1Kb = 1024 bytes).
• *output data size:* 8 Kb of data includes user-configurable data and 4K words of overhead. The overhead includes module control data, data object headers, and the number of headers depending on the user configuration. As a result, the maximum user-configurable output data size is approximately 7.56Kb (1Kb = 1024 bytes).</td></tr>
<tr><td rowspan="8">IEC 60870-5-104 / DNP3 NET server</td><td colspan="2">Memory consumption:
• *input:* 8 Kb
• *output:* 8 Kb
NOTE: Refer to the descriptions above.</td></tr>
<tr><td colspan="2">up to 150,000-event queue for all data types</td></tr>
<tr><td colspan="2">up to 40,000 event queue for DNP3 SAv5 security events
NOTE: This does not apply to IEC 60870-5-104.</td></tr>
<tr><td colspan="2">supports clock synchronization from a client</td></tr>
<tr><td rowspan="3">service over TCP</td><td>client IP address validation list (up to 10 IP addresses)</td></tr>
<tr><td>four concurrent client connections with configurable TCP service port (default port is 20000 for DNP3, 2404 for IEC60870–5–104)</td></tr>
<tr><td>event backup up to 10000 events</td></tr>
<tr><td colspan="2">support for DNP3 secure authentication version 2 and version 5, page 50.</td></tr>
</table>

SAv2 and SAv5, page 50 work on both client and server sides.

Use this formula to achieve the recommended minimum MAST task cycle time per BMENOR2200H module:

```
Tcycle min= ((DataInB + 128)*2+(DataOutB + 32)) / 23500B/S)*30ms
```

The result is approximately a 30ms MAST task cycle with 8Kb in and 8Kb out.

Electrical Characteristics

Consumed Current

This is the current that the BMENOR2200H module consumes:

Power Source	Consumption
24 VDC rack	90 mA
power dissipation	2.2 W

Wiring Considerations

Modules are re-initialized when the power is switched back on. This can create a temporary disruption in the application or communications.

Standards and Certifications

Download

Click the link that corresponds to your preferred language to download standards and certifications (PDF format) that apply to the modules in this product line:

Title	Languages
Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications	• English: EIO0000002726 • French: EIO0000002727 • German: EIO0000002728 • Italian: EIO0000002730 • Spanish: EIO0000002729 • Chinese: EIO0000002731

Safety Standards and Certifications

References

Refer to these guidelines from the *Modicon M580 Safety Standards and Certifications* guide:

- Certificates and Declarations (see Modicon M580 Safety, Standards and Certifications)
- Operating and Storage Conditions (see Modicon M580 Safety, Standards and Certifications)
- Environment Test Compliance Levels (see Modicon M580 Safety, Standards and Certifications)

The BMENOR2200H Module in Networks

Standalone Networks

Standalone Architectures

Introduction

This topic describes the use of the BMENOR2200H module in a standalone M580 system.

Connection Media

Make connections to the BMENOR2200H module with a cable:

- *upstream connection:* Connect the module to a SCADA system through the DNP3 or IEC 60870-5-104 protocol. (A Modbus TCP connection is another option.)
- *downstream connection:* Connect the module to remote server devices and stations through the DNP3 or IEC 60870-5-104 protocol.

Limitations

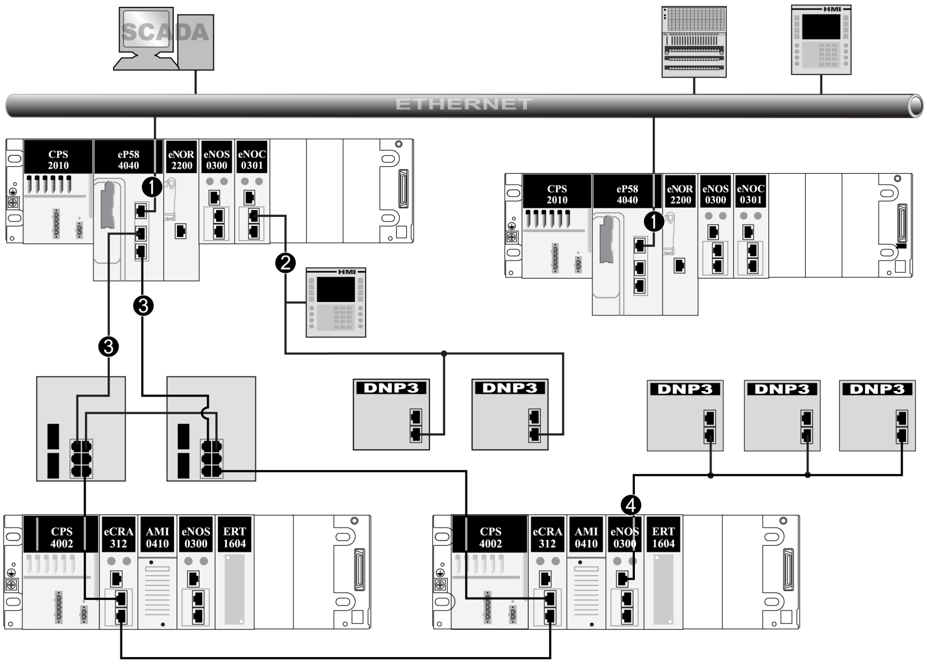
Observe these guidelines when you use the BMENOR2200H module:

- The BMENOR2200H SV1.0 module is compatible with Control Expert 14.1 Hot Fix and later.
- The BMENOR2200H SV2.01 module is compatible with Control Expert 15.0 Hot Fix and later.
- The module is compatible with CPUs that run firmware version 2.2 or later.
- The BMENOR2200H SV1.0 module does not support Hot Standby systems.

Standalone Network with One Subnet

Sample Network

This sample standalone network includes BMENOR2200H modules on local racks in a single subnet:



1 The service port on the CPU connects the RIO main ring and distributed equipment (DNP3 devices, HMI) to the Ethernet control network.

2 A BMENOC0301 module on the local rack connects distributed equipment (DNP3 devices, HMI) to the RIO main ring.

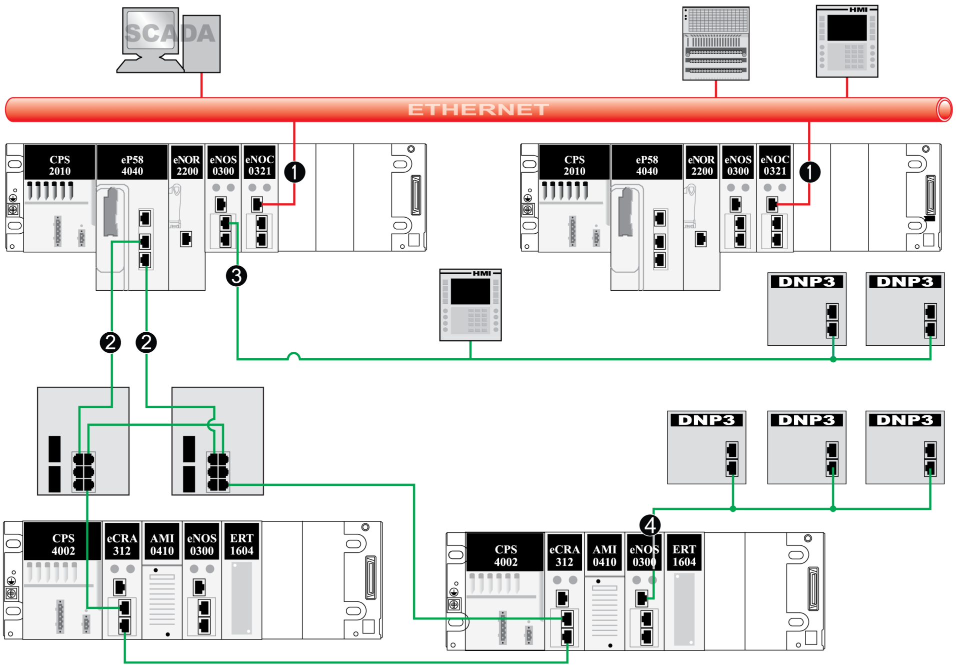
3 RIO main ring (Dual-ring switches connect the local rack to an RIO drop.)

4 A BMENOS0300 module on an RIO drop connects distributed equipment (DNP3 devices) to the RIO main ring.

Standalone Network with Two Subnets

Sample Network

This sample standalone network builds upon the single-subnet example, page 28 and includes BMENOR2200H modules on local racks that communicate with two different subnets:



1 BMENOC0321 modules on the local racks connect the RIO main ring and distributed equipment (DNP3 devices, HMI) to the Ethernet control network (red).

2 RIO main ring (Dual-ring switches connect the local rack to two RIO drops and distributed equipment.)

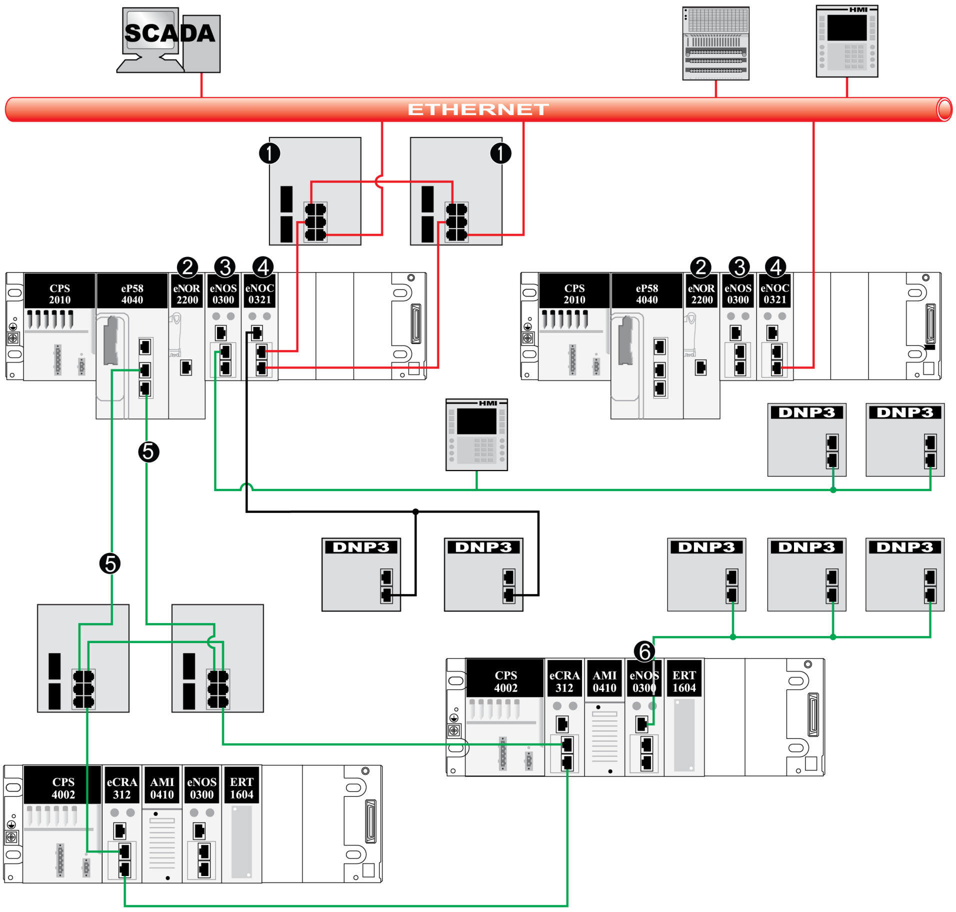
3 A BMENOS0300 module connects the local rack to isolated distributed equipment (DNP3 devices, HMI).

4 A BMENOS0300 module on an RIO drop connects distributed equipment (DNP3 devices) to the RIO main ring.

Standalone Network with Link Redundancy

Sample Network

This sample standalone network builds upon the two-subnet example, page 29, which includes communications on different subnets (red and green). In this case, the connections between the local racks and dual-ring switches facilitate redundant connections between the subnets:



1 A dual-ring switch connected to the Ethernet port of a BMENOC0321 module on the local rack creates a redundant link to the control network (red).

2 A BMENOR2200H module connects the local rack to distributed equipment (DNP3 devices, HMI) via the Ethernet backplane connection using redundant links.

3 A BMENOS0300 embedded switch module connects the local rack to distributed equipment (DNP3 devices) using redundant links.

4 The service port of a BMENOC0321 module allows distributed equipment (DNP3 devices, HMI) to communicate with the control network using redundant links.

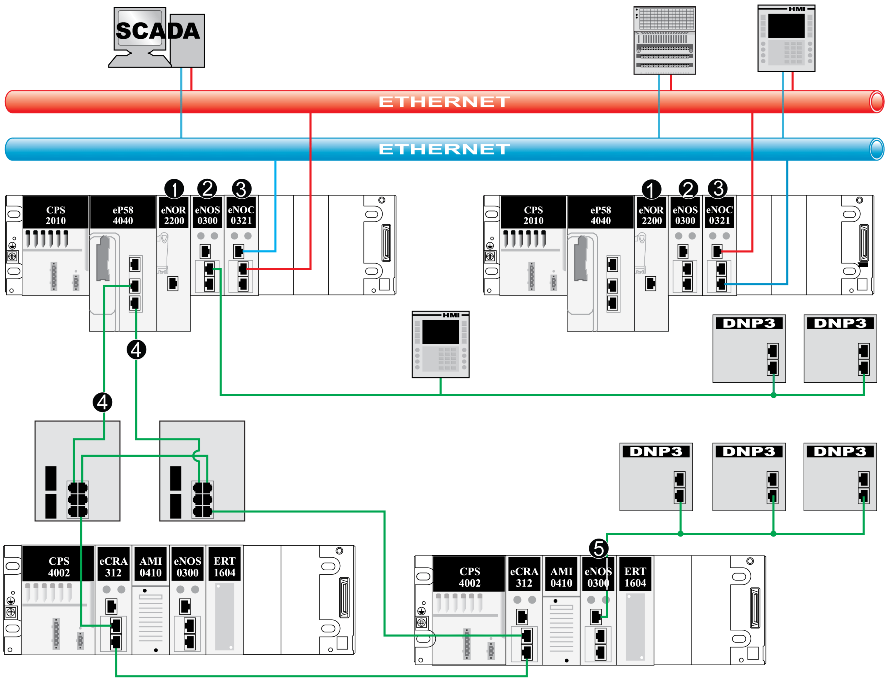
5 RIO main ring

6 A BMENOS0300 embedded switch module on an RIO drop connects the RIO main ring to distributed equipment (DNP3 devices) using redundant links.

Standalone Network with Three Subnets

Sample Network

This sample standalone network builds upon the two-subnet example, page 29 with different (red and green) subnets. In this case, BMENOC0321 modules with embedded IP forwarding in the local racks facilitate the connection to a third (blue) subnet:



1 A BMENOR2200H module

2 A BMENOS0300 module on the local rack connects distributed equipment (DNP3 devices, HMI) to the RIO main ring using redundant links

3 A BMENOC0321 module with IP forwarding enabled connects the RIO main ring and distributed equipment (DNP3 devices, HMI) to the blue network via the service port and the red network through the control network port using redundant links

4 RIO main ring

5 A BMENOS0300 module on an RIO drop connects distributed equipment (DNP3 devices) to the RIO main ring

Redundant Networks

Introduction

IP Address of the Module

Redundant systems contain separate primary and standby control networks. The configuration of the primary and standby racks is identical.

A redundant system that implements BMENOR2200H modules, therefore, includes one such module in both the primary and standby racks with these IP addresses:

- *IP address:* BMENOR2200H module in the primary configuration
- *IP address + 1:* BMENOR2200H module in the standby configuration

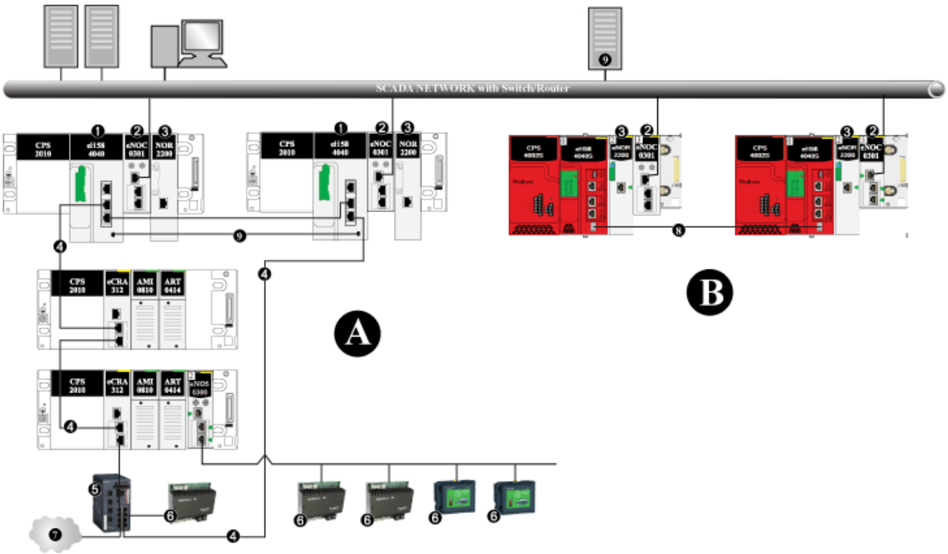
Upon a redundant switch-over, the IP address setting is automatically transferred from the (former) primary BMENOR2200H module to the (former) standby

BMENOR2200H module. The *IP address + 1* setting is also transferred from the (former) standby BMENOR2200H module to the **new** standby BMENOR2200H module.

Redundant Architecture

Sample Network

The following M580 architecture includes BMENOR2200H modules in both Safety and non-Safety primary and standby rack configurations in a redundant system that has routing functionality.



A M580 redundant system

B M580 Safety redundant system

1 M580 redundant PAC connecting the main ring (4) to the control network

2 BMENOC0301 module connected to the standalone and Safety Hot Standby PACs via the Ethernet backplane supporting distributed equipment

3 BMENOR2200 module (acting as the RTU server) supporting IEC60870-5-104 or DNP communication

4 RIO main ring

5 dual-ring switch (DRS) connecting distributed equipment to the RIO drop on the main ring

6 distributed equipment connected to the main ring via the DRS using IEC60870-5-104 or DNP communication

7 DIO cloud connected to the main ring via the DRS

8 redundant cable link connecting the primary and standby PACs

9 control network monitoring the following features: system log, firmware upgrade tool, SNMP client, SNTP server, and SMTP server

> **NOTE:** The primary and standby BMENOR2200H modules are using the RIO network or the upstream network to synchronize data. Otherwise, the pair of modules cannot establish Hot Standby functionality.

Hardware Installation

Mounting the Module on the Rack

Introduction

The BMENOR2200H module has a dual-bus connector, page 23 that supports both Ethernet and X Bus communications.

Use these instructions to install the module in a single slot on a BMEXBP Ethernet backplane.

Before You Begin

Take these steps before you insert the module on the rack:

- Remove the protective cap from the module connector on the rack.
- Determine the cyber security operating mode for the module and configure the appropriate cyber security mode with the rotary switch, page 22 before you install the module in the slot. The selected mode is implemented only after a power-up of the module.

Backplane Considerations

Install the module only on the local rack. You can install and configure a maximum of four communication modules (including BMENOR2200H modules) on a single local rack (depending on the selected CPU).

This table shows the maximum number of BMENOR2200H modules you can install in the local rack with respect to specific CPU references:

CPU	BMENOR2200H
BMEP582020	2
BMEP582040	3
BMEP584020	4
BMEP584040	4
BMEP586040	4
BMEH582040	2
BMEH584040	4
BMEH586040	4

NOTE: Refer to the CPU selection table in the *Modicon M580 Standalone, System Planning Guide for Frequently Used Architectures*. Also refer to *Modicon M580 – Hot Standby, System Planning Guide for Frequently Used Architectures; Modicon M580, Safety System Planning Guide; and Modicon M580 – Hot Standby, System Planning Guide for Frequently Used Architectures*.

Install the module in a dual-bus slot on one of the following Ethernet backplanes:

Backplane	Description
BMEXBP0400(H)	4-slot (hardened) Ethernet backplane
BMEXBP0800(H)	8-slot (hardened) Ethernet backplane
BMEXBP1200(H)	12-slot (hardened) Ethernet backplane
BMEXBP0602(H)	6-slot (hardened) dual-PWS Ethernet backplane
BMEXBP1002(H)	10-slot (hardened) dual-PWS Ethernet backplane

Rack and Slot Restrictions

The module occupies a single dual-bus slot. Observe these restrictions:

Rack	Slot	Instruction
all racks	0, 1	Do not insert the BMENOR2200H module in these slots. **NOTE:** These slots are reserved for the CPU module.
BMEXBP1200 (H)	2, 8, 10, 11	These X Bus-only slots do not support the Ethernet functionality of the dual-bus BMENOR2200H module.
BMEXBP1002 (H)	2, 8	
extended racks	—	You cannot install the dual-bus BMENOR2200H module in an extended rack. **NOTE:** Extended racks do not have Ethernet ports.
RIO drops	—	You cannot install the dual-bus BMENOR2200H module in an RIO drop.

Cyber Security Switch Considerations

NOTICE

UNINTENDED EQUIPMENT OPERATION

- Do not switch from the non-secure configuration (**Standard**) directly to the secure configuration (**Secured**) or vice-versa.
- Always power up the module with the rotary switch in the **Reset** position when you transition between the **Standard** and **Secured** modes.

Failure to follow these instructions can result in equipment damage.

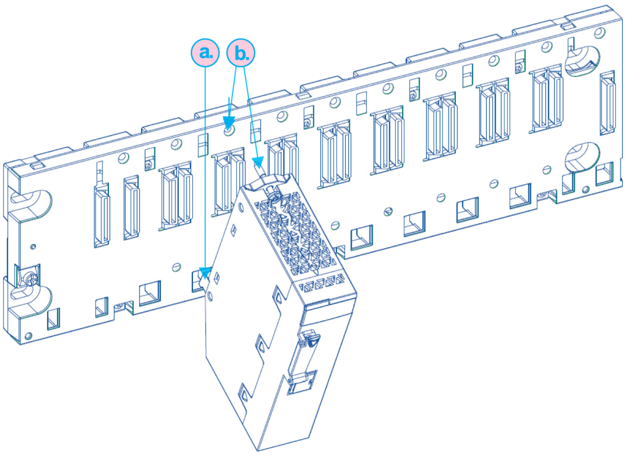
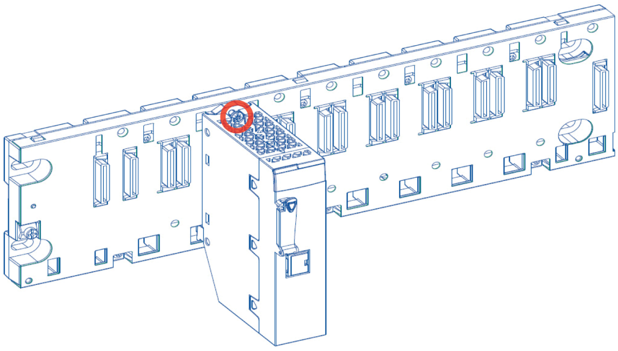
Follow these steps every time you insert a BMENOR2200H module on a powered rack:

Step	Action
1	Set the rotary switch, page 22 on the module to the **Reset** position.
2	Insert the module in the rack to power it up.
3	Remove the module from the rack to power it down.
4	Set the rotary switch on the module to the **Secured** or **Standard** position.
5	Reinsert the module in the rack to power it up.

Installing the Module on the Rack

Mount the module in a single slot on the backplane:

Step	Action
1	Turn off the power supply to the rack.
2	Remove the protective cover from the module interface on the rack.
3	Configure the cyber security level for the module with the rotary switch according to the cyber security considerations (above, page 34).

Step	Action
4	Notice sub-steps *a.* and *b.* in the graphic:  a. — Insert the locating pins on the bottom of the module into the corresponding slots in the rack. b. — Use the locating pins as a hinge and pivot the module until it is flush with the rack. (The twin connector on the back of the module inserts into the connectors on the rack.) **NOTE:** Do not insert the BMENOR2200H module in slot 0 or 1 in the local rack. Those slots are reserved for the CPU.
5	Tighten the retaining screw to hold the module in place on the rack:  **NOTE:** Tightening torque: 0.4...1.5 N•m (0.30...1.10 lbf-ft).

Replacing a Module

NOTICE

UNINTENDED EQUIPMENT OPERATION

- Do not switch from the non-secure configuration (**Standard**) directly to the secure configuration (**Secured**) or vice-versa.
- Always power up the module with the rotary switch in the **Reset** position when you transition between the **Standard** and **Secured** modes.

Failure to follow these instructions can result in equipment damage.

Any module on the rack can be hot-swapped at any time with 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.

When you switch from secure to non-secure operations or vice-versa, reset the module by setting the rotary switch to the **Reset** position to implement a clean configuration file and clear the security settings (including the user name and password).

We suggest that you export your cyber security configuration before you replace the module. When the rotary switch is set to the factory **Reset** mode, the entire cyber secure configuration is erased.

Replace the module:

Step	Action
1	Remove the module from the rack by reversing the above steps for installing the module. **NOTE:** Because this is a hot-swappable module, it is not necessary to power down the rack to remove the module.
2	Set the rotary switch, page 22 on the replacement module to the **Reset** position.
3	Insert the replacement module in the rack to power it up.
4	Remove the replacement module from the rack to power it down.
5	Set the rotary switch on the replacement module to the **Secured** or **Standard** position.
6	Reinsert the replacement module in the rack to power it up.

NOTE: The replacement module does not automatically recover the security settings from the web-based configuration. The security configuration file is stored locally in the module. Export this file, page 116 to create a backup configuration.

Grounding the Installed Modules

General

Grounding the modules is crucial to avoid electric shock.

Module Grounding

Follow all local and national safety codes and standards.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK

If you cannot prove that the end of a shielded cable is connected to the local ground, the cable must be considered as dangerous and personal protective equipment (PPE) must be worn.

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

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Ensure ground connection contacts are present and not bent out of shape. If they are, do not use the module and contact your Schneider Electric representative.

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Securely tighten the mounting screw to attach the module firmly to the rack.

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

Ethernet Communications

Ethernet Services

About this Section

This section describes the Ethernet services that are available to the BMENOR2200H module.

Available Ethernet Services

Introduction

This topic introduces the different services and functionalities that the BMENOR2200H module supports.

RTU Protocols

The module supports these RTU protocols:

- DNP3 NET server with SAv2 or SAv5
- DNP3 NET client with SAv2 or SAv5
- IEC 60870-5-104 client
- IEC 60870-5-104 server

Refer to the description of RTU protocols, page 45.

Ethernet Services

The module supports these Ethernet services:

- SNTPv1 client, page 84
- Modbus TCP server and client
- built-in HTTPS -based web pages, page 109
- FDR client, page 42 (basic service)
- SNMPv1 Agent, page 41
- Firmware upgrade, page 42
- Cyber Security, page 108 (RBAC, HTTPS, system hardening, cyber security event log, certificate management, etc.)

Other Services

The BMENOR2200H module also supports clock synchronization, page 51.

SNMP Service

Introduction

This section describes the Simple Network Management Protocol (SNMP).

> **NOTE:** To configure the SNMP service, refer to the instructions to configure SNMP in the DTM, page 83.

SNMP Overview

Introduction

An SNMP agent runs on:

- Ethernet communication modules
- CPUs with embedded Ethernet communications ports

Network management systems use SNMP to monitor and control Ethernet architecture components for the rapid network diagnosis.

Network management systems allows a network manager to:

- monitor and control network components
- isolate troubles and find their causes
- query devices, such as host computer(s), routers, switches, and bridges, to determine their status
- obtain statistics about the networks to which they are attached

NOTE: Network management systems are available from a variety of vendors.

Simple Network Management Protocol

Ethernet communication modules support SNMP, the standard protocol for managing local area networks (LANs). SNMP defines exactly how a manager communicates with an agent. SNMP defines the format of:

- requests that a manager sends to an agent
- replies that the agent returns to the manager

The MIB

The set of objects that SNMP can access is known as a Management Information Base (MIB). Ethernet monitoring and management tools use standard SNMP to access configuration and management objects included in the device's MIB, providing that:

- objects that SNMP can access are defined and given unique names
- manager and agent programs agree on the names and meanings of fetch and store operations

Transparent Ready products support the Standard MIB II SNMP network management level. This first level of network management can be accessed via this interface. It lets the manager identify the devices that create the architecture and retrieve general information on the configuration and operation of the Ethernet TCP/IP interface.

SNMP Communication

Overview

SNMP defines network management solutions in terms of network protocols and the exchange of supervised data.

The SNMP structure relies on the following elements:

- **Manager:** The manager allows entire or partial network supervision.
- **Agents:** Each supervised device has one or more software modules named Agent that are used by the SNMP protocol.
- **MIB:** The Management Information Base is a database or collection of objects.

The SNMP agent is implemented on the BMENOR2200H module. This allows a manager to access MIB-II standardized objects from the Modicon X80 agent through the SNMP protocol. The MIB-II allows management of TCP/IP communication layers.

SNMP Protocol

The SNMP protocol defines the types of messages between the agent and the manager. These messages are encapsulated in UDP datagrams.

Messages from the manager to an agent:

- `Get_Request`: Message used to obtain the value of one or more variables.
- `Get_Next_Request`: Obtains the value of the next variables.
- `Set_Request`: Sets the value of a variable.

Messages from an agent to the manager:

- `Get_Response`: Allows the agent to resend the value of the requested variable.
- `Trap`: Allows asynchronous event signaling by the agent.

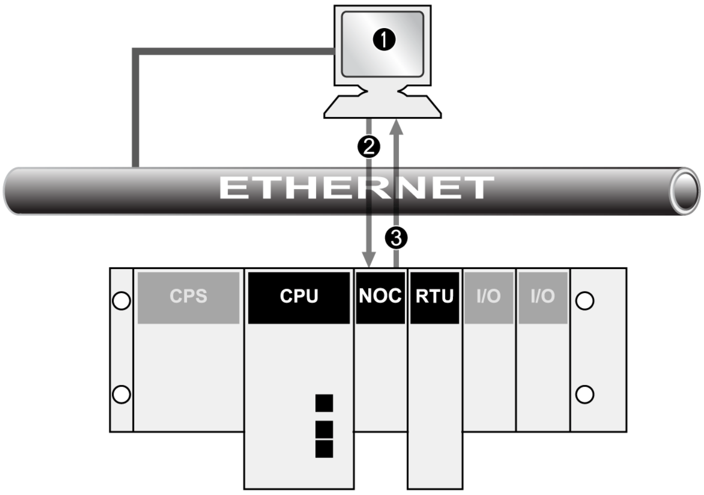
SNMP Operations Example

Introduction

The SNMP manager transmits read or write requests (**Set_Request**, **Get_Request**, **Get_Next_Request**), etc.) for objects defined in the MIB - II SNMP. The response is from the SNMP agent of the Modicon M580 module.

Modicon M580 Example

In this example, an SNMP manager on an Ethernet network sends a request to the SNMP agent in the BMENOR2200H RTU module (via a communications module in the same rack) and receives a response:



1 SNMP manager

2 request

3 response (trap)

The module's SNMP agent transmits events (traps) to the manager. The managed trap systems are as follows:

- `Coldstart Trap`: On the BMENOR2200H module, the event is transmitted following a module supply reset, a processor reset, or the downloading of an application to the PLC.
- `Authentication Failure Trap`: A transmitted event indicates that a network element cannot be authenticated. The **Community Name** field in the

received message is different from the one that is configured on the module. Enable this trap during the configuration of the module.

SNMP Agent Details

Introduction

The widely available SNMP agent service allows easy access to the module's diagnostic information and event notification for certain services (for example, a change in network topology, an LED state, etc.).

Configure this service in the Control Expert DTM to manage IP addresses (MIB browser, ConneXview, etc.) or as an event trap.

MIB Support

The module uses the SNMP agent to support MIB II, which provides diagnostics information that is specified in the MIB files. The module supports these MIB levels:

- **MIB II:** The standard MIB II provides diagnostic information to manage the TCP/IP stack:
    - TCP/IP diagnostics
    - bridge MIB
- **MIB Lite:** This subset of the standard MIB II provides information to discover the identity of a device.

Management Services

This table describes the basic SNMP network management group functions:

Function	Description
system group management	Discover the device and identify it in a standard way by using an SNMP manager.
authentication checking	Configure the community name, and check the authentication of the requester.
system trap management	Configure the SNMP manager.
MIB II management	Manage the MIB.

The service runs on the module to allow SNMP manager applications to configure these SNMP objects:

- sysLocation
- sysContact

SNMP Version

The module runs SNMPv1 for this service. This version extends the capabilities of SNMP to address ministration and security issues. It is a Framework architecture that can be easily extended with new user security protocols. A new frame format has been defined for SNMPv1 adding among other things some security information. In particular, the PDU contents can be encrypted. SNMP uses UDP Transport layer protocol through port 161 and 162.

Firmware Upgrade

EcoStruxure™ Automation Device Maintenance Tool

Tool Functions

Use the EcoStruxure™ Automation Device Maintenance tool to upgrade the firmware of the BMENOR2200H module.

Perform these actions with this web-based tool:

- Automatically or manually discover one or more BMENOR2200H modules in your project, based on IP addresses.
- Upgrade the latest firmware version that is applicable to those modules over the web.

For details on how to install and use this firmware upgrade tool, refer to the online help.

NOTE: You cannot use Schneider Electric's Unity Loader™ software tool to upgrade the firmware for the BMENOR2200H module.

User Role

Use the **INSTALLER** user role to perform the firmware upgrade.

NOTE:

- Certification is invalid and the firmware upgrade process is blocked if the BMENOR2200H module's internal clock is earlier than 2019. Confirm that the module's internal clock is set at the current time/date first.
- When the module operates in **Standard** mode, page 22, the default user role is **INSTALLER**.
- When the module operates in **Secured** mode, page 22, the default user role is **SECADM**. In that case, log in to the security setting page to create a new user, page 121 as an **INSTALLER** and upgrade the firmware in that role.

FDR Client Basic Service

FDR Client Basic Service

Introduction

The basic FDR client service (FDR_CLIENT) is applied to the IP configuration that the BMENOR2200H module receives from the CPU via X Bus.

NOTE:

- This module does not support DHCP or BOOTP.
- Static IP parameters are not stored locally in this module.
- The cyber security configuration is not stored in the CPU.

Configuration Process

The service configures the IP parameters for the module:

Stage	Description
1	The BMENOR2200H module gets its IP configuration data from the user-specified configuration source.
2	The BMENOR2200H module gets its configuration file from the CPU.

Stage	Description
3	The service validates the IP parameters (IP address, subnet mask, and gateway address).
4	The BMENOR2200H module configures the device with the validated IP parameters.

MAC-based default address information is used in these cases:

- There is no configuration file.
- The IP information is not valid.
- The configured IP address conflicts with the address of another module in the system.

When a default channel is used, the module does not get a valid IP address from the CPU. Instead, it uses the default IP address 10.10.mac5.mac.6. In this case, the module detects a duplicated IP status and does not run.

Behavior

When the initialization is complete, the FDR client service gets a MAC-based IP configuration (`10.10.mac5.mac6`) from the CPU. Then the service validates the parameters:

- OK: If the received IP parameters are valid and not duplicates, the FDR_CLIENT service uses those parameters.
- not OK: If any received IP parameter is invalid, missing, or a duplicate, the FDR_CLIENT service uses the default IP to execute DHCP until the device obtains a valid and non-duplicate IP.

  NOTE: When a duplicate IP address is found in the system, the **ETH STS** LED is solid red. Refer to the description of LED indications., page 19

If the default IP address is a duplicate, the FDR_CLIENT service configures the device with the loopback IP address 127.0.0.1.

After the IP configuration, the FDR_CLIENT service sends gratuitous ARPs.

Modbus TCP Messaging

Data Exchange

Exchanges

Data exchanges take place in one of two modes:

- **server mode**: The RTU module supports all Modbus-over-TCP requests from the PLC.
- **client mode**: This type of exchange enables Modbus-over-TCP requests to be sent using the functions:
  - READ_VAR
  - WRITE_VAR
  - DATA_EXCH

For more details about functions, refer to *EcoStruxure™ Control Expert, Communication, Block Library*.

NOTE: The maximum Ethernet frame size depends on the type of transaction. The maximum frame size is 256 bytes for messaging.

The BMENOR2200H module manages these TCP connections through port 502 messaging:

- Modbus server: 32 connections
- Modbus client: 16 connections

Port 502

TCP/IP reserves specific server ports for specific applications through IANA (Internet Assigned Numbers Authority). Modbus requests are sent to registered software port 502.

Port 502 messaging paths:

- server path:
  - Port 502 messaging can process up to 8 incoming requests from the network. Requests are received during the previous scan and sent to the Modbus server in the IN section.
  - Port 502 messaging can process up to 8 responses from the Modbus server in the IN section (including writing the data into the socket).
- client path:
  - Port 502 messaging can process up to 16 outgoing requests from the application in the OUT section (including writing the data into the socket).
  - Port 502 messaging can process up to 16 incoming responses from the network in the IN section. Responses are sent to the application.

How to Work with RTU Protocols

Introduction

This chapter describes the built-in RTU protocols characteristics for use in Telemetry and Supervisory Control and Data Acquisition (SCADA) applications.

RTU Protocols

Communication Protocols

Functions and Protocols

The BMENOR2200H module provides in-rack support for these functions and protocols in an M580 architecture:

RTU protocols	DNP3 NET and IEC 60870-5-104 (client or server) **NOTE:** When the module works as a client, the number of connected servers affects the module performance (web page access, module start-up and data exchange through the backplane).
Main RTU protocol features	time synchronization through a protocol facility or SNTP, page 52
	data synchronization on demand of the SCADA
	event management with time stamping, page 54 (Sequence of Events, SoE)
	event queue stored in RAM memory, page 55 (up to 150,000 events)
	events data backfill to SCADA application via protocol facility, page 58
	event routing, page 56
	report by exception data exchanges
	unsolicited messaging data exchanges
	DNP3 secure authentication, page 50 SAv2 and SAv5 with pre-shared key, page 50
	protocol setup via the DTM
Other built-in functionality	web server for security set-up and remote diagnostic
	advanced TCP/IP networking: SNTPv1 client, HTTPS server, and SNMP agent.

Limitations

NOTICE

UNINTENDED EQUIPMENT OPERATION

- Use different address values for each session in a channel or for each section in a session.
- Use successive DB mapping starting at 0 in the DNP3 protocol.
- Do not configure the DNP3 client to control a point that is not configured in the DNP3 server point mapping.

Failure to follow these instructions can result in equipment damage.

The BMENOR2200H module does not support multiple RTU protocols instances.

IEC 60870-5-104 Protocol

Introduction

IEC 60870-5 is an international standard released in the early 1990s by the International Electrotechnical Commission (IEC). This standard provides a communication profile for telecontrol, teleprotection, and associated telecommunications characteristics for electric power systems. It is widely used today for other infrastructures, including water applications in Europe and Asia.

The IEC 60870-5-104 protocol is the companion to the IEC 60870-5 standards that relate to transmission protocols.

IEC 60870-5-104

The IEC 60870-5-104 protocol is an extension of the IEC 60870-5-101 protocol. There are changes in transport, network, link & physical layer to open networking.

IEC 60870-5-104 enables communication between control stations and substations in a standard TCP/IP network. The TCP protocol is used for connection-oriented data transmission. To have connectivity to LANs and routers with different facilities (frame relay, etc.), connect it to the WAN. The application layer of IEC 60870-5-104 is the same as that of IEC 60870-5-101, except that some data types and facilities are not used. There are separate link layers defined in the standard, which facilitates the transfer of data over Ethernet and serial lines.

Supported Protocol Features

Features of the IEC 60870-5-104 protocols:

- general interrogation
- clock synchronization
- events transmission (time-stamped or not)
- counter interrogation
- command transmission modes (select and execute mode)

Supported Data Types

The IEC 60870-5-104 protocols include these data types:

- discrete inputs/outputs (single or double)
- measured values (with different formats)
- integrated totals
- commands
- step position
- bit string

Protocol Characteristics

The table lists the characteristics for the supported RTU protocols:

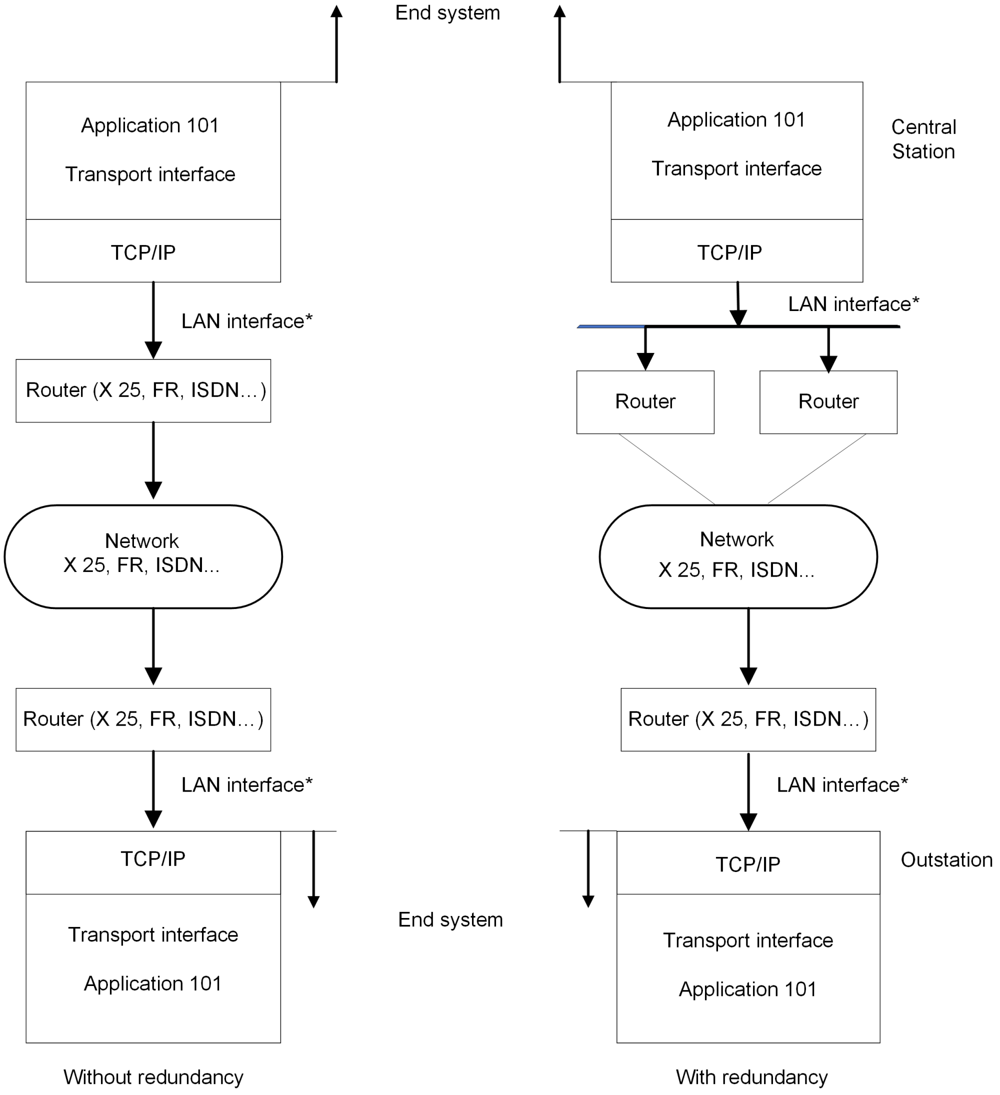
Protocol	Characteristics
IEC 60870-5-104 server	client IP address validation list (up to 10 IP addresses)
	up to four concurrent client connections with configurable TCP service port (standard is 2404)
	• *input:* 8 kb • *output:* 8 kb
	up to 150,000 events in a queue for all data types in all clients (each client has a dedicated event buffer)

Protocol	Characteristics
	event time-stamping configurable by type (None, CP56)
	channel redundancy
IEC 60870-5-104 client	• *input:* 8 kb • *output:* 8 kb
	up to 64 server connections supported
	connections share common channel configuration
	dedicated connection for each device configuration
	dedicated destination IP address and port settings for each connection

Channel Redundancy

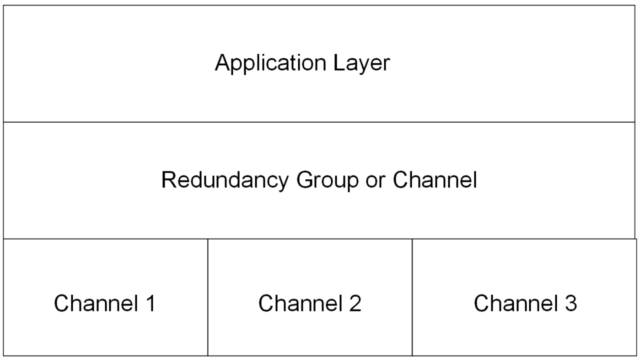
Redundancy is sometimes necessary to increase the availability of the communication system. In these cases, confirm that you establish multiple redundant connections between the two stations. Redundant communication in a system using IEC 60870-5-104 allows you to establish more than one logical connection between two stations. A logical connection is defined by a unique combination of two IP addresses and two port numbers, specifically the controlling station's IP address/port number pair and the controlled station's IP address/port number pair.

The following figure shows the general architecture for a redundant configuration in the central station as well as a non-redundant system:



** The LAN interface may be redundant.*

The following figure shows the redundancy software architecture in the BMENOR2200H module:



- Every main or virtual channel can be configured as **None**, which refers to it is independent channel; it does not belong to any group. Every main or virtual channel can be configured as **1/2/3**. There is only one **Active** channel in multiple channels of one redundant group, which performs all user application communications. All the other channels, except **Active** in multiple channels of one redundant group, are in **inactive** status if they are connected. Inactive channels are monitored to help make sure they are still operational. If an active link control is configured as **External**, when the **Active** channel goes down, communications are switched to the next operational channel by remote client (STARTDT). If an active link control is configured as **Module**, when the **Active** channel goes down, communications are switched to the next operational channel automatically by the module.

Interoperability Lists

The interoperability list (defined by the standard) facilitates interoperability between devices from different manufacturers. In the list, the function range is described for each device by marking the applicable functions.

NOTE: Refer to the IEC interoperability list for this RTU module in Appendices.

DNP3 Protocol

Introduction

The distributed network protocol (DNP3) was developed to achieve an open, standard interoperability for communications between client stations, substation devices, RTUs, and Intelligent Electronic Devices (IEDs). DNP3 has been used primarily by utilities such as the electric power industry in North America and has become widely used in other distributed infrastructures such as water/wastewater, transportation, and oil and gas industries.

DNP3 is based on the International Electrotechnical Commission Technical Committee 57 Working Group 03. The IEC TC57 WG03 has been working on the Enhanced Performance Architecture (EPA), a protocol standard for telecontrol applications. Each of the EPA’s three layers corresponds to a layer on the OSI reference model.

DNP3 is specifically developed for inter-device communications that use SCADA RTUs. The protocol facilitates both RTU-to-IED (Intelligent Electronic Device) and client-to-RTU/IED.

The protocol was originally designed for slow serial communications, but the current DNP3 IP version also supports TCP/IP-based networking.

NOTE: For more details about the supported RTU protocols (including input and output sizes), refer to the description of the I/O data exchange with the CPU, page 24.

Supported Protocol Features

These are the main features that DNP3 supports:

- clock synchronization
- polled interrogations
- polled report-by-exception
- unsolicited report-by-exception
- DNP3 security authentication
- events transmission (time-stamped or not)
- counter-specific treatment
- client commands

Supported Data Types

The DNP3 protocol includes these data types:

- discrete inputs/outputs (single or double)
- analog values (with different formats)
- integrated totals
- string exchange

- commands

Interoperability Lists

This implementation of DNP3 is fully compliant with DNP3 Subset Definition Level 3, which suits larger RTU applications and offers practically the complete range of DNP3 functionality.

This standard defines interoperability between devices from different vendors. It includes a device profile that describes the basic protocol functionalities supported by the device and an Implementation table that defines information objects and their representation supported by the device.

DNP3 Security Authentication

Introduction

In some cases, an attacker can learn the protocol used by an RTU unit to gain dial-up access. When an RTU does not employ strong authentication or other security mechanisms, it accepts and responds to any caller.

To address such concerns, the BMENOR2200H module uses these security authorization services within DNP3 to facilitate communications between remote RTU units.

Secure Authentication Versions

The RTU supports these DNP3 secure authentication versions:

- **SAv2:** *Secure Authentication version 2* is a protocol family within DNP3 that facilitates the authentication of critical controls and commands and helps increase message confidentiality when the BMENOR2200H module is used in conjunction with a suitable SCADA host or other devices that support SAv2.

  SAv2 requires pre-shared keys to be pre-installed on all devices.

  SAv2 is defined by the IEEE 1815-2010 DNP3 standard.
- **SAv5:** *Secure Authentication version 5* is a newer protocol family within DNP3 that addresses evolving threats.

  SAv5 is defined by the IEEE 1815-2012 DNP3 standard.

NOTE:

- Schneider Electric recommends that you use the same secure authentication version (SAv2 or SAv5) on both the client and server sides.
- Manufacturers design a single device to be compatible with only one of these security authorization service versions.
- The implementation of SAv2 or SAv5 authentication requires the use of a security administrator application.

Pre-Shared Keys

The BMENOR2200H module implements secure DNP3 communications through pre-shared keys.

Many utilities that do not choose to manage security credentials in a more sophisticated manner may nonetheless require the level of protection afforded by pre-shared keys.

By definition, users on the SCADA side and module side use the same pre-shared key to effect mutual authentication. Communications are facilitated by a session key that is derived from the pre-shared key.

NOTE:

- Refer to the instructions for the management of pre-shared keys.
- For general information about pre-shared keys, refer to the *Modicon Controllers Platform Cyber Security, Reference Manual*.

DNP3 Client Channel Configuration

The **Add Channel** dialog has the following configurable elements:

- **Secure Authentication**: Select an option from the drop-down list:.
  - SAv2
  - SAv5 (default)
  - Disabled
- **Enable Aggressive Mode**: Aggressive authentication support involving session key, reply time out, and maximum detected error count:
  - Select the check box to enable **Aggressive Mode**.
  - Deselect the check box to disable **Aggressive Mode**.
- **Current User**: Select an option for the user role from the drop-down list:.
  - single user (default, option if SAv2 authentication is selected)
  - viewer
  - operator

Refer to the RBAC topic for each role’s permissions.

NOTE: No user can change the role of another.

DNP3 Server Channel Configuration

The server channel configuration has the following parameters:

- **Secure Authentication**: Select an option from the drop-down list:.
  - SAv2
  - SAv5 (default)
  - Disabled
- **Key/Account Table**: Table for client/server with these options:
  - User Number
  - User Name
  - User Role: Operator, viewer, or single user
  - Key Wrap: Select AES-128 or AES-256.
  - Key: Enter the key wrap algorithm in hex format.

  Click **Apply** to save.
- **Secure Authentication Enabled**
- **Add User**: Click this button to add and configure permissions for another user.

Clock Synchronization

Overview

The clock synchronization service establishes time accuracy among device clocks over a network. The BMENOR2200H module provides two ways to synchronize the clock with the SCADA (client) and the connected devices:

- via the RTU protocol facilities
- via the NTP protocol

NOTE:

- These clock synchronization methods are independent of one another. Configure your application to help avoid clock synchronization conflicts.
- If the NTP protocol is not configured, the module gets its time stamp from the controller during a module restart.

Clock Synchronization with the RTU Protocol

Overview

One of the main features of the RTU is to manage events with time stamping. Time stamping requires effective time synchronization.

Behavior

The behavior of the clock synchronization command is determined by the role of the BMENOR2200H module:

Role(s)	Description
server	When acting as a server, the BMENOR2200H module can synchronize its clock with a client station (SCADA). When your enable this feature, the module receives the clock synchronization command, it updates its internal clock, and posts the new value to the CPU. This maintains a consistent time on the local rack.
client	When acting as a client, the BMENOR2200H module sends clock synchronization commands to connected servers. As with the case above, the clock is initialized from the CPU when it starts up.

Configuration

The SNTP client runs only when you configure the service in the DTM. To configure the SNTP service, refer to the clock synchronization instructions, page 84.

Clock Synchronization with SNTP

Introduction

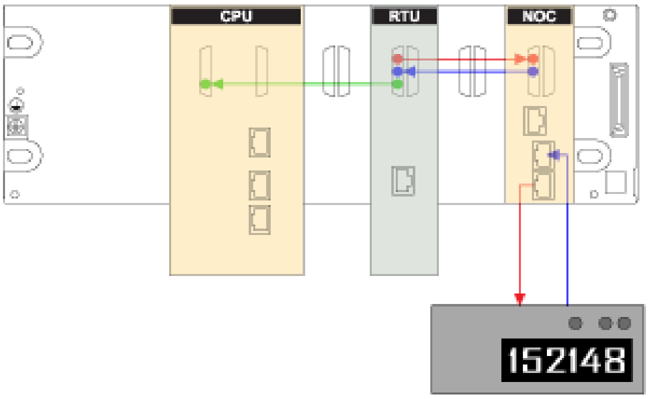
The BMENOR2200H module supports clock synchronization as an SNTP protocol client.

When the SNTP client is enabled, the module synchronizes the internal clock from the time server. This time is the basis for time stamping RTU events.

NOTE: Refer to the instructions for configuring the network time service in the DTM, page 84.

Clock Synchronization and Time Stamps

This sample network shows the flow of the synchronization signal from the perspective of the SNTP client in a BMENOR2200H module:



red line: The BMENOR2200H module sends an SNTP request over the Ethernet backplane to the NOC module, and the NOC module forwards the request to the SNTP server.

blue line: The SNTP server sends a reply to the NOC module, and the NOC module forwards the reply to the BMENOR2200H module.

green line: The BMENOR2200H module sends the source clock synchronization signal to the CPU over the Ethernet backplane.

NOTE:

- The BMENOR2200H module sends the signal to update the CPU’s internal clock only when you select **Update Clock to CPU** in the time synchronization parameters, page 85.
- The time received by the CPU is typically within 5 ms of the SNTP server time, with a worst-case difference of 10 ms and a free running drift time +/- 2.6 seconds per day.
- Between clock synchronization signals, the RTU updates its own clock every millisecond with its internal timer.

Clock Synchronization with the CPU

Introduction

You can configure the CPU as an NTP server. In this case, the CPU uses its internal clock and acts as an Ethernet NTP server for devices that are connected to the same Ethernet network.

Configure the CPU as an NTP Server

Access and set the NTP parameters in Control Expert:

Step	Action
1	Open a Control Expert project.
2	Expand these items in the **Project Browser**: **Project > Configuration**
3	Double-click **PLC bus** to see the modules and racks in your project.
5	Select the **NTP** tab.
6	From the **NTP** pull-down menu, select **NTP Server**.
7	Configure the parameters in the **NTP Server Configuration** area.

When the CPU is configured as an NTP server, the polling period is a parameter used by remote modules in the PAC. It represents the time elapsed before the remote modules resynchronize their internal clocks with the time from the CPU NTP server.

Time Stamping

Event Time Stamping

Overview

The BMENOR2200H module provides two ways for time stamping of events:

- Time stamping done at source in the CPU (requires PLC programming).
- Time stamping done in the BMENOR2200H module (does **not** require PLC programming).

NOTE: Improved time stamping resolution can be obtained when performing in the CPU. Time stamping resolution depends on the CPU scan time and I/O module type.

Events Management

Event Management

Introduction

The BMENOR2200H module generates events on changes of state, handles event lists, and provides these services:

- The management of a buffer of events (time stamped or not), overall buffer (queue) size can be up to 150,000 events.

  NOTE: One dedicated event buffer is managed per server application (up to four server applications are supported).

- Automatic event backfill to the SCADA or the client station via RTU protocol facility (on IEC 60870-5-104 or DNP3).

For the RTU IEC 60870-5-104 or DNP3 server configuration, each object type has an independent event queue setting. To enable event generation, set an event queue for the corresponding object type.

Access the Configuration

Access the event command configuration in Control Expert:

Step	Action
1	Follow the directions to configure a server channel, page 75.
2	Expand (**+**) **Channels > DNP3 NET server > <ServerName>**,
3	Select one of these items from the **Select Type Id** pull-down menu on the **DATA MAPPINGS** tab: • **Generate Events** • **Clear Events**

Step	Action
4	Select the **Add** button to view the parameters for the selected type: • **Generate Events:** ◦ **Point Number** ◦ **Point Count** ◦ **Object Group** ◦ **Point Name** ◦ **Add CMD_STATUS** • **Clear Events:** ◦ **Object Group** ◦ **Point Name** ◦ **Add CMD_STATUS** **NOTE:** When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.
5	• Click the **Apply** button to implement your configuration changes. • Click the **OK** button to implement your changes and close the dialog box.

Event Queue Setting Page

Configure the parameters on the **Events** tab to map the event queue status to the DDDT registers in the CPU. Each event queue status consumes one three-byte register.

NOTE: When the events number exceeds the configured buffer size, events are lost or overwritten.

Access the event queue configuration in Control Expert:

Step	Action
1	Expand: • **Channels/Devices > <DNP3 NET Server> > <ServerName>** – or– • **IEC104 Server > <ServerName> > <DeviceName>**
2	Make a selection in the **Select Type Id** pull-down menu on the **EVENTS** tab
3	Select the **Add** button to view the parameters for the selected type: • **Event Store Mode** • **Max Event Count** • **Buffer Setting** • **Max Event Count-1** • **Max Event Count-2** • **Max Event Count-3** • **Event Backup** **NOTE:** When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.
4	• Click the **Apply** button to implement your configuration changes. • Click the **OK** button to implement your changes and close the dialog box.

Maximum Event Buffer Size

All channels can support up to 150,000 events, but each point type only supports up to 65,535 events.

Hot Standby Event Performance

When a BMENOR2200H module generates up to 4,000 events per second, the module still supports a Hot Standby switch-over without any event loss (depending on configuration).

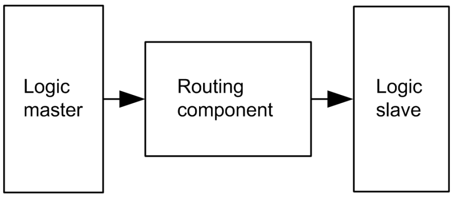
Event Routing

Introduction

The event routing component allows events from sub stations to be routed to SCADA within a single BMENOR2200H module.

To route events, one or more RTU client channels and at least one RTU server channel are needed inside the system. The solution is to create a logic RTU client and server in a single BMENOR2200H module. In the logic client, points are created to represent points in sub stations, and in the logic server, points are created to simulate the behavior of points in sub stations. The event routing component is responsible for collecting events in the logic client. These events are sent from sub stations and trigger the same events in the logic server.

BMENOR2200H module components:



NOTE: Event routing capabilities are possible only within a single module.

There are no automatic event routing capabilities between two BMENOR2200H modules (a server and a client) that are configured in the same station.

In a hierarchical architecture, time stamped events are automatically transferred from low-end server sub stations to the SCADA (or client) through the station. The automatic transfer uses path-through events functionality with a single BMENOR2200H module configured in both the client and server.

Configuration

Configure the BMENOR2200H module for event routing on the data mapping configuration page, page 87.

Considerations:

- The BMENOR2200H module does not detect events for event routing points in a server.
- There is no web page to configure event routing.
- In a valid configuration for event routing points, only one point is occupied in the database to reduce the data size stored in memory. Use the device DDT to see the point and its structure in the **Variables** list.

Point configuration considerations:

Configuration	Description
channel (See the note below.)	For routing events, configure one client channel and at least one server channel. One client channel is required so that the system can connect with more sub servers, and more server channels allow for more SCADA in the system. **NOTE:** Refer to the channel configuration instructions, page 75.
client data mapping (See the note below.)	Add data points in the client channel. These points show the mapping of client points in the sub server, which communicate with the client channel. **NOTE:** Refer to the DNP3 data object mapping instructions, page 87.

Configuration	Description
server point	After you configure the points in the client channel, the corresponding point is listed in the server channel. The points used to route are different from the normal points of the server. The parameters (CPU type, CPU address, variable name, and time stamp) of CPU mapping are no longer available, and the available parameters are read only. *Their lifetime is consistent with peer point configuration in the client*.
NOTE: When you configure these points in the client channel, select the events of the points to be routed, and route events to the corresponding server channel. For example, if the client channel receives events from the sub server Binary Input point and routes them to the logic server channel, they become events of the Binary Input point of logic server channel. Considerations: • When you specify one point in the client for event routing, such as the binary input point, one corresponding point configuration is automatically generated in the logic server channel. The point configuration for the logic server channel is read only; it cannot be changed or removed in its DB mapping panel. • If the channel number, session number, or point number mismatches in the server channel, an error page appears. • If you choose the route to the channel as Disable, the point does not need to be routed to a server.	

Channel Combination for Event Routing

To route events inside the RTU module, use the configuration instructions to combine the client channel and server channel.

The supported combinations are:

Client Channel	Server Channel
DNP3 net client	DNP3 net server
IEC 60870-5-104 client	IEC 60870-5-104 server

Limitations

- Events are routed inside the module. This means that it is not possible to route events between two or more modules and also that the PLC application in the CPU cannot get and process the events. (The CPU can still get the point value in events just like the standalone client channel.)
- Only events are routed. Requests (commands) from SCADA are not routed to the sub server. This means that inside the BMENOR2200H module, there is no other data exchange or communication between the client channel and the server channel except for events. Not all client and server channel combinations are supported by the event routing function.
- In the system, SCADA cannot communicate with sub servers. The solution uses the logic server in the BMENOR2200H module to simulate sub servers, so SCADA can communicate only with the logic the server in the BMENOR2200H module, and the sub server can communicate only with the logic client in the BMENOR2200H module.
- Some information related to events may be changed. Key information related to events like point value, flag, and time stamp is kept during event routing. Other information related to events like point number, events class, and variation is changed according to the client channel configuration.
- For broken connections, the downstream server does not generate events to an upstream supervision system.

Events Buffer Size

Confirm that the events buffer of the server are greater than the events buffer in the sub server.

Event Backup

Introduction

The BMENOR2200H module’s event backup buffer can store events when power to the module stops.

Event Backup Characteristics

You can configure the module for the events or data types that are saved upon a loss of power or a module hot-swap.

These are the capacities for event storage for the BMENOR2200H module and the RTU protocol:

- event buffer:
  - The module saves up to 150,000 event in the event buffer.
  - The module saves up to 10,000 events in the event buffer upon a loss of power. The event buffer is synchronized between the primary and standby modules in a redundant system.
  - The module saves up to 10,000 security events per server channel in the event buffer.
- flash memory:
  - The module saves up to 10,000 events into Flash memory upon a loss of power.
  - The module saves only the latest events when number of saved events exceeds 10,000.
  - The module reads events from Flash memory when power is restored.

  NOTE: You can enable or disable the exchange of unsolicited messaging data.

Retain or Clear the Buffer

The event buffer in RAM is retained in these situations:

- The CPU experiences a warm start.
- There is a network swap in a dual-network application.

The event buffer in RAM is cleared in these situations:

- Use a **Clear Events** command to clear the buffer in RAM.
- The CPU experiences a cold restart (such as during the download of a new configuration) or you press the reset button on the power supply. All communications are reset.
- Change the DNP3 cyber security configuration on the web page to clear the buffer.
- A SCADA command specifically clears the buffer.

Event Backup Behavior

The BMENOR2200H module has different backup behaviors in different cases. The type of case is defined from the user point view:

	Case	Description	Event
1	Loss of power	power lost	Saves events in non-volatile memory on loss of power.
2	Power start	power on/restore	Restores events when the RTU protocol starts.
3	Protocol restart	These actions clear the module event buffer: • The RTU protocol configuration changes. • The RTU receives a warm or cold start command from an RTU client.	Does not save events when the protocol exits.

Limitations

The BMENOR2200H module scans and stores events in each channel one by one when the number of events exceeds the Flash memory capacity, the module saves only the latest events.

RTU Protocol Data Flow

RTU Communications

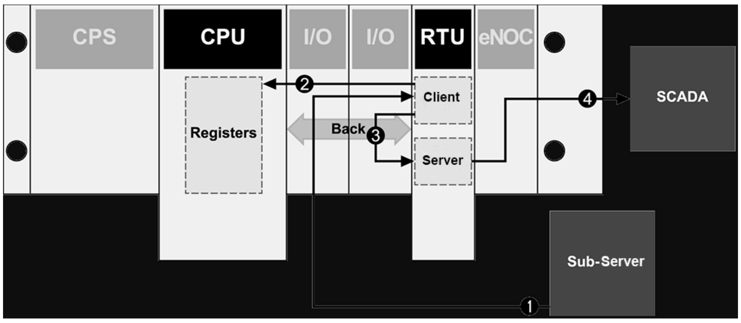
Communication Behavior

The BMENOR2200H module is equipped with a dual-bus connector, page 23 that supports both Ethernet and X Bus communications.

This Ethernet backplane port is used mainly to communicate with the remote client or server with RTU protocols. The backplane interface is used to communicate with the CPU. The main activity of the backplane interface is the synchronization of data between CPU registers and the RTU point database inside the module. The synchronization cycle can be one or more PLC application scan cycles, depending on the data amount and backplane load.

When the Client Channel Receives Events from the Sub Server

When something significant changes in the sub server (like the value of a point), the sub server sends an event. The system receives this event and the event is then routed to a SCADA system, as shown in this example:



1 The sub server sends events to the client channel of the BMENOR2200H module.

2 The client channel updates the point values in the module and the database of the logic server channel and synchronizes the value to CPU registers.

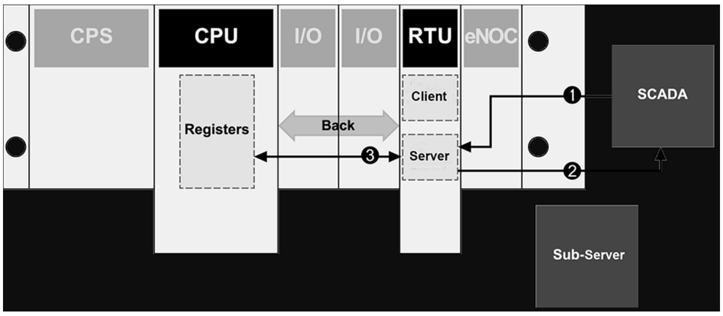
3 Events are routed to server channels according to point configuration.

4 The server channel buffers these events and sends events to SCADA when the communication link is established.

When the Server Channel Receives Request from SCADA

In the RTU system, a SCADA system sends requests (commands) like an Integrity Poll to the server connected to it. The server channel receives this request and sends a response to the SCADA system. With event routing, the behavior of the server channel is exactly the same as a standalone (no event routing) server channel. The client channel and sub servers are not involved in this case.

This sample illustration shows a request from a SCADA system:



1 The SCADA system sends an Integrity Poll request to the server channel.

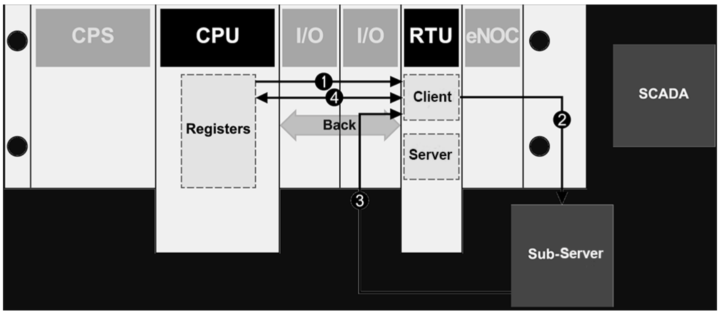
2 The server channel responds to the SCADA request with the point values in the database.

3 The point values are synchronized cyclically between the database of the server channel and CPU registers.

When the Client Channel Sends Request to the Sub Server

The client channel can send requests to a sub server connected to it, and a sub server sends the response back to the client channel. The behavior of the client channel in this case is exactly the same as a standalone client channel. **The points in the logic server channel should be synchronized with the updated point in the client channel.**

Send request to a sub server example:



1 The application in the M580 CPU sends an Integrity Poll command to the client channel.

2 The client channel sends Integrity Poll requests to the sub server.

3 The sub server responds to the request with the value of the latest points.

4 The logic server data base is synchronized while the client channel updates the database.

> **NOTE:** Point values are synchronized cyclically between the database of the client channel and CPU registers.

Connection Status

Connection Status

Introduction

The connection status of each channel of the BMENOR2200H module is put in a double-word descriptor in the DDDT mapping.

Detected Error Codes

The following tables describe the detected error codes for the connection status for both server and client roles.

Server:

Bit	Description
0	Channel security is not configured.
1	An initialization error for an unlocated variable is detected.
2	An internal error is detected (pipe create error IPT initialization error, etc.).
3...14	These bits are reserved.
15	A TLS error is detected.

Client:

Bit	Description
0	Channel security is not configured.
1	An initialization error for an unlocated variable is detected.
2	An internal error is detected (pipe create error IPT initialization error, etc.).
3	The authentication failed.
4	There is an unexpected response.
5	There is no response.
6	Aggressive mode is not supported.
7	The MAC algorithm is not supported.
8	The key wrap algorithm is not supported.
9	The authorization failed.
10	The update key change method is not permitted.
11	The signature is not valid.
12	The certification data are not valid.
13	An unknown user is detected.
14	The capacity of session key status requests is exceeded.
15	A TLS error is detected.

Hot Standby Capacity

Introduction

This section describes the functionality of BMENOR2200H redundant modules, including the operating state of redundant RTU modules, depending on the PAC state, Ethernet services, and the Hot Standby switch-over function.

Hot Standby Capacity

Overview

In a running Hot Standby system, you can perform the following actions (in either primary or standby rack, cabled or not cabled), and this action does not cause a Hot Standby switch-over or a duplicate IP address:

- hot-swap a BMENOR2200H module
- remove or reconnect a cable to a BMENOR2200H module

When you clear a detected fault on a BEMNOR2200H in a standby rack (network cabling cut, power off, hot swap), this action does not affect the Hot Standby primary operation; in other words, no primary stop or shut down, no I/O bump, or no switch-over occur. The RTU module can switch its servers or SCADA connections smoothly during a Hot Standby switch-over.

Hot Standby RTU Service

In a Hot Standby system, the input I/O image (••••_CONN DDDT) is synchronized cyclically between the M580 primary and standby PACs.

The content of diagnostic DDDT is not required to exchange between the primary and standby RTU modules.

Confirm that only the first section in the standby CPU is running. Do not update the RTU Ethernet variables in the first section in the standby CPU.

DNP3/IEC 60870-5-104 Server

With a DNP3/IEC 60870-5-104 server, only the primary module works as usual in a Hot Standby system, and the standby module has no communication with SCADA connections.

- When the DTM configuration of the primary module, as well as its security mode and firmware version are the same as that of the standby module, the two modules can synchronize. In this case, the primary module synchronizes the event history and internal data (unsolicited state, frozen counter....) with the standby module.

  NOTE: Confirm that the primary and standby modules have the same cyber security configurations. If they have different configurations, the modules could still synchronize, but they may not work properly because some channels are disabled due to a missing security policy.

- In run mode, if the primary and standby modules are synced, the following items are synchronized via internal protocol:
  - DNP/IEC event
  - DNP/IEC event acknowledgement
  - DNP frozen counter
  - DNP AII dead band
  - DNP enable/disable unsolicited
  - cold/warm start
  - DNP IIN
  - IEC MIT (frozen, sequential number)
  - IEC CRPNA
- When a Hot Standby switch-over occurs:
  - The primary module closes the connection with SCADA.
  - The secondary module gets the data in value from the PAC to the local database first (AO, BO, String, CMD status, P_ME_A, P_ME_B, P_ME_C, IEC P_AC) and then starts to take over and accept new SCADA connections.
  - During a switch-over, all server methods report any detected error codes.

  - With the DNP3 secure authentication enabled, the session key is forced time out.
  - For MIT:

    –> When Auto Local Freeze is set to auto freeze, the new primary module forces a freeze immediately after switch-over.

    –> When Auto Local Freeze is set to freeze by application, if the Freeze Cyclic point value is 1, the new primary module forces a freeze immediately after switch-over.
  - The new primary module handles the last two cycle's data and generates an event.
  - For AI, M_ME_A, M_ME_B, and M_ME_C:

    –> The second from last cycle before a switch-over is set as the base value, on which the data change check is based.

    –> Some of the last two cycle's events may already be synced with the standby module, which causes SCADA to receive duplicate events.
- If the module time source is set from the RTU protocol, time synchronizes cyclically between primary and standby RTU modules via internal protocol.
- For IEC 60870-5-104 message interval and background period, the primary and standby modules do not sync timer status information. After switch-over, the first cyclic/background message may not remain in time out. The second cyclic/background message remains in time out according to the user setting.

DNP3/IEC 60870-5-104 Client

For a DNP/IEC client, the primary module typically communicates with the remote server, and the standby module does not establish a connection with the remote IED.

- The primary and secondary modules synchronize data from the PAC memory with the local database, but the standby module does not send data to the remote server. Therefore, the remote server receives output data from the primary module only.
- When a Hot Standby switch-over happens, the primary module closes the connection with the remote server, and the standby module takes the role of communicating with the remote server.
- During a switch-over, if some commands (read class, read group, polling command, control operation) are not finished, a detected error code is returned in DDT instance status. We recommend that you manage the status to re-send commands that did not finish.

NOTE:

1. Confirm that the link status period of client and server is set to a non-zero value, such as 2s. If the link status period is set to zero, during a Hot Standby switch-over, the module cannot create a new connection because the old connection is not in time out.
2. Event backup is not supported in a Hot Standby system. If you enable this function in a standalone system and replace the CPU with a Hot Standby CPU, the event backup function is automatically disabled.
3. For IEC 60870-5-104, the client does not immediately send an event acknowledgement, which depends on the W value (maximum unacknowledged received APDUs) and the T2 S frame period (the time to wait before sending a supervisory ADPU acknowledgement). During a Hot Standby module hot swap, the client may receive duplicate events because an event is not acknowledged before the hot swap.
4. For both DNP3/IEC 60870-5-104, the event acknowledgement in the last cycle may not have synchronized from primary to standby. The acknowledgement also causes SCADA to receive the duplicate event, which has the same time stamp.

Managing Ethernet Services

Service Status

The following table describes the services that are running in the primary and standby BMENOR2200H modules at PAC state of RUN/STOP:

Service List	**Primary BMENOR2200 Module**		**Standby BMENOR2200 Module**	
PAC State	**RUN**	**STOP**	**RUN**	**STOP**
DNP3/IEC server	RUNNING	RUNNING	RUNNING (sync from primary)	RUNNING (sync from primary)
Event routing	RUNNING	RUNNING	RUNNING (sync from primary)	RUNNING (sync from primary)
DNP3/IEC client	RUNNING	RUNNING	STOPPED	STOPPED
SNTP client	RUNNING	RUNNING	RUNNING	RUNNING
Modbus TCP client	RUNNING	RUNNING	STOPPED	STOPPED
Syslog	RUNNING	RUNNING	RUNNING	RUNNING
Modbus TCP server	RUNNING	RUNNING	RUNNING	RUNNING
Firmware upgrade	RUNNING	RUNNING	RUNNING	RUNNING
SNMP V1	RUNNING	RUNNING	RUNNING	RUNNING
Web server (cyber security setting + diagnostic)	RUNNING	RUNNING	RUNNING	RUNNING
OEB (FDR+LLDP)	RUNNING	RUNNING	RUNNING	RUNNING

Sequence Of Events

Introduction

Use the information in this chapter to configure a BMXERT1604 module's time stamping events.

Time Stamp Sequence of Events

Introduction

Sequence of events (SOE) software applications help you understand a chain of occurrences that can lead to potentially unsafe process conditions and possible shutdowns.

Many process events can be generated quickly when a system does not behave according to design or expectations. In this case, the X80 BMXERT1604 time stamping module records all events with a time stamp accuracy of 1ms. Data is stored in the module until it is transmitted by the application. The BMENOR2200H module can call this event data and transfer it to an external supervisor system (SCADA, DCS, etc.) through the RTU protocol.

This topic describes SOE in the transfer of the time stamping function from a BMXERT1604 module to the RTU protocol in a Control Expert project that includes a BMENOR2200H module.

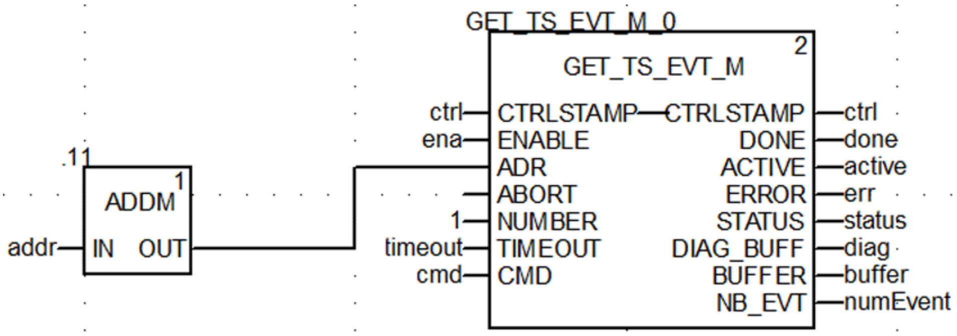
Process Overview

This is a broad overview of the time stamping SOE process.

Stage	Description
1	Use a DFB to read and send a time stamping event from a BMXERT1604 module to a BMENOR2200H module. In a single PLC cycle, a DFB instance processes a maximum of one time stamping event.
2	Based on the structure of the raw buffer read from the time stamping module, you can extract and convert the data.
3	Use a T850_TO_T870 EFB to convert the time stamping format into IEC60870 time format.

GET_TS_EVT_M Function Block

Use a `GET_TS_EVT_M` function block to read a time stamping event from a specific BMXERT1604 module:



NOTE: Read one event in a single PLC cycle for each time stamping module. When the DONE parameter turns to TRUE, the event has been read and stored in the buffer. You can move to the next step.

Refer to the EcoStruxure Control Expert System Block Library (see EcoStruxure™ Control Expert, System, Block Library) for detailed descriptions of the GET_TS_EVT_M function block parameters.

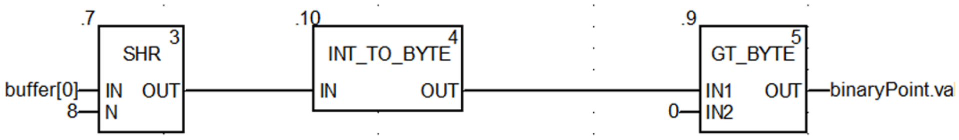
Event Format in Response Buffer

This table describes the format of the time stamping event in the response buffer:

Data Structure	Element	Type	Definition
Raw buffer format	Reserved	BYTE	Reserved
	Value	BYTE	Input value
	Event ID	WORD	Event ID defined by user or channel number
	SecondSinceEpoch	DWORD	The interval in seconds continuously counted from the epoch 1970-01-01 00:00:00 UTC
	FracOfSec_L	WORD	The fraction of the current second when the value of the TimeStamp has been determined. The fraction of the second is calculated as (SUM from i=0 to 23 of bi*2**—(i+1) s).
	FracOfSec_H	BYTE	
	TimeQuality	BYTE	Time Quality: • Bit 7: LeapSecondsKnown (not supported) • Bit 6: ClockFailure (not supported) • Bit 5: ClockNotSynchronized • Bit 0-4: Time accuracy

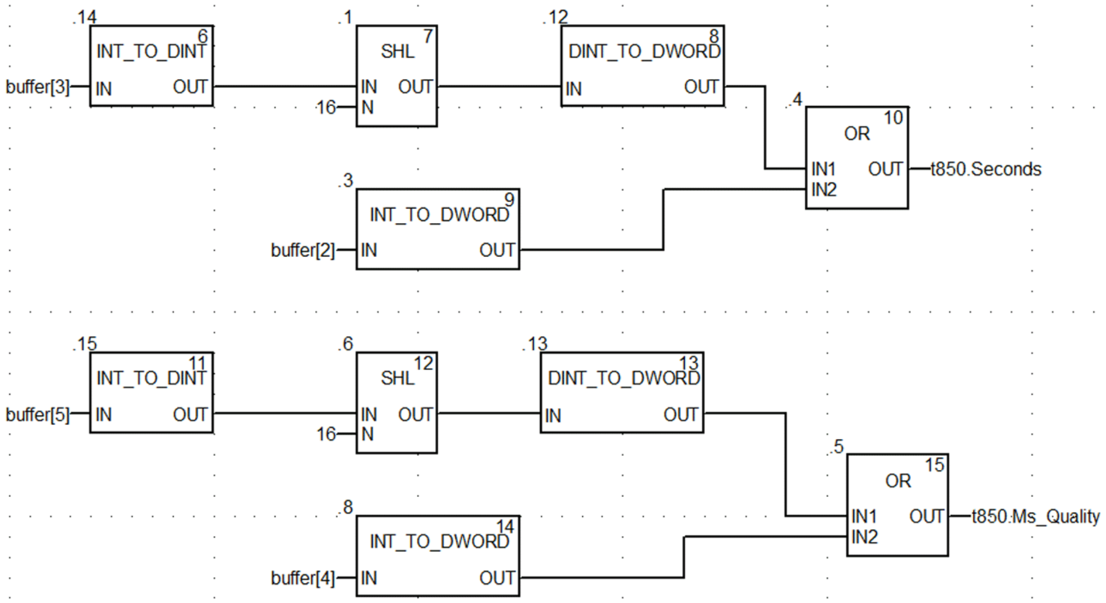
Extract the Time Stamp Event

Based on the raw buffer structure read from the time stamping module, you can extract and convert the data. First, extract the value of the binary point as shown in this example, which assumes that the first event starts from Buffer[0]:



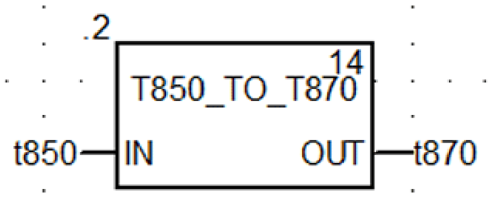
Extract the T850 Data

To extract the T850 data, as shown in this typical application example, put the binary point value in the right position of the DDT based on the BMXERT1604 module’s address and channel in the raw buffer:



Convert the Time Stamp Format

To convert the time stamp format from IEC61850 to IEC60870, use the T850_TO_T870 EFB as follows, where the input parameter is the 850 time format and the output parameter is the 870 time format:

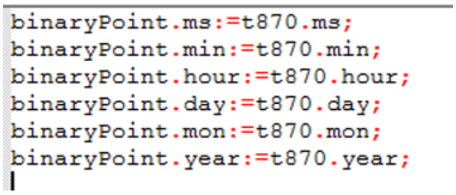


This table describes the structure of the 850 and 870 time format:

Data Structure	Element	Type	Definition
TIME_870_FORMAT	ms	WORD	Milliseconds: 0-59999 ms
	min	BYTE	Minutes: 0-59 min, the highest bit is invalid bit, 1: invalid time, 0: valid time
	hour	BYTE	Hour: 0-23 h, SU is not supported
	day	BYTE	Day: 1-31, day of week is not supported
	mon	BYTE	Month: 1-12 Year: 0-99
	year	BYTE	
	reserved	BYTE	Reserved
TIME_850_FORMAT	Seconds	DWORD	Seconds since 1970, confirm the time stamp is later than 2000.

Data Structure	Element	Type	Definition
	Ms_Quality	DWORD	• Bit 0-23: The fraction of the current second when the value of the TimeStamp has been determined. The fraction of second is calculated as (SUM from i = 0 to 23 of bi*2**—(i+1) s). • Bit 24-31: Time Quality • Bit 31: LeapSecondsKnown (not supported) • Bit 30: ClockFailure (not supported) • Bit 29: ClockNotSynchronized • Bit 24-28: Time accuracy

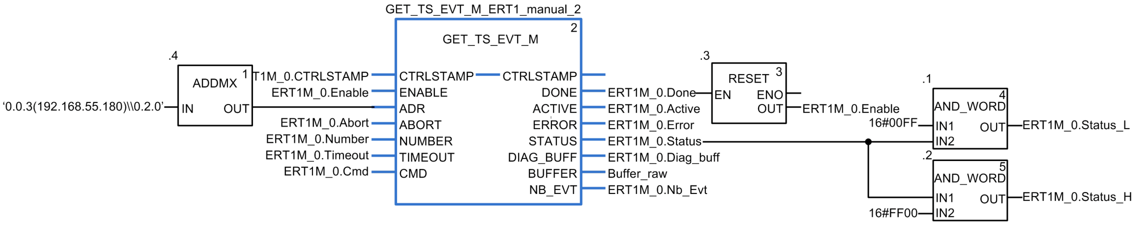
NOTE: The T870_TO_T850 function block does not consider time zone or summer when converting time. Set the T870 value to the DNP point's timestamp as follows:

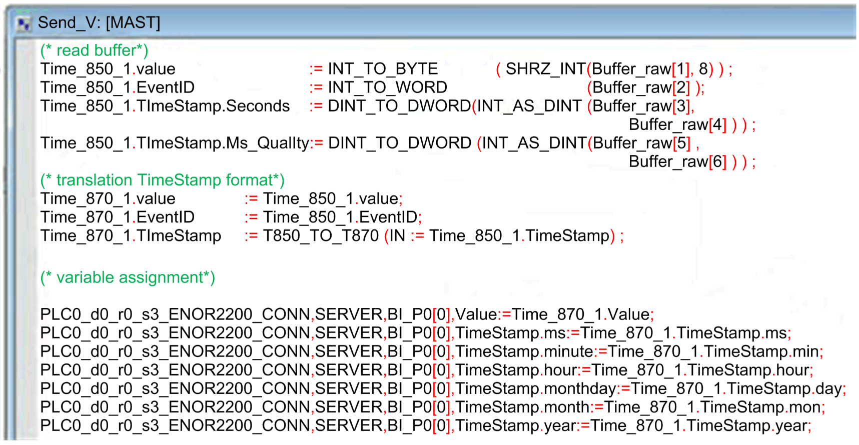


```
binaryPoint.ms:=t870.ms;
binaryPoint.min:=t870.min;
binaryPoint.hour:=t870.hour;
binaryPoint.day:=t870.day;
binaryPoint.mon:=t870.mon;
binaryPoint.year:=t870.year;
```

Typical SOE Application Example

This screenshot shows the use of the `Send_V` command to transfer output of `GET_TS_EVT_M` (Buffer raw) to the RTU points in a typical SOE application, in which read buffer and translation Time Stamp format in `Send_V` are equal to the function blocks in previous examples:





Send_V: [MAST]

```
(* read buffer*)
Time_850_1.value                    := INT_TO_BYTE        ( SHRZ_INT(Buffer_raw[1], 8) ) ;
Time_850_1.EventID                  := INT_TO_WORD                  (Buffer_raw[2] );
Time_850_1.TImeStamp.Seconds        := DINT_TO_DWORD(INT_AS_DINT (Buffer_raw[3],
                                                                     Buffer_raw[4] ) ) ;
Time_850_1.TImeStamp.Ms_QualIty:= DINT_TO_DWORD (INT_AS_DINT(Buffer_raw[5] ,
                                                                     Buffer_raw[6] ) ) ;
(* translation TimeStamp format*)
Time_870_1.value          := Time_850_1.value;
Time_870_1.EventID        := Time_850_1.EventID;
Time_870_1.TImeStamp      := T850_TO_T870 (IN := Time_850_1.TimeStamp) ;


(* variable assignment*)

PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],Value:=Time_870_1.Value;
PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],TimeStamp.ms:=Time_870_1.TimeStamp.ms;
PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],TimeStamp.minute:=Time_870_1.TimeStamp.min;
PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],TimeStamp.hour:=Time_870_1.TimeStamp.hour;
PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],TimeStamp.monthday:=Time_870_1.TimeStamp.day;
PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],TimeStamp.month:=Time_870_1.TimeStamp.mon;
PLC0_d0_r0_s3_ENOR2200_CONN,SERVER,BI_P0[0],TimeStamp.year:=Time_870_1.TimeStamp.year;
```

Configuring the Module

Configuration Overview

Configuration Components

Introduction

Observe these guidelines to configure the BMENOR2200H module after you add the module and its corresponding DTM to a Control Expert project, page 70.

Configuration Environment Components

Use this table to select the appropriate the component in the configuration environment with the intended configuration role:

Component	Functional Feature
Control Expert Configuration Overview	RTU module name definition, page 72
	IP address assignment, page 72
	Add the module to a Control Expert project., page 72
	basic online diagnostics
Device DTM	channel configuration, page 75
	SNMP agent, SNMP client, page 83
	Network Timing Service (SNTP), page 84
	DNP3 Net Client/Server, page 75
	IEC 60870-5-104 Client/Server, page 46
	Export / Import, page 104
	Module Information, page 106
	RTU protocol configuration, page 45
	RTU point configuration, page 87
	fast-access link to the diagnostic web page
HTTPS web pages	security configuration, page 108
	DNP3 Secure Authentication configuration, page 113
	TLS configuration, page 112
	RBAC configuration, page 121
Automation Device Maintenance	firmware upgrade, page 42
project migration	project migration considerations, page 170
	located variables with addresses (DNP3 AO/BO point "On Demand" mode, page 90)

Use the Module in a Control Expert Project

Before You Begin

Use the instructions in this section to add a module and its corresponding DTM to a Control Expert project.

Add the DTM and Module to Control Expert

About DTMs

Each module or device in the Control Expert **Hardware Catalog** is represented by a device type manager (DTM) that defines its parameters.

Any configuration done through the DTM is performed within the Control Expert environment.

DTM Installation

In general terms, the device DTM is automatically installed when you install Control Expert.

In any other case, you can install the DTM on a host PC (the PC that runs Control Expert) to make the device DTM available for use in Control Expert.

For third-party modules, the DTM installation process is defined by the manufacturer. Consult those instructions to install a DTM on your PC.

After a device DTM is successfully installed on your PC, update the Control Expert **Hardware Catalog** to see the new DTM in the catalog. The DTM is then added to your Control Expert configuration when the corresponding module is added to the project.

About the Control Expert DTM Browser

Introduction to FDT/DTM

Control Expert incorporates the Field Device Tool (FDT) / Device Type Manager (DTM) approach to integrate distributed devices with your process control application. Control Expert includes an FDT container that interfaces with the DTMs of EtherNet/IP and Modbus TCP devices and the BMENOR2200H module.

An EtherNet/IP device or Modbus TCP device is defined by a collection of properties in its DTM. For each device in your configuration, add the corresponding DTM to the Control Expert **DTM Browser**. From the **DTM Browser** you can open the device's properties and configure the parameters presented by the DTM.

Device manufacturers may provide a DTM for each of its EtherNet/IP devices, Modbus TCP devices, or the BMENOR2200H module. However, if you use a device that has no DTM, configure the device with one of these methods:

- Configure a generic DTM that is provided in Control Expert.
- Import the EDS file for the device. Control Expert populates the DTM parameters based on the content of the imported EDS file.

NOTE: The DTM for a BMENOR2200H module is automatically added to the **DTM Browser** when the module is added to the **PLC bus**.

Automatic DTM Creation

In a Control Expert application, DTMs for some Ethernet communication modules and other pre-configured devices (see the following list) are created automatically when added to an Ethernet rack on the main local or main remote drops. A default DTM name is assigned in the DTM topology, but you may modify the name:

- Right-click the desired DTM name in the **DTM Browser** and select **Properties**.
- select the **General** tab, and edit the DTM name in the **Alias name** field.
- Select **Apply** to save the changes.

  – or –

  Select **OK** to save the changes and close the dialog box.

NOTE: The **OK** button is valid to press only when Control Expert has confirmed that the DTM is unique.

Windows Compatibility

This table describes the minimum and recommended PC configuration to run M580 DTMs inside Control Expert:

Operating System	Requirements
Microsoft Windows 7 Professional 64-bit	*system:* Pentium Processor 2.4 GHz or higher, recommended 3.0 GHz
	RAM: 4GB minimum; 8GB recommended
	hard disk: 8GB minimum free space; 20GB recommended
	Microsoft Internet Explorer 5.5 or higher
	Windows Service Pack 1 (SP1) is required to use EcoStruxure™ Control Expert 15.1.
	NOTE: Microsoft Windows 7 Professional 32-bit is not supported.
Microsoft Windows 10 32(*)/64-bit	*system:* Pentium Processor 2.4 GHz or higher, recommended 3.0 GHz
	RAM: 4GB minimum; 8GB recommended
	hard disk: 8GB minimum free space; 20GB recommended
	The 64-bit OS is required to manage projects that implement a Modicon M580 controller or that install DTMs.
Microsoft Windows Server 2016	*recommended version*: standard
	recommended processor: 3.20 GHz
	recommended RAM: 16GB
Microsoft Windows XP	Control Expert does not support this OS.
Screen Resolution *recommended*: 1920 x 1080	

DTM Types

The **DTM Browser** displays a hierarchical list of DTM nodes on a connectivity tree. The DTM nodes that appear in the list have been added to your Control Expert project. Each node represents an actual module or device in your Ethernet network.

There are two kinds of DTMs:

- *client (communication) DTMs*: This DTM is both a device DTM and a communication DTM. The client DTM is a pre-installed component of Control Expert.
- *generic DTMs*: The Control Expert FDT container is the integration interface for any device’s communication DTM.

This list contains these node types:

DTM Type	Description
communication (client)	Communication DTMs appear under the root node (host PC). A communication DTM can support gateway DTMs or device DTMs as children if their protocols are compatible.
gateway	A gateway DTM supports other gateway DTMs or device DTMs as children if their protocols are compatible.
device	A device DTM does not support any child DTMs.

Node Names

Each DTM node has a default name when it is inserted into the browser. The default name for gateway and device DTMs for the BMENOR2200H module are in this format:

```
<EtherNet IP address>PLC0_d0_rX_sY_ENOR2200
```

- *X* is the rack number (usually *0*).
- *Y* is the slot number based on the module's location in the rack.

Therefore, a real-world example of a default name looks like this:

```
<10.10.1.72>PLC0_d0_r0_s2_ENOR2200
```

This table describes the components of the default node name:

Element	Description
address	This is the bus address of the device that defines the connection point on its parent gateway network (for example, the device IP address).
device name	The default name is determined by the vendor in the device DTM, but the user can edit the name.

Add the Module to a Project

Add the Module to the PLC Bus

Add a BMENOR2200H advanced RTU module to a Control Expert project and assign a name to it:

Step	Action
1	Open a project in Control Expert.
2	Expand (**+**) the **Project Browser** to see the **PLC bus** (**Project > Configuration > PLC bus**).
3	Double-click **PLC bus** to view the assembled rack(s).
4	Right-click an empty rack slot and select scroll to **New Device**. **NOTE:** Select a rack position that conforms to the module’s slot restrictions, page 34.
5	In the **Part Number** column in the **New Device** dialog box, expand **Communication** to see the available modules.
6	Double-click the BMENOR2200H module to open the **Properties of device** dialog box.
7	In the **Name** field, assign a name to the module (or accept the default name).
8	Confirm that the DTM for the module was automatically added to the project (**Tools > DTM Browser**). **NOTE:** When you add a module to the local rack configuration, the corresponding communication DTM is automatically added to the list (**All Devices > Device types > Communication Devices**).
9	Repeat these steps to add more RTU modules to the **PLC bus**. **NOTE:** The local rack in an M580 system can hold a maximum of four communications modules, including RTU modules.

Configuration with Control Expert

IP Address Configuration

Introduction

Use these instructions to configure the IP address parameters for a BMENOR2200H module.

Access the Configuration

Access the **IP address configuration** in Control Expert:

Step	Action
1	Open a Control Expert project that includes a BMENOR2200H module.
2	Double-click the BMENOR2200H module to see the **Configuration** tab.
3	Configure these parameters: • **IP Address:** Enter the IP address of the module. • **Subnet Mask:** Enter a subnet mask that corresponds to the IP address. • **Default Gateway:** This is the IP address of the gateway to which messages for other networks are transmitted. **NOTE:** The **Main IP address + 1** field is used for configuring a redundant system.
4	• Click the **Apply** button to implement your configuration changes. • Click the **OK** button to implement your changes and close the dialog box.

Limitations

The BMENOR2200H module uses the FDR client basic service to get IP parameters from the CPU.

NOTE:

- This module does not support DHCP or BOOTP.
- This module does not locally store static IP parameters.
- For details, refer to the description of the FDR client service configuration, page 42.

Debugging with Control Expert

Overview

This section describes procedures for debugging the configuration of an RTU module with Control Expert.

Module Debugging Screen

Introduction

Use the debugging screen to diagnose an Ethernet port on the BMENOR2200H module.

Parameters

Find these parameters on the **Debug** tab:

Field	Description
MAC address	BMENOR2200H module’s MAC address
IP address	BMENOR2200H module’s IP address
Subnetwork mask	BMENOR2200H module’s subnetwork mask address
Gateway address	BMENOR2200H module’s gateway address

LED Display

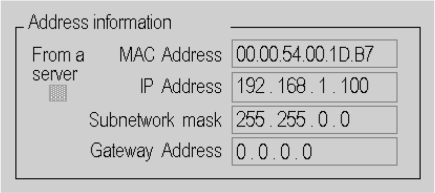
Observe these LEDs for conditions related to the module:

Location	LED	Description
upper-right window corner	**Run**	*on:* The module is operating normally.
		off: The PLC is not configured.
	Err.	*on:* A configuration or system error is detected.
		off: The module is operating normally.
Fault tab	**Fault**	Fault descriptions: • `%MW2.4`: detected internal fault • `%MW2.5`: detected configuration fault • `%MW2.6`: detected communication error • `%MW2.7`: detected application fault • `%MW2.8`: detected configuration error • `%MW2.9`: Ethernet disabled • `%MW2.10`: duplicate IP address • `%MW2.12`: link disconnection • `%MW2.13`: awaiting IP address • `%MW2.14`: storm detection

Debugging Parameters for TCP/IP Utilities

Address Information

The debugging parameters for TCP/IP utilities on the module debugging screen, page 73 are grouped together in the Address information window:



Address information

From a server □

MAC Address: 00.00.54.00.1D.B7

IP Address: 192 . 168 . 1 . 100

Subnetwork mask: 255 . 255 . 0 . 0

Gateway Address: 0 . 0 . 0 . 0

This window displays this configuration information for the BMENOR2200H module:

- MAC address
- IP address
- subnetwork mask
- gateway address

Configuration in the DTM

Introduction

Use the instructions in this section to configure services through the DTM after you access the services configuration link, page 75.

Access the DTM

Introduction

Some features and services for your module are configured with the aid of a device type manager, or DTM. You can access the DTM in Control Expert.

Access the DTM Configuration

There are two ways to access the configuration screens for services provided by the DTM in Control Expert.

Step	Action
1	Open the Control Expert project that includes the appropriate module.
2	Open the **DTM Browser** (**Tools > DTM Browser**).
3	In the **DTM Browser**, double-click the name that you assigned to the module., page 72 to open the configuration window.

– or –:

Step	Action
1	Expand (**+**) the **Project Browser** to see the **PLC bus** (**Project > Configuration > PLC bus**).
2	Double-click **PLC bus** to view the assembled rack(s).
3	Double-click the module.
4	Click the **Services Configuration** link.

DNP3 Communications Configuration in the DTM

Introduction

Configure DNP3 communications for your module in the Control Expert DTM.

Configure Channels

Configure **CLIENT** or **SERVER** channels:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the open **CONFIGURATION** window, expand (**+**) **Communication** and select **Channel Configuration**. **NOTE:** The **Channels/Devices** menu item cannot be expanded because there are no configured channels.
3	Select the appropriate tab: • Select the **CLIENT** tab to add client channels. • Select the **SERVER** tab to add server channels.
4	Select the **Add New** button to view the **ADD NEW CHANNEL** configuration parameters.
5	Configure the parameters according to the new channel parameter descriptions below, page 76.
6	Select the **Add** button to see the newly configured channel in the table. **NOTE:** The **Channels/Devices** menu can now be expanded because there is at least one configured channel. All configured channels appear in this menu.
7	After you create a *server* channel on the **SERVER** tab, repeat these steps to create the corresponding *client* channel on the **CLIENT** tab. – or – After you create a *client* channel on **CLIENT** tab, repeat these steps to create the corresponding *server* channel on the **SERVER** tab. **NOTE:** • Only one type of RTU protocol can be configured in the BMENOR2200H module, either DNP3 or IEC 60870–5–104. The module cannot support multiple RTU protocols configured at the same time. • If the DNP3 Secure Authentication is configured in the web cyber security setting, confirm that the configured name of the RTU channel matches the

Step	Action
	channel name in the DTM. Otherwise, the secure setting does not map to corresponding channel in the DTM.
8	• Select the **Apply** button to implement the changes • Select the **OK** button to implement the changes and close the dialog box. **NOTE:** When you create the first channel, the expandable **Channels/Devices** sub-menu appears on the **CONFIGURATION** screen.
9	Repeat these steps to create additional channels while observing these limitations: • *client:* 64 connections • *server:* 4 connections

NOTE: You can edit, page 78 or delete, page 78 a channel any time.

New Channel Parameter Descriptions

NOTE: When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.

These parameters in the **ADD NEW CHANNEL** fields are available for the DNP3 client and server channel configurations:

Field	Client	Server	Description
Channel Name	✓	✓	Assign a name to the server. **NOTE:** The web pages use the **Channel Name** parameter to identify the configuration that is applied to this channel. Therefore, assign an identical **Channel Name** when you configure cyber security settings, page 113.
Protocol	✓	✓	**DNP3 NET Client:** Configure the new channel as a DNP3 client.
			DNP3 NET Server: Configure the new channel as a DNP3 server.
Dest Port	✓		Define the destination port to use.
Local Port		✓	Define the local port for network communications.
IP Address	✓		The IP address in this field is the IP address of the source of the communications packets.
IP Filter		✓	Enter the IP address of the remote device. **NOTE:** The default value is 255.255.255.255 (present disable IP filter)
Network Type	✓	✓	Select a network protocol: • **TCP-IP** • **UDP-IP** • **TCP-UDP**

Advanced Parameter Configuration

After you create a channel with the instructions above, the new channel appears in the table on the **CLIENT** tab or **SERVER** tab. At this point, you can configure the **ADVANCED PARAMETERS** for the channel. These advanced parameters are global settings that are implemented on all server channels or client channels:

Step	Action
1	Select **Channel Configuration** from the **Communication** menu.
2	Select the appropriate tab: • Select the **CLIENT** tab to view the **CLIENT CHANNEL** table. • Select the **SERVER** tab to view the **SERVER CHANNELS** table.
3	Select a row in the table.

Step	Action
4	Click the **Advanced Settings** button to view the **ADVANCED PARAMETERS** table. **NOTE:** Depending on your Control Expert window size, you may have to scroll down in the **Client** or **Server** tab to see the **ADVANCED PARAMETERS** fields.
5	Configure the parameters according to the advanced parameter descriptions below, page 76.
6	• Select the **Apply** button to implement the changes. • Select the **OK** button to implement the changes and close the dialog box.

Advanced Parameter Descriptions

NOTE: When the Control Expert window is active, you can hover the cursor over any field to see a complete description of the functionality and the available range of values.

These are the available advanced parameters for the DNP3 client and server channel configurations:

Field	Client	Server	Description
Event Backup Enable		✓	*enabled (selected):* Events are backed up upon a power failure.
			disabled (empty): Events are not backed up upon a power failure.
Rx Frame Size	✓	✓	Configure the frame size in the receive link layer.
Rx Frame Timeout	✓	✓	Configure the timeout value for waiting for a complete frame after receiving the frame sync.
Confirm Timeout	✓	✓	Configure the maximum wait time for link level confirmation.
Offline Poll Period	✓		Configure an interval for reattempting to establish communications for an offline session.
Rx Buffer Size	✓	✓	Configure the receive buffer size for the physical port.
Tx Fragment Size	✓	✓	Configure the maximum transit application fragment sizes.
Channel Response Timeout	✓		Configure the wait time for the DNP3 client's response to a transmitted request.
Tx Frame Size	✓	✓	Configure the transmit link layer frame size.
Confirm Mode	✓	✓	**NEVER:** Never request link layer confirmations.
			SOMETIMES: Request link layer confirmations for multi-frame fragments.
			ALWAYS: Always request link layer confirmations.
Max Retries	✓	✓	Configure the number of reattempted link layer confirmation timeouts.
First Char Wait	✓	✓	Configure the minimum time (ms) after receiving a character before an attempt to transmit a character on this channel.
Rx fragment Size	✓	✓	Configure the maximum receive application fragment sizes.
Restore Mode		✓	**Main Channel:** Restore events for the main channel.
			All Channels: Restore all events.
Max Queue Size	✓		Configure the maximum number of requests that are queued on a DNP3 client.

After you edit any of these parameters, click the **Update** button to update the configuration.

Edit Channels

Edit the parameters for an existing channel:

Step	Action
1	Click the pencil icon in the **Edit** column for the channel you want to edit.
2	Re-configure the parameters in the **EDIT CHANNEL** and **ADVANCED PARAMETERS** fields (described above).
3	Click the **Update** button to update the configuration.
4	Click the **OK** or **Apply** button to save the changes.

Delete a Channel

Delete an existing channel:

Step	Action
1	Select the check box that corresponds to the client or server channel.
2	Select the **Delete** button.
3	Select the **Update** button.
4	• Select the **Apply** button to save the changes. –or– • Select the **OK** button to save the changes and close the dialog box.

IEC 60870-5-104 Communications Configuration in the DTM

Introduction

Configure IEC 60870-5-104 communications for your module in the Control Expert DTM.

Basic Parameter Configuration

To configure the **CLIENT** or **SERVER** channels:

Step	Action
1	Access the DTM configuration for your module, page 74.
2	In the open **CONFIGURATION** window, expand (+) **Communication** and select **Channel Configuration**. **NOTE:** The **Channels/Devices** menu item cannot be expanded because there are no configured channels.
3	Select the appropriate tab: • **CLIENT**: Add client channels. • **SERVER**: Add server channels.
4	Select the **Add New** button to view the **ADD NEW CHANNEL** configuration parameters.
5	Configure the parameters according to the new channel parameter descriptions below.
6	Select the **Add** button to see the newly configured channel in the table. **NOTE:** The **Devices** menu can now be expanded because there is at least one configured device. All configured devices appear in this menu.
7	After you create a *server* channel on the **SERVER** tab, repeat steps 1-6 to create the corresponding *client* channel on the **CLIENT** tab (or vice versa). **NOTE:** Only one client and one server are supported.

Step	Action
8	• Select the **Apply** button to implement the changes. • Select the **OK** button to implement the changes and close the dialog box. **NOTE:** When you create the first channel, the expandable **Channels/Devices** sub-menu appears on the **CONFIGURATION** screen.
9	Repeat steps 1-8 to create additional channels while observing these limitations: • *client*: 64 connections • *server*: 4 connections

Basic Parameter Descriptions

NOTE: When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.

These parameters in the **ADD NEW CHANNEL** fields are available for the IEC 60870-5-104 client and server channel configurations:

Field	Client	Server	Description
Channel Name	✓	✓	Assign a name to the server. **NOTE:** The web pages use the **Channel Name** parameter to identify the configuration that is applied to this channel. Therefore, assign an identical **Channel Name** when you configure cyber security settings.
Protocol	✓	✓	IEC60870–5–104 Client/IEC60870–5–104 Server
Redundant Group		✓	Select None, 1, 2, or 3 from the drop-down list.
Local Port		✓	Define the local port for network communications. **NOTE:** The default value is 2404.
IP Address		✓	When you select the **IP Address** filter field, the **IpAddress Panel** dialog box opens. Enter the IP address of the remote device. Select the **Change** button.
Server IP Address	✓		Enter the IP address of the server with which the client communicates.
Dest Port	✓		Define the destination port.
Common ASDU Address		✓	Enter a value for the common address of an ASDU. • The value scope is 1...65535. • 65535 is the broadcast address. • The default value is 3.
Cyclic Message Interval (ms)		✓	Enter a value for the number of milliseconds between cyclic updates. • The value scope is 1...4294967295. • The default value is 10000.
Background Period (ms)		✓	Enter a value for the period allowed to generate background scan data on a particular sector. • The value scope is 1...4294967295. • The default value is 20000.
Read Time Format		✓	Select the completeness time format for responding to C_RD_NA from the drop-down list: • None • CP56 The default value is None.

Field	Client	Server	Description
C_RD_NA Measure and Time Format		✓	Select the time stamp format in the response to read command from the drop-down list: • None • CP56 **NOTE**: • This field is used for measured points. • The default value is None.
C_IC_NA Time Format		✓	Select the time stamp format in the response to read command from the drop-down list: • None • CP56 **NOTE**: • This field is used for counters. • The default value is None.

Advanced Parameter Configuration

After you create a channel using the instructions above, the new channel appears in the table on the **CLIENT** or the **SERVER** tab. You can configure **ADVANCED PARAMETERS** for the channel. These advanced parameters are global settings that are implemented on all server or client channels.

Step	Action
1	Select **Channel Configuration** from the **Communication** menu.
2	Select the appropriate tab: • **CLIENT**: View the **CLIENT CHANNEL** table. • **SERVER**: View the **SERVER CHANNEL** table.
3	Select a row in the table.
4	Select the **Advanced Settings** button to view the **ADVANCED PARAMETERS** table. **NOTE:** Depending on your Control Expert window size, you may have to scroll down in the **Client** or **Server** tab to see the **ADVANCED PARAMETER** fields.
5	Configure the parameters according to the advanced parameter descriptions below.
6	• Select the **Apply** button to implement the changes. • Select the **OK** button to implement the changes and close the dialog box.

Advanced Parameter Descriptions

Field	Client	Server	Description
Event Backup Enable		✓	Specify whether to back up events when a power failure is detected. The default is check box deselected.
Data Sync Mode		✓	Select a data synchronization mode: • **Cyclic Sync**: Use the default (cyclic) synchronization. • **Sync On Demand**: Allow the PAC application to implement local changes on the binary or analog output. **NOTE:** Enabling a Sync On Demand point changes the variable structure (out of the DDDT).
Prefix		✓	This string is part of the variable name for analog

Field	Client	Server	Description
Delay Before Transmission (T1)	✓	✓	0...65535 (As the unit is 10ms, the range is 0...655.35 s.) The default value is 0. This field is only used with DCE flow control algorithm, transmission delay after RTS is set.
Delay After Transmission (T2)	✓	✓	0...65535 (As the unit is 10ms, the range is 0...655.35 s.) The default value is 0. This field is only used with DCE flow control algorithm, transmission delay after RTS is set.
Delay Between Transmission (T3)	✓	✓	0...65535 (As the unit is 10ms, the range is 0...655.35 s.) The default value is 0. This field is only used with DCE flow control algorithm, transmission delay after RTS is set.
Sector		✓	Select a value to determine the sector number to route. The options are 0, 1, 2, 3, 4. The default value is 0.
First Char Wait (ms)	✓	✓	Enter a value for the minimum time between reception and transmission. • The value scope is 0...65535. • The default value is 0.
Rx Buffer Size	✓	✓	Enter a value for the receive buffer size of serial port (bytes). • The value scope is 0...256. • The default value is 256.
Offline Poll Period (ms)	✓	✓	Enter a value for the period to re-establish transfer of an offline session. • The value scope is 0...4294967295. • The default value is 10000.
Incremental Timeout (ms)	✓	✓	Enter a value for the incremental application layer time-out. • The value scope is 0...4294967295. • The default value is 30000.
Max Queue Size	✓		Enter a value for the maximum request message number with a specific application specific data unit (ASDU) type and destination matching an outstanding request that will be queued on a client. • The value scope is 0...65535 (unlimited queue). • The default value is 0 (disabled queue).
Default Response Timeout (ms)	✓	✓	Enter a value for the default timeout for the confirmation of request. • The value scope is 0...4294967295. • The default value is 60000.
Select Timeout (ms)		✓	Enter a value for the period after which a previously received selection is timed out. Confirm that an executed command is received before the time-out in order to be valid. • The value scope is 0...4294967295. • The default value is 5000.

Field	Client	Server	Description
ACTTERM with C_SE Setpoint	✓	✓	Select the check box for ACT TERM to be transmitted upon completion of the set point commands: • C_SE_NA, C_SE_NB, C_SE_TA, C_SE_TB, C_SE_TC • The check box is selected by default.
ACTTERM with Command	✓	✓	Select the check box for ACT TERM to be transmitted upon completion of commands, other than the set point commands. **NOTE:** The check box is selected by default.
Clock Valid Period (ms)		✓	Enter a value for the period for which the system clock remains valid after a clock synchronization. If this period expires without a clock synchronization, all times are reported invalid. • The value scope is 0...4294967295. • The default value is 86400000.
Send Clock Sync Events		✓	Select the check box to send spontaneous clock synchronization events to the client. **NOTE:** The check box is de-selected by default.
Max Command Age (ms)		✓	Enter a value for the maximum time delta at which commands are accepted. The command time tag is checked and if the elapsed time is greater than `MAX Command Age (ms)`, the command gets no response. • The value 0 indicates that the command time tag is not checked. • The value scope is 0...600000. • The default value is 30000.
Delete Oldest Event		✓	Indicates whether or not the oldest event is removed from the event queue when the buffer is full and a new event arrives. • Select the check box to remove the oldest event. • De-select the check box to ignore the new event. • The check box is de-selected by default.
Summer Bit		✓	Select this check box to manage the summer bit of time stamp that comes from an external device or the CPU. • This feature is effective only if Daylight Saving Time is enabled. • The check box is de-selected by default.
CMD Type Depth		✓	Enter a value for the size of a command queue to process in parallel for each point type. • The value scope is 1...128. • The default value is 1.
M_EI_NA GI	✓		Select the check box for general interrogation to be performed after receiving an M_EI_NA EOI message. **NOTE:** The check box is selected by default.

Field	Client	Server	Description
M_EI_NA Time sync	✓		Select the check box to indicate that Clock Sync is performed after receiving an M_EI_NA EOI message. **NOTE:** The check box is selected by default.
M_EI_NA CI	✓		Select the check box to indicate that counter interrogation is performed after receiving an M_EI_NA EOI message. **NOTE:** The check box is de-selected by default.
Online GI	✓		Select the check box to indicate that general interrogation is performed when a remote device has come online and is available for devices that do not generate an M_EI_NA EOI message. **NOTE:** The check box is selected by default.
Online Time Sync	✓		Select the check box to indicate that Clock Sync is performed when a remote device has come online and is available for devices that do not generate an M_EI_NA EOI message. **NOTE:** The check box is selected by default.
Online CI	✓		Select the check box to indicate that counter interrogation is performed when a remote device has come online and is available for devices that do not generate an M_EI_NA EOI message. **NOTE:** The check box is de-selected by default.
Command with Time Tag	✓		Select the check box to indicate that the control command follows the time tag. **NOTE:** The check box is de-selected by default.

SNMP Configuration in the DTM

Access the SNMP Configuration

Access the SNMP parameters in the Control Expert DTM:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the **CONFIGURATION** menu, expand (**+**) the **Communication** sub-menu.
3	Select **SNMP**.
4	Configure the SNMP parameters. **NOTE:** The parameters are described in the next table.
5	• Select the **Apply** button to implement your configuration changes. • Click the **OK** button to implement your changes and close the dialog box.

Parameters

This table shows the SNMP parameters that are available for your module.

NOTE: When the Control Expert window is active, you can hover the cursor over any parameter field to see a description of the functionality and the available range of values.

SNMP parameters:

Field	Parameter	Description
IP ADDRESS MANAGERS	**IP Address Manager 1**	Configure an IP address of the primary SNMP manager in the range 0.0.0...255.255.255.255.
	IP Address Manager 2	Configure the IP address of the secondary SNMP manager.
AGENT	**Enable SNMP Manager**	*selected*: The SNMP manager is enabled.
		deselected: The SNMP manager is disabled.
	Location (SysLocation)	Specify the physical location of the module when the SNMP manager is enabled.
	Contact (SysContact)	Enter the name of a maintenance person to contact when the SNMP manager is enabled.
COMMUNITY NAMES	**Set**	Enter the community name for the **Set** utility.
	Get	Enter the community name for the **Get** utility.
	Trap	Enter the community name for the **Trap** utility. **NOTE:** • Traps are sent through UDP port 161. • Confirm whether you configure trap settings on the SNMP manager that are consistent with those on the processor.
SECURITY	**Enable Authentication Failure Trap**	*selected*: The SNMP agent sends a trap message to the SNMP manager when an unauthorized manager sends a **Get** or **Set** command to the agent.
		deselected: This feature is disabled.

NOTE: The characteristics and details of the SNMP service are described in the Ethernet services chapter, page 38.

Network Time Service Configuration in the DTM

Introduction

The BMENOR2200H module supports clock synchronization as an SNTP client.

When the SNTP client is enabled, the module synchronizes the internal clock from the time server. This time is the basis for time stamping RTU events.

NOTE: For details, refer to the description of the BMENOR2200H module as an SNTP client, page 52.

Features of the Service

The clock synchronization via SNTP offers:

- periodic time corrections obtained from the reference standard, for example, the SNTP server
- automatic switchover to a backup time server if an abnormal event is detected with the normal server system
- local time zone configurable and customizable (including daylight saving time adjustments)

Controller projects use a function block to read the clock, a feature that allows events or variables in the project to be time stamped.

Time stamping is accurate to:

- 5 ms typical
- 10 ms worst case

Access the SNTP Configuration

Access the SNTP parameters in the Control Expert DTM:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the **CONFIGURATION** menu, expand (**+**) the **Communication** sub-menu.
3	Select **Network Timing Service**.
4	Configure the SNTP parameters. **NOTE:** The parameters are described in the next table.
5	• Click the **Apply** button to implement your configuration changes. • Click the **OK** button to implement your changes and close the dialog box.

Time Synchronization Parameters

This table shows the SNTP parameters that are available for your module:

Field	Parameter	Description
Time Source Setting	**Time Synchronize Source**	Select a value from the drop-down list to identify the time source of synchronization: • **RTU Protocol**: If SCADA or the client synchronizes time with the BMENOR2200H module, its time source is the Controlling Station. • **SNTP Server**: If the NTP client is enabled and connected with the NTP server, its time source is the NTP server when it synchronizes the BMENOR2200H module’s clock.
SNTP Server	**Primary IP Address**	Enter a valid IP address for the primary SNTP server.
	Secondary IP Address	Enter a valid IP address for the secondary SNTP server.
	Polling period	This value represents the number of seconds between updates from the SNTP server.
Time Zone	**Time Zone**	Select a time zone from the pull-down menu.
	Timezone Offset	This value represents the difference (in minutes between the configured time zone and UTC.
	Automatically adjust clock for daylight saving	*selected:* Adjust the clock for daylight saving time.
		deselected: Do not adjust the clock for daylight saving time.
	Start Daylight Saving	Configure the start and end times for daylight saving in the available fields.
	End Daylight Saving	
TIME TO CPU	**Update Clock to CPU**	*selected:* Update the clock to the CPU.
		deselected: Do not update the clock to the CPU.

NOTE: When the Control Expert window is active, you can hover the cursor over any parameter field to see a description of the functionality and the available range of values.

Clock Synchronization Terms

SNTP terms:

Term	Description of Service
local clock offset	Accurate local time adjustments are made via a local clock offset. The local clock offset is calculated as: `((T2 - T1) + (T4 - T3))/2` where: • T1 = time when SNTP request is transmitted from the module • T2 = time when SNTP server receives the request (provided by the module in response) • T3 = time when the SNTP server transmits the response (provided to the module in the response) • T4 = time when SNTP response is received by the module
time accuracy	The local time margin is < 10 ms compared to the referenced SNTP server time. • typical: 5 ms • worst case: <10 ms
settling time	Maximum accuracy is obtained after 2 updates from the SNTP server.
polling period dependency	Accuracy depends on the polling period. Less than 10 ms of margin is achieved for polling periods of 120 ms or less. To obtain a high degree of accuracy (when your network bandwidth allows), reduce the polling period to a small value—for example, a polling time of 5 s provides better accuracy than a time of 30 s.
leap second	To compensate for the deceleration of the earth rotation, the module automatically inserts a leap second in the UTC time every 18 months via an international earth rotation service (IERS). Leap seconds are inserted automatically as needed. When needed, they are inserted at the end of the last minute in June or December, as commanded by the SNTP server.

Obtaining and Maintaining Accuracy

The time service clock starts at 0 and increments until the Ethernet network time is fully updated from the module.

Model	Starting Date
M580	January 1, 1980 00:00:00.00

Clock characteristics:

- Clock accuracy is not affected by issuing stop/run commands on the PLC.
- Clock updates are not affected by issuing stop/run commands on the PLC.
- Mode transitions do not affect the accuracy of the Ethernet network.

NOTE: For details, refer to the descriptions of available time sources.

General Time Synchronization Terms

General terms:

Term	Description of Service
time zone	The default format is universal time, coordinated (UTC). Optionally you may configure the service to use a local time zone (for example, GMT+1 for Barcelona or Paris). *Refer to the note at the end of this table.*
daylight saving time	The module automatically adjusts the time change in the spring and fall. *Refer to the note at the end of this table.*

Term	Description of Service
update clock to CPU	When no other time source is configured, the BMENOR2200H module sends the source clock synchronization signal to the CPU over the Ethernet backplane, page 53.
NOTE: This setting is implemented at the module level even if there is no SNTP configuration for the module. The implementation of this setting owes to the BMENOR2200H module's support for several time sources (for example, DNP3). It you, therefore, use DNP3 for time synchronization instead of SNTP, the time zone is applied to the module.	

DNP3 Data Object Mapping

Introduction

To facilitate communications with the BMENOR2200H module, create data points for the DNP3 communication protocol in the **DATA MAPPINGS** tab in the DTM.

Access the Configuration Tab

Access the configuration parameters on the **DATA MAPPINGS** tab in Control Expert:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	Confirm that you already created client or server channels, page 75.
3	In the **CONFIGURATION** menu, expand (**+**) the **Channels**/Devices sub-menu.
4	Make a selection in the **Channels**/Devices sub-menu: • **DNP3 NET Server** • **DNP3 NET Client**
5	Select a specific channel in the sub-menu.
6	Select the **DATA MAPPINGS** tab for the channel.
7	Configure the data mapping parameters.
8	• Select **Apply** to implement your configuration changes. • Select **OK** to implement your changes and close the dialog box.

DNP3 Client Data Mappings

A newly applied data point configuration is added to the X80 client DTM. It appears in the Control Expert variable manager.

DNP3 Data Mappings

Using a **Binary Input** as an example, edit the data point configuration on the **DATA MAPPINGS** tab:

Step	Action
1	At **Select Type Id**, select a type ID. **NOTE:** For this example, select **Binary Input**.
2	Click **Add** to see the name of the binary input (**DNP3_SERVER_BINARY_INPUT**) in the **Type Identification** column.
3	Select the table row that corresponds to the new binary input to see the **BINARY INPUT** configuration options.

Step	Action
4	Modify the parameters. **NOTE:** When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.
5	• Select **Apply** to implement your configuration changes. • Select **OK** to implement your changes and close the dialog box.

NOTE: A newly applied data point configuration is added to the X80 client DTM. It appears in the Control Expert variable manager.

Exchangeable CPU Data Object

⚠ **WARNING**

UNINTENDED EQUIPMENT OPERATION

Do not create an instance of redundant data access.

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

Implement the data dictionary in Control Expert:

Step	Action
1	Open the **Project Settings** (**Tools > Project Settings**).
2	Expand (**+**) the menu: **Project Settings > General**
3	Select the **PLC Embedded Data** setting to see the **Property label** and **Property value** columns.
4	In the **Data label** column, find the **Data Dictionary** row and check the corresponding box in the **Property value** column. **NOTE:** Check this box when you program the PLC application. Otherwise, unlocated variables may not be mapped to RTU data points. However, a compiled application consumes more memory when the data dictionary is included, which can have an impact on unlocated variables that are implemented in RTU solutions.
5	• Select **Apply** to implement your configuration changes. • Select **OK** to implement your changes and close the dialog box.

Unlocated variables can be exchanged between the CPU and the BMENOR2200H RTU module after you define and manage the memory map of the CPU to exchange data with the module.

The CPU data objects are mapped and only linked for the BMENOR2200H module's purpose.

Data Exchange

To sustain a high rate of data exchange, we recommend that you define the BMENOR2200H module's RTU memory for data objects in a sequential ARRAY data type to group points with the same settings.

Use consecutive point numbers (0, 1, 2, 3...) in DNP3 request fragments.

Predefined Command List

The required input fields are requested to define a predefined command item for DNP3 client/DNP3 NET client, page 134.

Static Variation Name of DNP3

Data object type	Static variation
Binary Input	g1v1 Binary In
	g1v2 Binary In Flag
Double Input	g3v1 Double In
	g3v2 Double In Flag
Binary Output	g10v1 Binary Out
	g10v2 Binary Out Flag
Binary Counter	g20v1 32bit Counter
	g20v2 16bit Counter
	g20v5 32bit Ctr No Flag
	g20v6 16bit Ctr No Flag
Frozen Counter	g21v1 32bit Frozen Ctr Flag
	g21v2 16bit Frozen Ctr Flag
	g21v5 32bit Frozen Ctr Flag Time
	g21v6 16bit Frozen Ctr Flag Time
	g21v9 32bit Frozen Counter
	g21v10 32bit Frozen Counter
Analog Input	g30v1 32bit Analog In
	g30v2 16bit Analog In
	g30v3 32bit AI No Flag
	g30v4 16bit AI No Flag
	g30v5 Short Float AI
Analog Input Deadband	g34v1 16bit AI Deadband
	g34v2 32bit AI Deadband
	g34v3 Short Float AI Deadband
Analog Input Dband_Ctrl	g34v1 16bit AI Deadband
	g34v2 32bit AI Deadband
	g34v3 Short Float AI Deadband
Analog Output	g40v1 32bit Analog Output
	g40v2 16bit Analog Output
	g40v3 Short Float AO
Read_Group	—
Read_Class	—
Write_Octet_String	—
Freeze_Counter	—
Unsolicited_Class	—
Time_Sync	—
Restart	—
Octet String	g110 Octet Strings
Integrity_Poll	—
Gen_Events	—
Clear_Events	—

DNP3 Net Server Parameters

The tables below describe the DNP3 net server parameters that appear on the **SERVER MAPPINGS** tab.

> **NOTE:** When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.

PARAMETERS:

Parameter	Description
Local Address	This field contains the source address for this session.
Client Address	This field contains the remote client (destination) address for this session.

ADVANCED PARAMETERS:

Parameter	Description
Link Status Period	Configure the frequency (ms) for the transmission of status requests when no DNP3 frames are received during this session.
Validate Source Address	Check this box to validate the source address in received frames.
Enable Self Address	Check this box to have the server respond to address 0xfffc as if it received a request at its configured address. The server responds with its own address so that the client can automatically discover the server address.
Multi Frag Resp Allowed	Check this box to allow the application to send multi-fragment responses.
Multi Frag Confirm	Check this box to request application layer confirmations for non-final fragments of a multi-fragment response. (Application layer confirmations are always requested for responses that contain events.)
Respond Need Time	Check this box to tell the device to set the Need Time IIN bit in response to this session at start-up after the clock valid period elapses.
Clock Valid Period	Configure the length of time (ms) that the local clock remains valid after it receives a time synchronization.
Application Confirm Timeout	Configure the length of time (ms) that the server DNP3 device waits for an application layer confirmation from the client for a solicited response.
Select Before Operation (SBO) Timeout	Configure the maximum amount of time (ms) that a selection remains valid before the corresponding operate is received.
Warm Restart Delay	Configure the length of time that the client waits after it receives a response to a warm restart request. This value is encoded in a time delay fine object in the response of a warm restart request.
Cold Restart Delay	Configure the length of time (ms) that the client waits after it receives a response to a cold restart request. This value is encoded in a time delay fine object in the response of a cold restart request.
Allow Multi CROB Requests	Check this box to allow multiple control relay block objects (CROBs) in a single request.
Max Control Requests	Configure the maximum number of binary (CROB) or analog control outputs that are allowed in a single request.
Unsol Allowed	Check this box to allow unsolicited responses.
Send Unsol When Online	Check this box to send unsolicited null responses when the session comes online.
Unsol Class 1 Max Events	When unsolicited responses are enabled, configure this value to specify the maximum number of events in the corresponding class (1, 2, or 3) that are allowed before an unsolicited response is generated.
Unsol Class 2 Max Events	
Unsol Class 3 Max Events	
Unsol Class 1 Max Delay	Configure the maximum amount of time (ms) after an event in the corresponding class (1, 2, or 3) is received before an unsolicited response is generated.

Parameter	Description
Unsol Class 2 Max Delay	
Unsol Class 3 Max Delay	
Unsol Max Retries	Configure the maximum number of unsolicited retries before changing to the offline retries value.
Unsol Retry Delay	Configure the length of the delay (ms) after an unsolicited response.
Unsol Offline Retry Delay	Configure the length of the delay (ms) after an unsolicited timeout before retrying the unsolicited response after the configured number of **Unsol Max Retries**.
Delete Oldest Event	Configure the behavior for an event queue that is full: • *checked:* Delete the oldest event. • *unchecked:* Delete the newest event.
Counts to Class0 Poll	Configure the type of value that is returned in a poll of class 0 data: • **Count Value:** Return a static binary counter value. • **Frozen Value:** Return a static frozen counter value.
SBO Mode	Select a mode for a before-and-after operation: • **Interference Mode:** The server cancels the selection if the next received request is not an operate request. (Only read requests are processed.) • **Noninterference Mode:** The server does not cancel the selection even if the next received request is not an operate request by following the selection. The DNP3 group recommends this selection.
Unsol Confirm Timeout	Configure the value for an unsolicited confirm timeout.
Data Synch Mode	Select a data synchronization mode: • **Cyclic Synch:** Use the default (cyclic) synchronization. • **Synch On Demand:** Allow the PLC application to implement local changes on the binary or analog output. **NOTE:** Enabling a **Synch On Demand** point changes the variable structure (out of the Device DDT).
Prefix	This string is part of the variable name for analog or binary output points when you select **Synch On Demand** as the **Data Synch Mode** (range: 1 ... 6). Considerations: • Use **Prefix** names that are unique for each BMENOR2200H module. Duplicate names cause the overwriting of variables. • In the **Sync On Demand** mode, client-side routing points for the analog or binary output status do not support server-side mapping. • Do not use an underscore (_) as the last character in the **Prefix**. • In the **Synch On Demand** mode, the **Prefix** consumes 7 characters. The remaining available length of the variable name is therefore reduced to 23 characters.

Mapping Tables

Depending on the data object type and the selected protocol profile, different configuration fields are required to define a data object mapping item. The tables below describe the available parameters for each selection in the **Select Type Id** pull-down menu on the client and server **DATA MAPPINGS** tabs.

> **NOTE:** These tables include brief descriptions of each data mapping parameter. When the Control Expert window is active, hover the cursor over any parameter field to see a description of the functionality and the available range of values.

Binary Input

This table describes the DNP3 net client parameters that appear on the **DATA MAPPINGS** tab when you select a **Binary Input** in the **DATA MAPPINGS** tab:

Client Parameter		Description
Point Number		Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count		Indicates the number of points.
Store to CPU		Choose a source for the event time stamp and flag: • **Value only:** module time • **Value with time:** CPU register time • **Value with flag:** point flag information from the CPU registers • **Value with flag and time:** flag and time from the CPU registers
Point Name		Name of the unlocated register
Static Variation		Select the static variation for the data point.
Event Routing	**Route Channel**	• **Disable:** Disable routing for the channel. • **Enable:** Enable routing for the channel.
	Route Point	Point number to route. (This point number appears in the server side but cannot be modified on the server side.)
	Point Name for the Flag	Server or client name that you can configure **Default**: P<PointNumber_P<PointNumber+PointCount>
	Default Event Variation	Indicates the default event variation for data point.
	Routing Offline	Specify the flag when the routing channel is offline: • **Valid Quality:** Use any available routing channel connection. • **Invalid Quality:** Set the flag to offline when the routing channel is offline.

This table describes the DNP3 net server parameters that appear on the **DATA MAPPINGS** tab when you select a **Binary Input** in the **DATA MAPPINGS** tab:

Server Parameter	Description
Point Number	Indicates the start number of the point. **NOTE:** The DNP3 point number starts at 0 and is contiguous in server mode. If this is not the case, the nonconsecutive points do not work normally.
Point Count	indicates the number of points.
CPU Reg Mapping	Choose a source for the event time stamp and flag: • **Value only:** module time • **Value with time:** CPU register time • **Value with flag:** point flag information from the CPU registers • **Value with flag and time:** flag and time from the CPU registers **NOTE:** Select one of these values to implement SOE for time stamping, page 65.
Point Name	Name of the unlocated register
Default Static Variation	Select the default static variation for the data point.
Default Event Variation	Select the default event variation for the data point.

Server Parameter	Description
Event Class Mask	Defines the event class of points. `Unsolicited` is not allowed with class 0 only. In client, `Channel` is 0.
PLC State	Specify the flag when the routing channel is offline: • **No Impact Quality:** The quality is **valid** when the PLC runs. • **Impact Quality:** If the PLC is stopped or removed from the rack, the quality is **invalid**.

Analog Input

This table describes the client data mapping parameters for analog input types:

Client Parameter		Description
Point Number		Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count		Indicates the number of points.
Store to CPU		Choose a source for the event time stamp and flag: • **Value only:** module time • **Value with time:** CPU register time • **Value with flag:** point flag information from the CPU registers • **Value with flag and time:** flag and time from the CPU registers
Static Variation		Select the static variation for the data point.,
Point Name		Name of the unlocated register
Display Deadband In Variable		Specify a deadband variable name.
Point Name		Name of the unlocated register when **Display Deadband In Variable** is selected (checked)
Event Routing	**Channel**	Enable or disable the routing of the channel number.
	Route Point	Define the point number to route.
	Event Class Mask	Defines the event class of points. `Unsolicited` is not allowed with class 0 only. In client, confirm that `Channel` is at 0 for normal operations.
	Default Event Variation	Indicates the default event variation for data point.
	Routing Offline	Specify the flag when the routing channel is offline: • **Valid Quality:** Use any available routing channel connection. • **Invalid Quality:** Set the flag to offline when the routing channel is offline.

This table describes the server data mapping parameters for analog input types:

Server Parameter	Description
Point Number	Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count	Indicates the number of points.
Event Class Mask	Defines the event class of points. In client, confirm that `Channel` is at 0 for normal operations.
Default Static Variation	Select the default static variation for the data point.

Server Parameter	Description
Default Event Variation	Select the default event variation for the data point.
CPU Reg Mapping	Choose a source for the event time stamp and flag: • **Value only:** module time • **Value with time:** CPU register time • **Value with flag:** point flag information from the CPU registers • **Value with flag and time:** flag and time from the CPU registers **NOTE:** Select one of these values to implement SOE for time stamping, page 65.
Deadband	Deadband value of the analog input
Use Percent Data	Use low and high range for the percentage of deadband calculation when the check box is selected.
Low Range	Lowest value in the range when the **Use Percent Data** check box is selected.
High Range	Highest value in the range when the **Use Percent Data** check box is selected.
Point Name	Name of the unlocated register
PLC State	Specify the flag when the routing channel is offline: • **No Impact Quality:** The quality is **valid** when the PLC runs. • **Impact Quality:** If the PLC is stopped or removed from the rack, the quality is **invalid**.
Display Deadband In Variable	Specify a deadband variable name.
Point Name	Name of the unlocated register when the **Display Deadband In Variable** check box is selected.

Binary Output

This table describes the client data mapping parameters for binary output types:

Client Parameter	Description
Point Number	Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count	Indicates the number of points.
Operation Mode	The selected operation mode
Control Code Type	Specify the control code used by the CROB: • **Latch_On_Off:** Trigger the CROB. • **Pulse_On:** Change the value. **NOTE:** Refer to the description of binary output behavior, page 96.
Default Static Variation	Select the default static variation for the data point.
Pulse Duration	Specify the width of the pulse (ms).
Point Name	Name of the unlocated register
Add CMD_STATUS	Specify the CMD_STATUS variable name.

Server data mapping parameters for binary output types:

Server Parameter	Description
Point Number	Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count	Indicates the number of points.
Default Static Variation	Select the default static variation for the data point.
Default Event Variation	Select the default event variation for the data point.
Add Flag Variable	Specify the flag variable name.
Point Name	Name of the unlocated register when the **Add Flag Variable** check box is selected.
PLC State	Specify the flag when the routing channel is offline: • **No Impact Quality:** The quality is **valid** when the PLC runs. • **Impact Quality:** If the PLC is stopped or removed from the rack, the quality is **invalid**.
Prefix	This prefix for the variable name is followed with an underscore (_). Configure the prefix in the server advanced parameters. Example: `RTU001_Point1`.
CPU Register Type	The only available option for the binary output is %MW.
CPU Register Address	This is the start %MW address in the CPU. This field applies only to located variables. To create a variable without a %MW address, use the value -1. Considerations: • The binary output value (0 or 1) is bit 0 the %MW (INT) in the global variable list. The binary output flag data remains in the Device DDT. • The %MW range depends on the CPU %MW register range (default 2048).

NOTE:

- The **Binary_Output_Status** is applied in the client, which saves the latest value, state (flag), and time stamp.
- Floating point values (scientific notation) can be entered for the **deadband**.

Analog Output

This table describes the client data mapping parameters for analog output types:

Client Parameter	Description
Point Number	Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count	Indicates the number of points.
Operation Mode	Selected operation mode
Default Static Variation	Select the default static variation for the data point.
Point Name	Name of the unlocated register
Add CMD_STATUS	Specify the CMD_STATUS variable name.

This table describes the server data mapping parameters for analog output types:

Server Parameter	Description
Point Number	Indicates the start number of the point. **NOTE:** Confirm that the DNP3 point number starts at 0 and is contiguous in server mode. If this is not applied, the nonconsecutive points cannot work normally.
Point Count	Indicates the number of points.
Event Class Mask	Defines the event class of points. `Unsolicited` is not allowed with class 0 only. In client, confirm that `Channel` is at 0.
Default Static Variation	Select the default static variation for the data point.
Default Event Variation	Select the default event variation for the data point.
Deadband	Deadband value of the analog point
Point Name	Name of the unlocated register
Add Flag Variable	Specify the flag variable name.
Point Name	Name of the unlocated register when the **Add Flag Variable** check box is selected.
PLC State	Specify the flag when the routing channel is offline: • **No Impact Quality:** The quality is **valid** when the PLC runs. • **Impact Quality:** If the PLC is stopped or removed from the rack, the quality is **invalid**.
Prefix	The prefix for the variable name is followed with an underscore (_). Configure the prefix in the server advanced parameters. The final variable name follows this format: `Prefix_VariableName.Pointx.value` Example: `RTU001_AO01.Point[10].value`
CPU Register Type	The only available option for the analog output is %MW.
CPU Register Address	This is the start %MW address in the CPU. This field applies only to located variables. To create a variable without a %MW address, use a start address of the type float/32 bit. A valid analog output type value is an even number. Use address `-1`. Considerations: • The analog output value is in the global variable list. The binary output flag data remains in the Device DDT. • The %MW range depends on the CPU %MW register range (default 2048).

NOTE:

- The **Analog_Output_Status** is applied in the client, which saves the latest value, state (flag), and time stamp.
- Floating point values (scientific notation) can be entered for the **deadband**.

Behavior of a Binary Output

This configuration depends on the selection you made in the **Control Code Type** field in the binary output client parameters, page 94.

The configuration applies **latch on/off** and **pulse on**:

Operation type field	Control code	Point model in server
pulse on	01 hex	activation
latch on	03 hex	latch complement
latch off	04 hex	
pulse on	41 hex	two’s complement
	81 hex	

NOTE: The DNP3 client provides on-time configuration data only but does not provide configured off-time and count. The DNP3 server also only applies pulse on which the count is 1 and the off-time value is 0.

CROB sent in DNP3 client	Point number in DNP3 client	Point number in DNP3 server
Pulse on	0	0
Trip/Pulse on	0	1
Close/Pulse on	2	2
Trip/Pulse on	2	3
Close/Pulse on	n+2	n+2
Trip/Pulse on	n+2	n+2+1

Op type field	Trigger mechanism	Description
Close/Pulse_on	any value change (0...65535)	pulse on if value change
Latch_on	0 to 1	latch on
Latch off	1 to 0	latch off
Close/Pulse_on	0 to 1	pulse on for close output
Trip/Pulse_on	1 to 0	pulse on for trip output

Long and Short Pulses of Binary Outputs

This configuration depends on the selection you made for these parameters in the binary output client parameters, page 94:

- **Pulse Duration**
- **Short Pulse Duration**

NOTE: The server uses the entered **Pulse Duration**. The value 0 indicates that the device uses a pre-configured value.

Set Measured Value

Apply analog input deadband (**obj34**) to set deadband of measured value. The parameters of the measured points are activated immediately after the DNP3 server receives the request from the DNP3 client.

For DNP3 **obj34**, there is no qualifier to set as it only applies the parameter **deadband**. Set the static variation and point number at the same setting of the analog input. Analog input **deadband** is applied both on the DNP3 client and the DNP3 server. The DNP3 server uses it to store the current value which is reported in the response of read requests, the DNP3 client uses it to display the current **deadband** value which can be controlled by the server through the analog input **deadband** control block.

This configuration depends on the deadband settings you made in these fields:

- **Point Number** (analog input client parameters)
- **Point Number** (analog input server parameters)
- **Default Static Variation** (analog input server parameters)

NOTE: Refer to the description of the analog input client and server parameters, page 93.

Octet String Mapping for DNP3

In DNP3, Octet String applies to group 110. It supports read, write, and response function codes.

For the BMENOR2200H module, the octet string splits into two types of points, input points and output points.

The client uses a Read_Group command to read the Octet String.

This is the interpretation of the Octet String from the perspective of the client:

- **Octet String** points are input points.
- **Write Octet String** points are output points.

This is the interpretation of the Octet String from the perspective of the server:

- **Octet String** points with **protocol** variable access are input points for the DNP3 client.
- **Octet String** points with **CPU** variable access are output points from the controller.

Octet String lengths:

maximum	255 characters
default	16 characters

IEC 60870-5-104 Data Object Mapping

Introduction

To facilitate communications with the BMENOR2200H module, create data points for the IEC 60870-5-104 communication protocol in the **DATA MAPPINGS** tab in the DTM.

Access the Configuration Tab

Access the configuration parameters on the **DATA MAPPINGS** tab in Control Expert:

Step	Action
1	Access the DTM configuration for your module, page 74.
2	Confirm that you already created client and/or server channels, page 76.
3	In the **CONFIGURATION** menu, expand (+) the **Channels** sub-menu.
4	Make one of the following selections in the **Channels/Devices** sub-menu: • **IEC104 Client** • **IEC104 Server**
5	Select the desired device in the sub-menu.
6	Select the **DATA MAPPINGS** tab for the channel.
7	Configure the data mapping parameters.
8	• Select **Apply** to implement your configuration changes. • Select **OK** to implement your changes and close the dialog box.

IEC 60870-5-104 Data Mappings

Edit the data point configuration on the **DATA MAPPINGS** tab:

Step	Action
1	Select a type ID in the **Select Type Id** drop-down list.
2	Select the **Add** button to configure the data object type.

Step	Action
3	Configure the data object type. Depending on the data object type and the selected protocol profile, different configuration fields are required to define a data object mapping item.
4	• Select **Apply** to implement your configuration changes. • Select **OK** to implement your changes and close the dialog box.

IEC 60870-5-104 Data Mapping Parameters

NOTE: When the Control Expert window is active, you can hover the cursor over any field to see a description of the functionality and the available range of values.

This table describes the parameters:

Field	Client	Server	Value Scope	Default Value	Description
IOA	✓	✓	1~16777215	1	Indicates the information object address of the object.
Point Count	✓	✓	1...7000	1	Indicates the number of objects defined. The IOA of each object defined. The IOA of each object is in sequence from the first object address.
Variable Name	✓	✓	Max length: 32	M_SP_P1/...	Indicates the variable name.
CPU Reg Mapping	✓	✓	• Value only • Value with time • Value with flag • Value with flag and time	Value only	Indicates the choice of the stored time or flag; follows the value in the CPU DDDT variable.
Operation Mode	✓		• Auto • Select • Execute • Deselect	Auto	Indicates the operation mode for C_SC/C_DC/C_RC/C_SE_A/C_SE_B/C_SE_C control command.
	✓		• Activation • Deactivation	Activation	Indicates the active/deactive operation for the C_IC/P_AC point.
	✓		• Read • Freeze • Freeze with reset • Reset	Read	Indicates the operation mode for C_CI control command.
Qualifier	✓	✓	• Default • Short pulse • Long pulse • Persistent output	Persistent output	Indicates the qualifier for C_SC/C_DC/C_RC control command. When it is received, a C_SC/C_DC/C_RC command with 'default qualifier,' the server operates the command with this configured qualifier.
	✓		G/1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/16	G	Indicates the interrogation group for C_IC control command.
	✓		1/2/3/4/G	1	Indicates the counter interrogation group for C_CI control command.

Field	Client	Server	Value Scope	Default Value	Description
	✓		• General • Event	General	Indicates general reset or event clear for C_RP control command.
	✓		• Threshold • Low limits • High limits	Threshold	Indicates the parameter type to set for P_ME_A/P_ME_B/P_ME_C point.
Threshold	✓	✓	0...32767	0	Indicates the default threshold value for M_ME_A/M_ME_B point to trigger event.
	✓	✓	0~3.402823466385288E+38	0	Indicates the default threshold value for M_ME_C point to trigger event.
Low Limit	✓	✓	-32768...32767	—32768	Indicates the low limit value for M_ME_A/M_ME_B point to trigger event.
	✓	✓	-3.402823466385288E+38~3.402823466385288E+38	—3.402823466385288E+38	Indicates the low limit value for M_ME_C point to trigger event.
High Limit	✓	✓	—3.4028823466385288E+38~3.402823466385288E+38	3.402823466385288E+38	Indicates the high limit value for M_ME_C point to trigger event.
	✓	✓	-32768...32767	32767	Indicates the high limit value for M_ME_A/M_ME_B point to trigger event.
Short Pulse Duration		✓	0~4294967295 ms	100 ms	Indicates the short pulse duration for C_SC/C_DC/C_RC control point.
Long Pulse Duration		✓	0~4294967295 ms	1000 ms	Indicates the long pulse duration for C_SC/C_DC/C_RC control point.
Need Select		✓	Check box	Selected	Indicates the need to select before operation for C_SC/C_DC/C_RC/C_SE_A/C_SE_B/C_SE_C control command.
Cdc Mode		✓	• Determinate state • Indeterminate state	Determinate state	Indicates the pulse recovery state for C_DC command. In determinate state mode, it recovers to the previous on (2)/off (1) state. In indeterminate state mode, it recovers to the fixed intermediate (0) state.
Qualifier		✓	• Threshold • Low limits • High limits	Threshold	Indicates the parameter type to set for P_ME_A/P_ME_B/P_ME_C point.
Event Routing					
Route Channel	✓		Disable/Enable	Disable	Indicates whether the event routing function is disabled or enabled.
Route Session	✓		0	0	Indicates the session number to route.
Route Sector	✓		Server device list	First device	Indicates the device to route.
Route Point	✓		1...16777215	1	Indicates the information object address to route.
Routing Offline	✓		• Valid quality	Valid quality	Specifies the flag when routing channel is offline.

Field	Client	Server	Value Scope	Default Value	Description
			- Invalid quality		
Background Scan	✓	✓	Check box	Deselected (disabled)	Indicates the background scan is enabled. (The check box is selected.)
Cyclic Data Transmission	✓	✓	Check box	Deselected (disabled)	Indicates the cyclic data transmission is enabled. (The check box is selected.)
Event Generation	✓	✓	Check box	Selected (fixed)	Indicates that events for points can be configured.
Groups					
Global 1/2/3/4/5/6/7/8/910/11/12/13/14/15/16	✓	✓	Check box	Global	Defines the data object group responding to the interrogation command from the client. It can be a combination of options.

DNP3 Events

Introduction

You can configure the **Events** tab for DNP3 NET server channels.

Access the Configuration Tab

Access the configuration parameters on the **EVENTS** tab in Control Expert:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	Confirm that you already created client or server channels.
3	In the **CONFIGURATION** menu, expand (**+**) the **Channels/Devices** sub-menu.
4	Select **DNP3 NET Server** from the **Channels/Devices** sub-menu. **NOTE:** The **EVENTS** tab is not available for **DNP3 NET Client** channels.
5	Select the tab **EVENTS** tab.
6	Configure the event parameters. **NOTE:** The parameters on the **Events** tab are similar to the DNP3 data mapping parameters, page 87.
7	Click the **OK** or **Apply** button to implement your configuration changes.

NOTE: Configure the DNP3 SAv5 security events (object 121/122) on the web pages, page 121

Events Parameters

GENERATE EVENTS dialog:

Field	Parameter	Description
Data Mappings	Point Number	Start point number of the point (min: 0, max: 65535, default: 0)
	Point Count	Number of the points (min: 0, max: 7000, default: 1)
	Object Group	Object group to read (default: binary input)
	Point Name	Name of located or unlocated register (default: –, forbidden symbol: {} “ [], max length: 50) default: CE_P0_P0

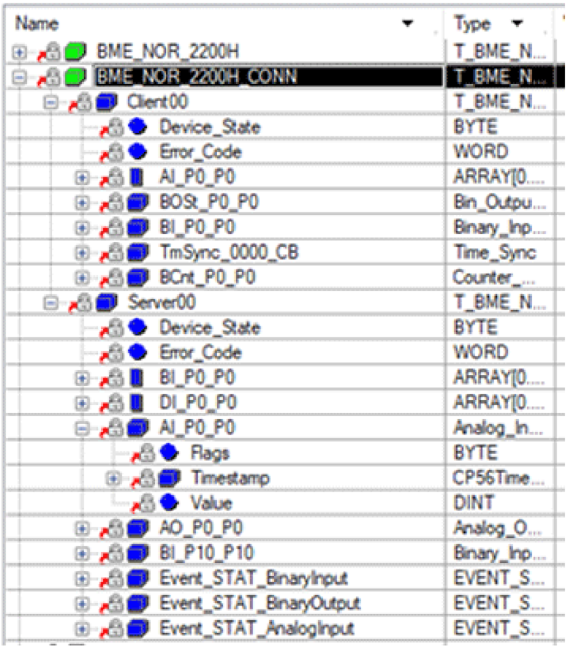
Field	Parameter	Description
	Add CMD_STATUS	Specify CMD_STATUS variable name (default: check box deselected)
	Point Name	Name of located or unlocated register (default: –, forbidden symbol: {} " [], max length: 50) default: empty

CLEAR EVENTS dialog:

Field	Parameter	Description
Data Mappings	Object Group	Object group to read (default: binary input)
	Point Name	Name of located or unlocated register (default: –, forbidden symbol: {} " [], max length: 50) default: CE_P0_P0
	Add CMD_STATUS	Specify CMD_STATUS variable name (default: check box deselected)
	Point Name	Name of located or unlocated register (default: –, forbidden symbol: {} " [], max length: 50) default: empty

Generating Events in the Server

In the server DTM configuration tab, the device DDT structure (unlocated variable) looks like this:



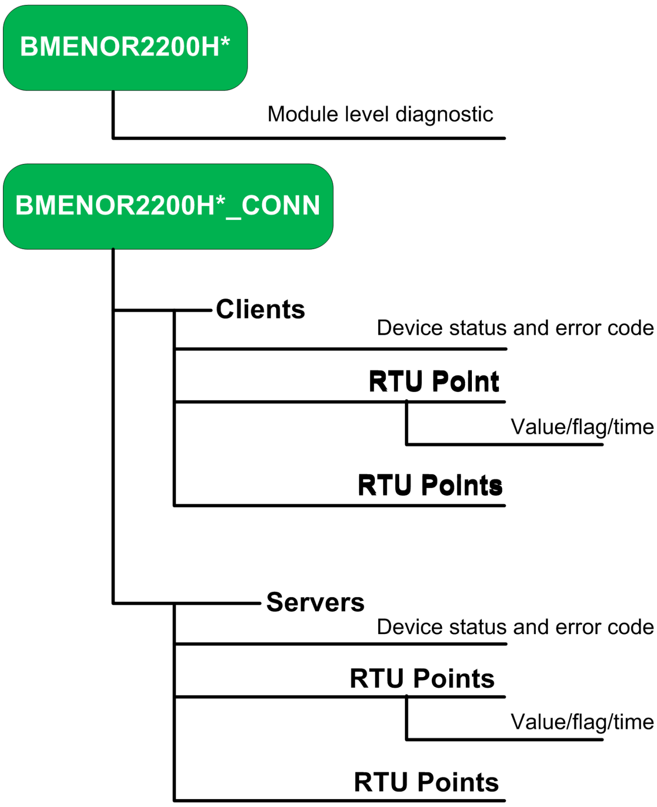
Name	Type
BME_NOR_2200H	T_BME_N...
BME_NOR_2200H_CONN	T_BME_N...
Client00	T_BME_N...
Device_State	BYTE
Error_Code	WORD
AI_P0_P0	ARRAY[0....
BOSt_P0_P0	Bin_Outpu...
BI_P0_P0	Binary_Inp...
TmSync_0000_CB	Time_Sync
BCnt_P0_P0	Counter_...
Server00	T_BME_N...
Device_State	BYTE
Error_Code	WORD
BI_P0_P0	ARRAY[0....
DI_P0_P0	ARRAY[0....
AI_P0_P0	Analog_In...
Flags	BYTE
Timestamp	CP56Time...
Value	DINT
AO_P0_P0	Analog_O...
BI_P10_P10	Binary_Inp...
Event_STAT_BinaryInput	EVENT_S...
Event_STAT_BinaryOutput	EVENT_S...
Event_STAT_AnalogInput	EVENT_S...

where (as shown in the following illustration:

- The customer-defined variable name corresponds to the T_BME_NOR type.
- The client corresponds to these RTU points:
  - Device_State: BYTE type
  - Error_Code: WORD type
  - AI_Px: Analog_input_xxx Type

    NOTE: When the point count is less than 1, the point type uses the `ARRAY` format.
  - BOSt_P0_P0: Bin_Output_xxx type
  - BI_P0_P0: Binary_Input_xxx type
  - TmSync_0000_CB: Time_Sync type
  - BCnt_P0_P0: Counter_... type
- The server corresponds to the following RTU points:

- Device_State: BYTE type
- Error_Code: WORD type
- BI_P0_P0: Binary_Input_xxx type
- DI_P0_P0: Double_Input_xxx type
- AI_P0_P0: Analog_Input type (Flags, Timestamp, Value)
- AO_P0_P0: Analog_Output type
- BI_P10_P10: Binary_Input_xxx type
- Event_STAT_BinaryInput: WORD type (counter); BYTE type (overflow)
- Event_STAT_BinaryOutput: WORD type (counter); BYTE type (overflow)
- Event_STAT_AnalogInput: WORD type (counter); BYTE type (overflow)



*** customer-defined name***

Clearing Events in the Server

Clear_Events supports a new point type which clears the event buffer in the DNP3 server. It enables the user to clear the events buffer in a local or remote SCADA through mapping memory.

Clear_Events can be created only for DNP3 server; select Data Mapping.

When the value of the *Clear_Events* register changes, the BMENOR2200H module clears the events of the object group in the configuration.

Parameter	Value Scope	Definition
Object Group	All Objects Binary Input Double Input Binary Counter Analog Input Binary Output Analog Output	Specifies the object group whose event is cleared o. demand
Variable Name	—	Indicates the name of the located register.

IEC 60870-5-104 Events

Access the Configuration Tab

Access the configuration parameters on the **EVENTS** tab in Control Expert:

Step	Action
1	Access the DTM configuration for your module, page 74.
2	Confirm that you already created client and/or server channels, page 76.
3	In the **CONFIGURATION** menu, expand (+) the **Channels/Devices** sub-menu.
4	Make one of the following selections in the **Channels/Devices** sub-menu: • **IEC104 Client** • **IEC104 Server**
5	• Select the specific channel in the sub-menu. • Select the specific device in the sub-menu.
6	Select the **EVENTS** tab.
7	Configure the event parameters. **NOTE:** The event parameters are similar to the data mapping parameters, page 99.
8	• Select **Apply** to implement your configuration changes. • Select **OK** to implement your changes and close the dialog box.

Export and Import .xml Files with the DTM

Introduction

A BMENOR2200H module stores its configuration in an .xml file. You can use the import and export functions in the Control Expert DTM to share that file among different modules to implement the same configuration.

Use the Control Expert **EXPORT/IMPORT** functionality:

- *export:* Save the module and protocol configurations to an .xml file.
- *import:* Import .xml files that include configuration parameters and data mapping to one or more modules.

Use Cases

These practical examples represent some common implementations of the import and export functions:

Use Case	Action	
Redundant Configuration	1	Export the .xml configuration file from a BMENOR2200H module.
	2	Import the .xml configuration file to one *or more* BMENOR2200H modules.
	3	Reuse the BMENOR2200H module's configuration file in other BMENOR2200H modules
Project Migration	Migrate the configuration file from a BMXNOR0200H module to a BMENOR2200H module. **NOTE:** All located addresses are lost after the import of .xml files from the BMXNOR0200H module. The type and length of the name are changed according to the new format. Account for the data type substitutions that are required when you migrate the XML file, page 170.	

Import

Import an .xml configuration file:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the **CONFIGURATION** menu, expand (**+**) the **General** sub-menu.
3	Select **Export / Import**.
4	In the **Import / Export** dialog, click the **Browse** button in the **Import File Name** field to find the .xml configuration file name path you want to import, located on your local or network drive.
5	Select the respective configuration file and click the **Open** button to enter the file name path for the **Import File Name** field.
6	Select or deselect the **Use system defined data mapping point names** check box: • *selected:* The import setting allows you to import user-defined mapping point names. • *deselected:* Data mapping point name is assigned based on point type, point number, and point count.
7	Select the **Import** button.
8	Select **Apply** to save your changes, or select **OK** to save your changes and close the dialog.

Export

Export an .xml configuration file:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the **CONFIGURATION** menu, expand (**+**) the **General** sub-menu.
3	Select **Export / Import**.
4	In the **Import / Export** dialog, copy/paste the path file name of the .xml configuration file saved from the BMENOR module and protocol parameters, which you want to export to a local drive, in the **Import File Name** field.
5	Select or deselect the **Use system defined data mapping point names** check box: • *selected:* The import setting allows you to import user-defined mapping point names. • *deselected:* Data mapping point name is assigned based on point type, point number, and point count.
6	Select the **Export** button. **NOTE:** The .xml configuration file is exported to a pre-determined location on your local or network drive.
7	Select **Apply** to save your changes, or select **OK** to save your changes and close the dialog.

Bulk Configuration

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the **CONFIGURATION** menu, expand (**+**) the **Communication** sub-menu.
3	Select **Channel Configuration**.
4	To edit, double-click the pencil in the **Bulk Configuration** tab of the **CLIENT CHANNELS** dialog. **Result**: An **Open** dialog box appears where you can navigate to the required bulk configuration file.
5	Select the **DataMapping_BulkConfiguration.xlsm** file to the required folder required in step 4 and open the Excel worksheet.
6	Based on the requirement, (data points for server and client for IEC or DNP3), copy the respective data to the IEC Client or IEC Server worksheet.
7	Open the corresponding data mapping, and the data should be successfully imported.
8	Save and import the Excel worksheet.

Excel worksheet details:

- IEC Server: IECDataPoint_Ref sheet to IECServer
- IEC Client: IECDataPoint_Ref sheet to IECClient
- DNP3 Server: DNP3DataPoints_Ref to DNP3Server
- DNP3 Client: DNP3DataPoints_Ref to DNP3Client

Module Information in the DTM

Access the Information

View the **Module Information** function in the Control Expert DTM:

Step	Action
1	Access the DTM configuration for your module, page 75.
2	In the **CONFIGURATION** menu, expand (**+**) the **General** sub-menu.
3	Select **Module Information**.

Description

The **Module Information** page shows read-only information:

- **IP ADDRESS INFORMATION:** These fields contain the IP parameters for the module.
- **MEMORY STATUS:**
  - **Input:** The level indicator displays the memory usage (in bytes) for input memory type.
  - **Output:** The level indicator displays the memory usage (in bytes) for output memory type.

Limitations

Monitor the consumed implicit resources while respecting the total size of input and output types as follows:

Type	Memory
Input	8 K bytes
Output	8 K bytes

NOTE: For details, refer to the description of the I/O data exchange with the CPU, page 24.

Cyber Security Configuration

About Cyber Security Web Pages

Introduction to Cyber Security Web Pages

Introduction

The BMENOR2200H module has a built-in Hyper Text Transfer Protocol Secure (HTTPS) web server that provides access to various secure web pages. Use these pages to monitor the status of the module without installing Control Expert or the module's corresponding DTM.

Use these web pages to import, export, or delete encrypted cyber security management files.

You can monitor the security of communications through the **SEC** LED, page 19.

> **NOTE:** Web page access is available only when the module is in secure mode. Refer to the directions for configuring the appropriate level of cyber setting with the rotary switch, page 22.

Before You Begin

Use the web pages described in this chapter to apply cyber security features to configured channels on the BMENOR2200H module

You can apply cyber security to the module after you satisfy these requirements:

- You have configured at least one communications channel for the module in the Control Expert DTM.
- You have configured the appropriate setting (**Secured**) on the rotary switch, page 22.

The first time you log in to secure mode, the cyber security file is not valid. Therefore, follow these steps to configure the file:

Stage	Description
1	Log in to the web pages as an administrator., page 115
2	Access the cyber security setting page., page 109
3	Configure the event log with a valid IP address (or disable event log)., page 111
4	Apply the configuration to the module.

Main Features

This list represents the major cyber security features for the module in terms of communications management:

- individual security:
  - HTTPS, page 109
  - DNP3/IEC 60870-5-104, page 49
- confidential transmission:
  - HTTPS, page 109
  - DNP3/IEC 60870-5-104, page 49
- enabled/disabled unused services:
  - SNMP v1, page 38
  - Modbus TCP server
  - DNP3/IEC 60870-5-104 server

Browser Requirements

The BMENOR2200H module’s HTTPS web server facilitates secure remote and local access to the embedded web pages through these standard browsers:

- Google Chrome 50+ (recommended)
- Mozilla Firefox 40+
- Microsoft Edge 14+
- Internet Explorer 11

Web Page Access

Access the Web Pages

Step	Action
1	Enter the module’s IP address or URL (`https://...`) in a web browser to open the module’s **Home** page. **NOTE:** • Web access via the URL is not supported by the BMENOR2200H module, but it can be implemented by system integration. • You may see an on-screen message that says the web pages are not secured. Ignore this message and open the web page. • When the module processes a heavy communications load, the web page may not open immediately. In this case, execute your browser's refresh function.
2	In the pull-down menu, select the appropriate language.
3	Enter the default user name and password that conforms to the selected cyber security mode, page 18 the first time you access the web: • **Secured** cyber security mode: ◦ *user name:* **admin** ◦ *password:* **password** • **Standard** cyber security mode: ◦ *user name:* **installer** ◦ *password:* **Inst@ller1**
4	Click the **Login** button.
5	Change your user name and password when prompted.

You can now access these tabs from the **Home** page:

- **Setup**, page 109
- **Diagnostics**, page 123

Cyber Security Setup

Cyber Security Web Page

Access the Parameters

Access the cyber security parameters for the BMENOR2200H module:

Step	Action
1	Access the cyber security web pages for the module, page 109.
2	Select the **SETUP** tab in the page banner.
3	Expand one of these sub-menus in the Cybersecurity Setttings menu: • **DEVICE SECURITY SETTINGS > User Account Policy** ◦ Event Logs ◦ Network Services ◦ Security Banner ◦ Hot Standby • **CERTIFICATES MANAGEMENT** ◦ PKI Configuration ◦ Trust List Management ◦ Root CA Management • **DNP3 SECURE AUTHENTICATION** ◦ Client Configuration ◦ Server Configuration ◦ Key Management • **IEC 60870-5-104 SECURE AUTHENTICATION** ◦ Client Configuration ◦ Server Configuration • **MANAGEMENT** ◦ User Management ◦ Configuration Management

Firmware Modifications

Most web pages have **Apply** or **OK** buttons to allow you to apply or save your modifications.

The firmware, however, is updated (or not) with the buttons in the banner across the top of each web page:

- **Apply:** Click to apply modifications to the firmware.
- **Discard:** Click to discard modifications.

Device Security Settings

Access the Settings

Access the **DEVICE SECURITY SETTINGS** from the **SETUP** web page:

Step	Action
1	Access the cyber security web pages for the module, page 109.
2	Select the **SETUP** tab in the page banner.
3	Expand the **MENU** navigation tree.
4	Expand the **DEVICE SECURITY SETTINGS** in the navigation tree banner to see these settings: • **User Account Policy** ◦ **Event Logs** ◦ **Network Services** ◦ **Security Banner** ◦ **Hot Standby**

NOTE: These security settings are described individually below. When the Control Expert window is active, you can hover the cursor over any field or click the information (*i*) icon to see a description of the functionality and the available range of values.

User Account Policy

Apply time and attempt limits to user interactions:

Parameter	Description
Session maximum inactivity (minutes)	The idle session timeout period for HTTPS connections.
Maximum login attempts	The number of times a user may attempt, and fail, to login. **NOTE:** When this maximum is reached, no additional logins may be attempted for the configured period.
Login attempt timer (minutes)	The maximum time to enter a user password.
Account locking duration (minutes)	Time period during which no additional logins may be attempted after the maximum login attempts is reached.
Apply	Click this button to apply your changes.

Event Logs

Configure the syslog client in the module. The logs are stored locally in the module and exchanged with a remote syslog server:

Parameter	Description
Service activation	Turn the Syslog client service on or off.
Syslog server IP address	This is the IPv4 address of the syslog server. **NOTE:** If you configure the Syslog server, all events are forwarded to this IP address.
Syslog server port	The Syslog client service uses this port number.
Apply	Click this button to apply your changes.

Refer to the topic Event Log Descriptions, page 178 for a description of event log entries.

Network Services

The SNMP, Syslog, and Modbus network services are not inherently secure protocols. They are rendered secure when they are installed in external VPN devices.

The synergy of these network services constitutes a firewall that permits or denies the passage of communications through the RTU module

Configuration:

Service	Enforce Security	Unlock Security
SNMP Agent	disabled	enabled
Modbus TCP Server	disabled	enabled
DNP3 Server	enabled	disabled
IEC 60870–5–104	enabled	disabled

Security Banner

Parameter	Description
Banner text	View this editable text when you access the web pages.

HSBY

- In secured mode, the BMENOR2200H module first boots from the factory mode. Configure the Hot Standby cyber security settings. The module uses TLS V1.2.
- In non-secured mode, the BMENOR2200H Hot Standby module's internal communication disables DTLS.

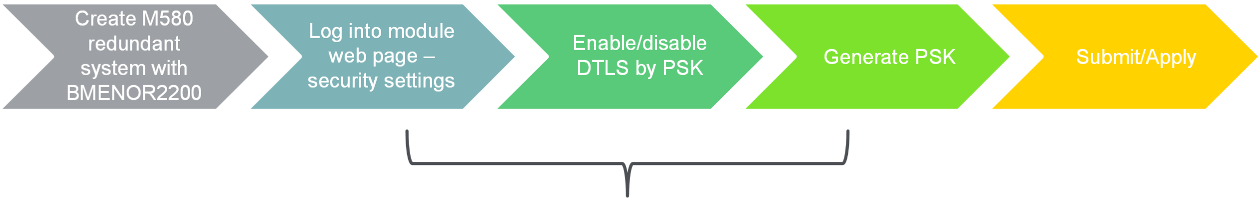
Navigate to the **HSBY SECURITY SETTINGS** field on the **SETUP** web page to configure Hot Standby cyber security.

Parameter	Description
Enable DTLS	• Select the check box to enable DTLS. • Deselect the check box to disable DTLS.
Pre-shared Key	Enter a key value of 16 characters.

Communication over DTLS

Hot Standby over DTLS

In a Hot Standby system, the BMENOR2200H module supports datagram transport layer security (DTLS). This cyber security feature helps defend against attacks by hiding Hot Standby communication in encrypted traffic.


Create M580 redundant system with BMENOR2200
Log into module web page – security settings
Enable/disable DTLS by PSK
Generate PSK
Submit/Apply

You can enable or disable the DTLS protocol for each module. The feature is enabled by default when the module is in secure mode. Enter the pre-shared key or disable DTLS when the BMENOR2200 module initially boots (like the syslog function).

Connecting via the HTTPS Protocol

If your application experiences connection problems, check with your local IT support to confirm that your network configuration and security policies are consistent with HTTPS (port 443) access to the RTU module IP address.

The RTU module accepts the HTTPS connections with transport layer security (TLS) protocol v1.2 or later. For example, Windows 7 could require an update to enable TLS 1.2 to upgrade the firmware of the RTU module or access to its web site.

DNP3 Client Channel Configuration

The **Add Channel** dialog has the following configurable elements:

- **Channel Name**: Enter the name for the DNP3 over TLS Channel.
- **Enable TLS**:
  - Select the check box to enable TLS.
  - Deselect the check box to disable TLS.

DNP3 Server Channel Configuration

The server channel configuration has the following parameters:

- **Channel Name**: Enter the name for the DNP3 over TLS Channel
- **Secure Authentication**: Select an option from the drop-down list:

  - SAv2
  - SAv5 (default)
  - Disabled
- **Key/Account Table**: Table for client/server with these options:
  - User Number
  - User Name
  - User Role: Operator, viewer, or single user
  - Key Wrap: Select AES-128 or AES-256
  - Key: Enter the key wrap algorithm, in hex format

  Click **Apply** to save.
- **Secure Authentication Enabled**
- **TLS Enabled**
  - Select the check box to enable TLS.
  - Deselect the check box to disable TLS.
- **Add User**: Click this button to add and configure permissions for another user.

IEC 608705-104 Client Channel Configuration

The client channel configuration has the following parameters:

- **Channel Name**: Enter the name for the IEC 60870-5-104 over TLS Channel
- **TLS Enabled**:
  - Select the check box to enable TLS.
  - Deselect the check box to enable TLS.
- **Add Channel**: Click this button to configure another channel.

IEC 60870-5-104 Server Channel Configuration

The server channel configuration has the following parameters:

TLS Enabled

- Select the check box to enable TLS.
- Deselect the check box to disable TLS.

DNP3 Secure Authentication

About DNP3 Secure Authentication

The implementation of DNP3 secure authentication (SA) facilitates mutual authentication for communications between a DNP3 client and a DNP3 server:

- A DNP3 server uses DNP3 SA to unambiguously determine that it is communicating with a user who is authorized to access the services of the server.

  NOTE: Secure authentication option is enabled by default. The server works properly only when a valid server channel is configured in the cyber security settings. Disable this function when your application does not require secure authentication. This global setting applies to all server channels. You cannot enable or disable a single specific channel independently of other channels. If the DNP3 service is disabled, no channels work, regardless of the configured security level.
- A DNP3 client uses DNP3 SA to unambiguously determine that it is communicating with the appropriate server.

NOTE: On the client side, you can configure individual client channels for secure authentication. For such cases, confirm that those channels are included in the table with an assigned security level (None, SAv2, SAv5).

Access the Settings

Access the **DNP3 SECURE AUTHENTICATION** page from the **SETUP** web page:

Step	Action
1	Access the cyber security web pages for the module, page 109.
2	Select the **SETUP** tab in the page banner.
3	Expand the **MENU** navigation tree.
4	Expand the **DNP3 SECURE AUTHENTICATION** in the navigation tree banner to see these settings: • **Client Configuration** • **Server Configuration** • **Key Management** **NOTE:** These security settings are described individually below.

- For the client channel, refer to the configuration topic, page 112.
- For the server channel, refer to the configuration topic, page 112.

Key Management

Create a list of users that can access your module:

Step	Description
1	In the **Key Management** web page, press the **Create Table** button and follow the directions to assign a name to the table. **NOTE:** The tables you create appear in a pull-down menu next to the **Create Table** button.
2	Press the **Add User** button to add a list of authorized users at the supervision (SCADA) environment. **NOTE:** You can configure a maximum of 64 users for DNP3 Secure Authentication.
3	Populate the fields in the **Add User** dialog box. **NOTE:** When the Control Expert window is active you can hover over the blue circle (*i*) next to the feature to see an explanation for each field.
4	*optional step*: For the pre-shared key field (**Update Key**), you have the option to click the **Generate** button to use a randomly generated key.
5	*optional step*: You can copy the **Update Key** information by clicking the copy icon next to the **Generate** button. **NOTE:** You can copy the key to share the key more easily with the SCADA system.
6	Press the **Apply** button to add the user to the table of authorized users.
7	Repeat these steps to add additional users. **NOTE:** The DNP3 standard limits the number of users to 64.

The user(s) in your table will be able to access your module from the SCADA environment.

This table describes the **Key Management** parameters:

Parameter	Description
CLIENT (tab)	**User Number:** This number corresponds to the current DNP3 user. **NOTE:** Use the value *1* when this user is assigned SAv5.
	User Name: This field shows the current user.

Parameter	Description
	NOTE: Because the BMENOR2200H RTU module acts as a data concentrator, the current user role on the **CLIENT** side is SINGLE USER.
	Key Wrap: Select the appropriate wrap algorithm (**AES-128**, **AES-256**). Encryption Standard. **NOTE:** AES-256 does not work with SAv2. In this case, the **Update Key** value is 32 Hex.
	Key: This column shows the content of the **Update Key** value.
SERVER (tab)	**User Number:** This number corresponds to the current DNP3 user.
	User Name: This field shows the current user.
	User Role: This field shows the role performed by the user (**OPERATOR**, **ENGINEER**, **INSTALLER**, **SECURITY ADMINISTRATOR**, **VIEWER**, **SINGLE USER**).
	Key Wrap: Select the appropriate wrap algorithm (**AES-128**, **AES-256**). Encryption Standard. **NOTE:** AES-256 does not work with SAv2. In this case, the **Update Key** value is 32 Hex.
	Key: This column shows the content of the **Update Key** value.

Cyber Security Management

Access the Settings

Access the **MANAGEMENT** page from the **SETUP** web page:

Step	Action
1	Access the cyber security web pages for the module, page 109.
2	Select the **SETUP** tab in the page banner.
3	Expand the **MENU** navigation tree.
4	Expand **MANAGEMENT** in the navigation tree banner to see these settings: • **Certificates Management** • **User Management** • **Configuration Management**

Certificates Management

These **Certificates Management** parameters assist in the import and export functions relative to a secure (HTTPS) browser. For detailed information, refer to the Certificates Management topic, page 117.

Parameter	Description
Name (CN)	This field shows the name of the certificate.
Distinguished Name (DN)	This field corresponds to the name of the certificate.
Expiration Date	This field shows the expiration date of the certificate.
Trusted Certificate	This field shows the name of a trusted certificate that is purchased from a Certification Authority.
Browse	Click this button to locate a different certificate.
Submit	Click this button to implement the selected **Trusted Certificate** file.

User Management

This table describes the **User Management** parameters:

Parameter	Description
User Name	This field shows the current user.
Roles	This field shows the role performed by the user (**OPERATOR**, **ENGINEER**, **INSTALLER**, **SECURITY ADMINISTRATOR**). **NOTE:** A single user can perform multiple roles.
Add User	Click this button to add a maximum of 15 new users with defined roles in the process. **NOTE:** To add a user, use your web page login credentials, page 109.

Click the pencil icon to edit these parameters, and click the **Apply** button.

NOTE: Hover over the blue circle next to the feature (*i* icon) to see an explanation for each field.

Configuration Management

Import, export, or reset the cyber security management:

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td rowspan="3"><b>IMPORT CONFIGURATION</b></td><td>Use the <b>IMPORT CONFIGURATION</b> fields to import a cyber security configuration file and apply it to the module. The cyber security settings that are applied with this command overwrite the existing settings and are immediately applied to the module.
To import a cyber security configuration file and apply it to the module:
<table>
<tr><td>1</td><td>In the <b>IMPORT</b> page, click the file icon to open a window where you can select a <b>Configuration</b> archive.</td></tr>
<tr><td>2</td><td>Navigate to and select the configuration file you want to import, and click <b>OK</b>.
<b>NOTE:</b> This is not the web login password. It is a password for exporting the cyber security settings.</td></tr>
<tr><td>3</td><td>In the <b>IMPORT</b> page, enter your security administrator <b>Password</b>.</td></tr>
<tr><td>4</td><td>Click <b>Upload</b> to apply the selected configuration file to the local module.</td></tr>
</table>
(See the note below.)</td></tr>
<tr><td><b>Configuration Archive:</b> Make a selection.</td></tr>
<tr><td><b>Import:</b> Click this button to import the configuration.</td></tr>
<tr><td><b>EXPORT CONFIGURATION</b></td><td>Export the cyber security configuration file for the module:
<table>
<tr><td>1</td><td>In the <b>EXPORT</b> page, enter your <b>Password</b>, which is an <b>encryption key</b> to archive the exported configuration file. This password is also used to archive an imported configuration file.</td></tr>
<tr><td>2</td><td>Re-enter your password in the <b>Confirm password</b> field.</td></tr>
<tr><td>3</td><td>Click <b>Export</b> to export the configuration.</td></tr>
</table>
(See the note below.)</td></tr>
<tr><td><b>RESET CONFIGURATION</b></td><td>Click the <b>Reset</b> button to restore the factory default cyber security settings for the module.
Restart the module to implement the reset.</td></tr>
<tr><td colspan="2"><b>NOTE:</b> Use the same password to encrypt the <b>EXPORT CONFIGURATION</b> value and decrypt the <b>IMPORT CONFIGURATION</b> value. Only a user with permission to update the configuration file can execute these commands.</td></tr>
</table>

Certificates Management

Certificates Management With and Without PKI

The BMENOR2200H module relies upon certificates for authentication. To provide cyber security, each entity manages a trust list of all certificates of devices/ applications that communicate with it.

The method of certificate management depends on your system design, which may or may not apply a public key infrastructure (PKI) with a certificate authority (CA).

Certificate Management without PKI:

Use this certificate management method if your system does not include a CA. Manage certificates in the **Certificates Management** web pages as follows:

- **Self-signed only** is the system default **PKI mode**.
- You can only switch the device **factory reset** mode to **self-signed only** mode.
- Manage the **Certificate Trust List** using the **Add** and **Delete** functions to create an allowed list that is authorized to communicate with the RTU module.
- Export the RTU module certificate to communicated devices using the **Download** command in the **PKI Configuration > Device Certificate** page.

Certificate Management with PKI:

Use this certificate management method if your system includes a CA. Manage certificates in the **Certificates Management** web pages as follows:

- Set **PKI mode** to either:
  - **CA only**: if all installed devices support PKI.
  - **Self-Signed & CA**: if some of the installed devices do not support PKI.
- If **PKI mode** is set to **CA only**:
  - Manually enroll each RTU module with the CA.
- If **PKI mode** is set to **Self-Signed & CA**:
  - Manually enroll each RTU module with the CA.
  - Manage the **Certificate Trust List** using the **Add** and **Delete** functions to create an allowed list that is authorized to communicate with the RTU module.

Authentication Overview

A BMENOR2200H module can be authenticated in two ways:

- Self-signed certificate
- Certificate Authority (CA)

To provide the required level of cyber security, each entity RTU module manages a trust list of all certificates of devices/applications that communicate with it.

The RTU module creates a self-signed certificate for:

- Configuration of the cyber security settings via the module web pages
- Diagnostic of the module via its web pages
- Firmware upgrade

NOTE:

- The expiration dates of the trusted certificates are made by reference to the internal Date and Time settings of the RTU module. To help avoid inconsistency, use the NTP service to update the date and time settings of the RTU module, and check that the NTP server is accessible and has an updated time and date settings.
- The RTU module does not automatically manage the expiration dates of certificates.
  - For a self-signed certificate file, it is determined by the device.
  - For a CA certificate file, it depends on the CA agent.

Managing Certificates

In the RTU module web pages, starting in the **Home** page, select **SETUP** to display links to the following application instance certificate management pages:

- PKI Configuration
- Trust List Management
- Root CA Management

Certificate Limitations

To support communication with the RTU module, note the self-signed and CA certificate limitations, as follows:

Self-Signed Certificates:

- KeyUsage (marked as critical):
  - DigitalSignature
  - KeyEncipherment (No usage for TLS suite based on ephemeral keys such as TLS_ECDHE_xxxx; usage for TLS_RSA_xxxx)
  - KeyCertSign: when the subject public key is used for verifying signatures on public key certificates (Value TRUE)
  - nonRepudiation
  - dataEncipherment
- Subject Alt Name: In the SAN field the following values can be specified: IPAddress V4/V6, URI
- Basic Constraints:
  - cA field: whether the certified public key may be used to verify certificate signatures (Value TRUE) and pathLenConstraint=0
- Subject Key Identifier:
  - means of identifying certificates that contain a particular public 160-bit SHA-1 hash of the value of the BIT STRING subjectPublicKey (excluding the tag, length, and number of unused bits).
- Extended Key Usage extension:
  - id-kp-serverAuth if TLS Web server authentication
  - id-kp-clientAuth if TLS Web client authentication

CA Certificates:

- KeyUsage (marked as critical):
  - DigitalSignature
  - KeyEncipherment (No usage for TLS suite based on ephemeral keys such as TLS_ECDHE_xxxx; usage for TLS_RSA_xxxx)
  - KeyCertSign: when the subject public key is used for verifying signatures on public key certificates (value FALSE)
  - nonRepudiation
  - dataEncipherment

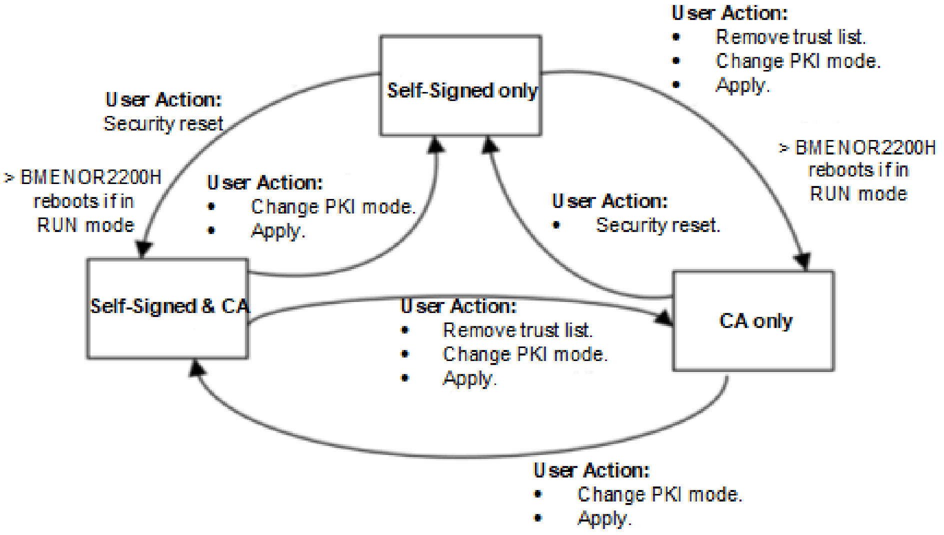
- Subject Alt Name: In the SAN field the following values can be specified: IPAddress V4/V6, URI
- Basic Constraints:
  - cA field: whether the certified public key may be used to verify certificate signatures (value FALSE)
- Extended Key Usage extension:
  - id-kp-serverAuth if TLS Web server authentication
  - id-kp-clientAuth if TLS Web client authentication
- CRL Distribution points
- Authority Key Identifier:
  - Identification of the public key corresponding to the private key used to sign a certificate.

PKI Configuration

Use the **PKI Configuration** page to specify the types of certificates accepted, including:

PKI Mode	Description
Self-Signed only	Only certificates in the **Trusted List Management** list (“white list”) need to be managed.
CA only	All system devices need certificates signed by a CA.
Self-Signed and CA	Certificates are managed as follows: • The certificate for the RTU module is issued by a CA. • Certificates for devices that support PKI are issued by a CA. • Certificates for devices that do not support PKI are self-signed.

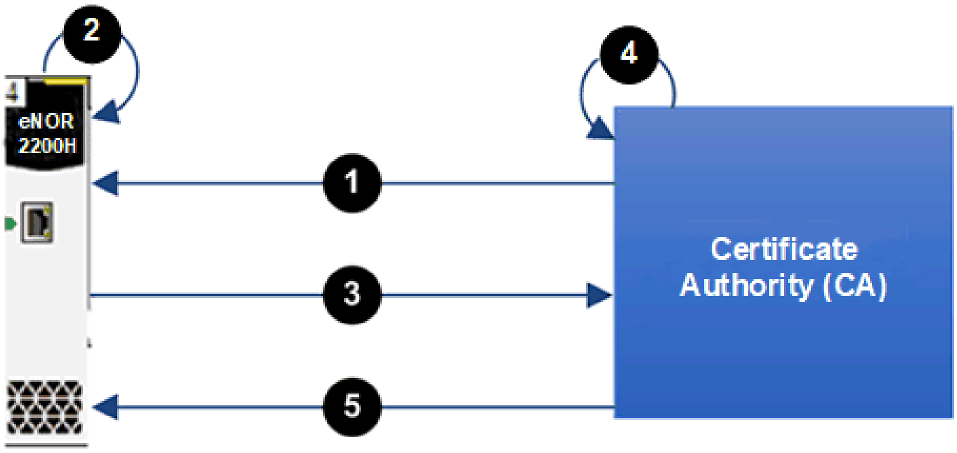
The following diagram illustrates the user actions and events related to changing the PKI mode setting:



Manual Enrollment

After configuring the RTU module in Control Expert, you can use the **PKI Configuration MENU, ENROLLMENT** section to *get* a CSR file to be submitted to a CA. After submitting the CSR file, you can then extract the correspondent CA certificate. Thereafter, you can push this CA Certificate into the RTU module. The combined get and push operations manually enroll a certificate issued by a third-party CA. After the certificate is pushed, the server applies this certificate for the purpose of signing and encrypting its communication with the client.

The following is an overview of the manual certificate enrollment process:



1 BMENOR2200H imports a Root CA Management MENU from the certificate authority (CA).

2 BMENOR2200H generates a certificate signing request (CSR).

3 BMENOR2200H exports the CSR to the CA.

4 The CA executes the CSR and generates a certificate.

5 BMENOR2200H imports the certificate from the CA.

Trust List Management

Only devices that have provided the RTU module with an application instance certificate can communicate with RTU. The module implements local (module-based) management of application instance certificates, which are stored in a trust list. Use the commands on the **Certificates Management** web pages to **Add**, **Download**, or **Delete** a certificate.

NOTE: Application instance trust list certificates are encoded in ANSI CRT.

To add a certificate to the list:

Step	Action
1	In the Trust List management menu, click **Browse**, then navigate to and select the certificate you want to add to the list.
2	Click **Submit** to add the certificate.
3	Click **Apply** to save the change to the configuration.

To remove a certificate from the list:

Step	Action
1	In the trust list, click the certificate you want to remove
2	Select **Delete**.
3	Click **Yes** to remove the certificate from the list.
4	Click **Apply** to save the change to the configuration.

Device Certificates Export

You can export the RTU module certificate for HTTPS in the **CERTIFICATES MANAGEMENT > PKI CONFIGURATION** page by clicking the **Download** button

Root CA Management

The CA certificate is a public key certificate that identifies the certificate authority (CA) in a public key infrastructure (PKI). Use the **Root CA Management** page to push the CA certificate(s) in the device.

To add a certificate from the CA to the CA Certificates list:

Step	Action
1	Open the web pages for the module, and in the **Login** dialog, enter: • username • password Click **Login**.
2	Navigate to **SETUP > CERTIFICATES MANAGEMENT** to access the certificates management tab, then select **Root CA Management**.
3	In the **TRUSTED CA CERTIFICATES** list, click **ADD** to add the CA certificate to the list.
4	Apply the changes to the cyber security configuration.

NOTE: A maximum of ten (10) CA certificates can be added.

RBAC

Introduction

Role-based access control (RBAC) is a method for reducing the risk of cyber security attacks by assigning different levels of access that are based on the access privileges associated with a user's defined role.

The BMENOR2200H module uses RBAC to provide defined levels of access for users. RBAC is predefined according to IEC 62351-2, but it is also configurable according to user requirements.

These threats are defined by IEC 62351-2:

- spoofing
- modification
- replay
- eavesdropping (on the exchange of cryptographic keys)

Limitations

- The maximum number of active web server user connections is 5.
- Observe theses maximums for the number of DNP3 users that can participate in key management configuration:
  - DNP3 SAv2: 10
  - DNP3 SAv5: 64

RBAC Workflow

This is the global RBAC workflow:

Stage	Description
1	Access the RBAC management page.
2	Create a new **USER** and assign a role from list.
3	Enter and confirm a password.
4	Submit the RBAC configuration.
5	Access the server key management page for DNP3 secure authentication.

Stage	Description
6	Pick a **USER** from the server user table for RBAC management.
7	Enter the other security settings for the DNP3 secure authentication version.

NOTE: A single user is now active (client only).

Available Functionality

This table shows the available functionalities for each value and its corresponding name:

Value	Name	DNP3 Protocol		Firmware	Web Page Settings		FTP	HTTPS
		Monitor Data	Operator Control	Upgrade	Security	Diagnostic	Data Logging Server	Web Login Server
1	**OPERATOR**	✓	✓			✓	✓	✓
2	**ENGINEER**	✓				✓	✓	✓
3	**INSTALLER**	✓		✓		✓		✓
4	**SECADM**				✓	✓		✓
32768	**SINGLEUSER (COMMON)**	✓	✓					**X**

Web Page and Device DDT Diagnostics

Introduction

This chapter describes diagnostics for the BMENOR2200H Web pages and Device DDDT as configured in a Control Expert application.

Web Page Diagnostics

Introduction

This section describes diagnostics for the BMENOR2200H Web pages as configured in a Control Expert application.

Web Page Diagnostics

Accessing Diagnostics

The following table describe how to access diagnostic information for the BMENOR2200H module via Web pages:

Step	Action
1	Select **Tools** > **DTM Browser** to open your project DTM.
2	Double-click the BMENOR2200H module.
3	In the DTM **Configuration** dialog, expand **General**, and select **Module Information**.
4	In the right-side pane, scroll to the bottom of the dialog to view **Web Diagnostics**.
5	Click the **Launch** button to access the diagnostic Web pages.
6	Select the **Diagnostics** tab.
7	Expand the **MENU** to view the available diagnostic pages: • **MODULE** ◦ Status Summary ◦ HSBY Status ◦ Event Buffer Status ◦ Port Statistics • **CONNECTED DEVICES** ◦ RTU Protocol ◦ Messaging • **CD SERVICES** ◦ SNTP ◦ Clock

Module Diagnostics

Status Summary

Monitor the status of the module via the following parameters:

Field	Description
RUN, **ERR**	• *green* • *red* **NOTE:** The diagnostics information is explained in the description of LED activity and indications, page 19.
SERVICE STATUS	Monitor the performance of each listed service on the communications link: • *green:* The service is operating normally. • *red:* An error is detected for a service. • *black:* The service is not present or not configured.
NETWORK INFORMATION	**Host Name:** This field shows provides the host name for the module (**BME NOR 2200H**).
	IP Address: This field shows the IP address of the module.
	Subnet Address: This field shows the subnet address of the module.
	Gateway Address: This field shows the gateway address of the module.
	MAC Address: This field shows the MAC address of the module.
VERSION INFORMATION	View the software versions that currently run on the module: • **SV** • **Web Server Version** • **Web Page Version**
MISCELLANEOUS	**Communication Security:** The status of the security service (enabled or disables) is reported.
	Rack ID: This field identifies the local rack (1).
	Slot ID: This field shows the slot number in which the BMENOR2200H module is installed.
MANUFACTURING INFORMATION	View the serial number for the device.
HSBY	• Service Status: Defines whether or not the HSBY service is working properly. • Sync Status: Defines whether or not the HSBY status is syncing properly. • Parameter Validity: Defines whether or not any partner devices are valid in a HSBY system. • Sync Counter: Describes the numerical value of the sync counter. • Last Sync: Defines the last time the HSBY status was synced in date/time format. • Packet Statistics: Defines the status of each packet set: ◦ Inbound Packets ◦ Outbound Packets ◦ Inbound Packet Errors ◦ Outbound Packet Errors • Detected Errors: Describes any error codes that are detected in the HSBY system. • Local/Remote Module: Defines the status of these parameters for local and remote modules: ◦ Role: Primary or Standby ◦ IP Address ◦ Firmware Version

Event Buffer Status

View the module's event buffer status for the commissioning of communications:

Parameter	Description
EVENT BUFFER USAGE	This indicates the percentage of the event buffer that is consumed.
EVENT OVERFLOW	This field indicates that the capacity of the event buffer is exceeded or not.
EVENT RESOURCE USAGE	This indicates the percentage of event resources that are consumed.
EVENT BACKUP	**Enabled:** Events are backed up.
	Disabled: Events are **not** backed up.
CHANNEL/POINT EVENT STATUS	**No.:** This number is represents the sequence of device connections.
	Channel Name: This is the configured DNP3 channel name, page 76.
	Current Event Buffer Usage%: This indicates the percentage of the event buffer that is consumed.
	Current Event Quantity: This is the number of events in the buffer.
	Configured Event Quantity: This is the configured size of the event buffer.
	Current Overflow Event Quantity: This is the number of events that are not in the buffer owing to an overflow.
	Total Current Overflow: This is the total number of current overflow events for the module.
	NOTE: Click the plus (+) or minus (-) sign to expand or collapse any channel in the **Event Buffer Status** page to view status details from the perspective of the module.

Port Statistics

The **Port Statistics** page reports the statistics for the module's Ethernet backplane connection:

Parameter	Description
backplane port	• *green:* The port is active. • *gray:* The port is not active. • *yellow:* An error is detected on the port. • *red:* An error is detected on the port.
Speed	This field shows the configured port speed (0, 100, 1000 Mbps).
Duplex, **Half**	The current duplex mode is composed of some combination of these elements: • **TP**/**Fiber** • **-Full**/**-Half**/**-None** • **Link**/(no word) • **None** **NOTE:** When the thirteenth bit of the word in the Modbus response is 1, "**Link**" is added to the duplex mode string (**TP-Full Link**, **TP-Half Link**, etc.).
Success Rate	This field shows the percentage of successful requests out of the total number of requests.
Total Errors	This field shows the number of detected errors.
Toggle Detail View	Click this button to expand or compress the list of port statistics.

This table describes the port statistic parameters:

Parameter	Description
Frames Transmitted	This field shows the number of frames that are successfully transmitted from the port.
Frames Received	This field shows the number of frames that are successfully received from the port.

Parameter	Description
Excessive Collisions	This field shows the number of times that the transmission of an Ethernet frame on this port was not successful owing to excessive collisions (more than 16 attempts per packet).
Late Collisions	This field shows the number of times a collision is detected after the slot time of the channel elapses. **NOTE:** A value appears in this field only wen the hardware provides the information.
CRC Errors	This field shows the number of received frames for which the Cyclic Redundancy Check (CRC) is not valid. A detected CRC error is an RMON statistic that combines the values for **FCS Errors** and **Alignment Errors**.
Bytes Received	This field shows the number of octets that are received on the port.
Inbound Packet Errors	This field shows the number of packets that are received on the port for which errors are detected. **NOTE:** Does not include Out Discards.
Inbound Packets Discarded	The field shows the number of inbound packets that are received on the port but discarded.
Bytes Transmitted	This field shows the number of octets that are sent on the port.
Outbound Packet Errors	This field shows the number of packets that are sent on the port for which errors are detected. **NOTE:** Does not include Out Discards.
Outbound Packets Discarded	The field shows the number of outbound packets that are sent on the port but discarded.
Carrier Sense Errors	This field shows the number of times that the carrier sense condition was lost or was never asserted in an attempt to transmit a frame on this port.
FCS Errors	This field shows the number of frames that are received on this port that are an integral number of octets but do not pass the FCS check.
Alignment Errors	This field shows the number of frames that are received on this port that are not an integral number of octets long and do not pass the FCS check.
Internal MAC Trans. Errors	This field reports the number of frames that the port does not successfully transmit owing to a detected internal MAC sub-layer receive error.
Internal MAC Rec. Errors	This field reports the number of frames that the port does not successfully receive owing to a detected internal MAC sub-layer receive error.
SQE Test Errors	This field shows the number of times a SQE TEST ERROR is received on the port. **NOTE:** This counter does not increment on ports that operate at speeds greater than 10 Mb/s or on ports that operate in full-duplex mode

Connected Device Diagnostics

RTU Protocol

This table shows the RTU connection status for client devices and server RTUs:

Parameter	Description
Number of Connected / Connecting Devices	This value represents the number of connected devices.
Number of Disconnected Devices	This value represents the number of disconnected devices.
RTU CONNECTIONS - SERVERS / CLIENTS	**No.:** This number is represents the sequence of device connections.
	Channel Name: This is the configured DNP3 channel name, page 76.
	Protocol: This field shows the implemented connection protocol.
	State: This is the status of the connection (**Connected**, **Connecting**, **Disconnected**).
	Remote Address: This is the remote IP address.
	Remote Port: This is the remote TCP port.

Parameter	Description
	Local Port: This is the local TCP port.
	Secure Statistics: Click the link in this column to access detailed statistics, page 180 for the specific secure authentication version, page 50.
	Error Code: Click the error code, page 216 in this column to get information about a detected error.

Messaging

This table contains information about the exchange of data in terms of Modbus statistics:

Parameter	Description
MESSAGING STATISTICS	View the total number of sent and received messages on port 502: • **Msgs. Sent:** This field shows the number of messages sent from port 502. • **Msgs. Received:** This field shows the number of messages received by port 502. • **Success Rate:** This field shows the percentage of successful requests out of the total number of requests. **NOTE:** These values are not reset when the port 502 connection closes. The values, therefore, account for the number of messages since the last module restart.
ACTIVE CONNECTIONS	View the connections that are active when the **Messaging** page is refreshed: • **Remote Address:** This column shows the remote IP address. • **Local Port:** This column shows the local TCP port. • **Type:** This column shows the connection type. • **Sent:** This column shows the number of messages sent from this connection. • **Received:** This column shows the number of messages received by this connection. • **Errors:** This column shows the number of errors that are detected in association with this connection.

Service Diagnostics

SNTP

This table describes the SNTP parameters:

Parameter	Description
SERVICE STATUS	**Running:** The correctly configured service is running.
	Disabled: The service is disabled.
	Unknown: The status of the service is not known.
SERVER TYPE	**Primary:** A primary server polls a client time server for the current time.
	Secondary: A secondary server polls a client time server for the current time.
CURRENT DATE	**This field shows the current date in the selected time zone.**
SERVER STATUS	• *green:* The server is connected and running. • *red:* An error is detected. • *gray:* The server status is not known.
DST STATUS	**On:** DST (daylight saving time) is configured and running.
	Off: DST is disabled.
	Unknown: The DST status is not known.
CURRENT TIME	This field shows the time of day.
TIME ZONE	This field shows the time zone.

Clock

This table describes the clock parameters:

Parameter	Description
CURRENT DATE AND TIME	**Date** (module date)
	Time (module time)
TIME ZONE	(module time zone)
LATEST TIME SYNCHRONIZATION	**Date** (synchronization timestamp)
	Time (synchronization timestamp)
	Time Source (synchronization timestamp): • **CPU:** If the RTU protocol is configured, the RTU can get its initial time from the CPU when the RTU protocol starts or restarts. • **DNP3/IEC 60870–5–104:** This field shows the time source when a SCADA system or a client synchronizes its time with the RTU. • **SNTP:** If the SNTP client is enabled and connected to the SNTP server, its time source is from an SNTP server that synchronizes to the BMENOR2200H module's internal clock.

Device DDT Diagnostics

Introduction

This section describes Device DDT diagnostics for the BMENOR2200H module in a Hot Standby configuration.

Device DDT Diagnostics

Modbus Diagnostics

The following table displays the Device DDT diagnostics for a BMENOR2200H module (NOR_S2) communicating via the Modbus protocol.

Diagnostic Name	Value	Type	Comment
NOR_S2ETH_STATUS	0	WORD	Ethernet status
NOR_S2ETH_BKP_PORT_LINK	0	BOOL	Link up/down for Ethernet backplane port
NOR_S2SCANNER_OK	0	BOOL	Scanner OK and scanning at least one device (if at least one device configured)
NOR_S2GLOBAL _STATUS	0	BOOL	0: One or more services not operating normally / 1: all operational
NOR_S2NETWORK_HEALTH	0	BOOL	1: No traffic overload detected / 0: Traffic overload detected (ex: broadcast storm) Check your network topology and configuration.
NOR_S2IN_PACKETS	0	UINT	Number of packets received on interface
NOR_S2IN_ERRORS	0	UINT	number of inbound packets that contain errors
NOR_S2OUT_PACKETS	0	UINT	Number of packets sent on interface
NOR_S2OUT_ERRORS	0	UINT	Number of outbound packets that contain errors
NOR_S2SERVICE_STATUS	0	WORD	One bit for each user-observative feature
NOR_S2PORT502_SERVICE	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled

Diagnostic Name	Value	Type	Comment
NOR_S2SNMP_SERVICE	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2IP_ADDRESS_STATUS	0	BOOL	IP address status (0 in case of duplicate IP or no IP assigned)
NOR_S2SNTP_CLIENT	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2WEB_SERVER	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2FIRMWARE_UPGRADE	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2FTP_SERVER	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2TIME_VALID	0	BOOL	0: Time invalid / 1: Time valid
NOR_S2LLDP_SERVICE	0	BOOL	IP address A/B status (0 in case of duplicate IP or no IP assigned)
NOR_S2SYSLOG_STATUS	0	BOOL	0: Syslog service not operating normally / 1: Syslog service operating normally or disabled
NOR_S2SYSLOG_SERVER_NOT_REACHABLE	0	BOOL	1: No acknowledgement received from the syslog server / 0: otherwise
NOR_S2SMTP_SERVICE	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2DATALOGGING	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2RTU_DNP3	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2RTU_IEC60870	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2SD_STATUS	0	BYTE	0: SD card is missing and not usable / 1: SD card is normal
NOR_S2FIRMWARE_VERSION	0	WORD	[HEX] MSB: Major revision, LSB: Minor revision
NOR_S2PROTOCOL_STATUS	—	T_PROTOCOL_STATUS	General variable for RTU protocol status
NOR_S2PROTOCOL_STATUSEVENT_OVERFLOW__COUNT	0	UDINT	Number of total event overflows
NOR_S2PROTOCOL_STATUSEVENT_BUFFER_USAGE	0	BYTE	%Event buffer used in configured size
NOR_S2PROTOCOL_STATUSDNP3_CLIENT_CONNECTION_COUNT	0	BYTE	Number of total DNP3 client connections
NOR_S2PROTOCOL_STATUSSTATUSDNP3_SERVER_CONNECTION_COUNT	0	BYTE	Number of total DNP3 server connections
NOR_S2PROTOCOL_STATUSIEC60870_CLIENT_CONNECTION_COUNT	0	BYTE	Number of total IEC60870 client connections
NOR_S2PROTOCOL_STATUSIEC60870_SERVER_CONNECTION_COUNT	0	BYTE	Number of total IEC60870 server connections
NOR_S2PROTOCOL_STATUS_MODBUS_CLIENT_CONNECTION_COUNT	0	BYTE	Number of total Modbus client connections
NOR_S2PROTOCOL_STATUSMODBUS_SERVER_CONNECTION_COUNT	0	BYTE	Number of total Modbus server connections

Diagnostic Name	Value	Type	Comment
NOR_S2CS_STATUS	—	T_CS_STATUS	—
NOR_S2CS_STATUS_SECURE_MODE	0	BYTE	Coding wheel state, 0: Standard / 1: Secure
NOR_S2CS_STATUSCD_LED_STATUS	0	BYTE	Cybersecurity LED status
NOR_S2HTSB_DIAG	—	T_HTSB_DIAG	—

Hot Standby Diagnostics

The following table displays the Device DDT diagnostics for a BMENOR2200H module (NOR_S2) in a Hot Standby system:

Diagnostic	Value	Type	Comment
NOR_S2RTU_IEC60870	0	BOOL	0: Service not operating normally / 1: Service operating normally or disabled
NOR_S2SD_STATUS	0	BYTE	0: SD card is missing and not usable / 1: SD card is normal
NOR_S2FIRMWARE_VERSION	0	WORD	[HEX] MSB: Major revision, LSB: Minor revision
NOR_S2PROTOCOL_STATUS		T_PROTOCOL_STATUS	General variable for RTU protocol status
NOR_S2CS_STATUS		T_CS_STATUS	—
NOR_S2HTSB_DIAG		T_HTSB_DIAG	—
NOR_S2HTSB_DIAGSERVICE_STATE	0	BYTE	HTSB service state: 0: Fault / 1: Running
NOR_S2HTSB_DIAGSYNC_STATE	0	BYTE	HTSB sync status: 0: In progress / 1: OK
NOR_S2HTSB_DIAGINTERNAL_STATE	0	BYTE	Internal HTSB state: 0: Init / 1: Link establish / 2: Reserved / 3: Integrity / 4: Wait sync / 5: synced
NOR_S2HTSB_DIAGPARTNER_VALIDITY	0	BYTE	Partner validity: 0: Not reachable / 1: OK
NOR_S2HTSB_DIAGERROR_CODE1	0	WORD	Bit 0: Firmware mismatch / Bit 1: DTM config mismatch / Bit 2: Security mode mismatch / Bit 3: DTLS certification error / Bit 4: CS config mismatch (Reserved) / Bit 5–15: Reserved
NOR_S2HTSB_DIAGFW_VERSION_MISMATCH	0	BOOL	Application of the primary and standby are running with different firmware version
NOR_S2HTSB_DIAGDTM_CFG_MISMATCH	0	BOOL	Application of the primary and standby are running with different DTM configuration
NOR_S2HTSB_DIAGCERTIFICATION_ERROR	0	BOOL	DTLS certification error
NOR_S2HTSB_DIAGSYNC_COUNT	0	UDINT	HTSB
NOR_S2HTSB_DIAGDIN_PACKETS	0	UDINT	HTSB
NOR_S2HTSB_DIAGIN_ERRORS	0	UDINT	HTSB

Diagnostic	Value	Type	Comment
NOR_S2HTSB_DIAGOUT_PACKETS	0	UDINT	HTSB
NOR_S2HTSB_DIAGOUT_ERRORS	0	UDINT	HTSB

RTU Diagnostics

The following table displays the Device DDT diagnostics for a BMENOR2200H module (NOR_S2) communicating via the RTU protocol:

Diagnostic Name	Value	Type	Comment
RTU Protocol Diagnostics			
NOR_S2_CONN	—	T_NOR_S2_CONN	—
NOR_S2_CONNFreshness	0	BOOL	All Device DDT variables of the module are freshness
NOR_S2_CONNScan_State	0	BYTE	0: Idle / 1: Busy
NOR_S2_CONNHSBY_Event_Index	0	UDINT	Index number of current events generated in module
NOR_S2_CONNHSBY_EventSync_Index	0	UDINT	Index number of current events synchronized to standby module
Channel/Device Diagnostics			
NOR_S2_CONNclient_102_0	—	T_NOR_S2_C_0	—
NOR_S2_CONNclient_102_0Device_state	0	BYTE	0: Unconnected / 1: Connected
NOR_S2_CONNclient_102_0Error_code	0	WORD	0: Security not configured / 1: Variable initialized error 2: Internal error / 3: Authentication failed / 4: Unexpected response / 5: No response / 6: Aggressive mode not supported / 7: MAC algorithm
NOR_S2_CONNclient_102_0Security_not_configured	0	BOOL	Bit0: Security not configured
NOR_S2_CONNclient_102_0Variable_initialize_error	0	BOOL	Bit1: Variable initialized error
NOR_S2_CONNclient_102_0Internal_error	0	BOOL	Bit2: Internal error
NOR_S2_CONNclient_102_0Authentication_failed	0	BOOL	Bit3: Authentication failed
NOR_S2_CONNclient_102_0Unexpected_response	0	BOOL	Bit4: Unexpected response
NOR_S2_CONNclient_102_0No_response	0	BOOL	Bit5: No response
NOR_S2_CONNclient_102_0Aggressive_mode_not_supported	0	BOOL	Bit6: Aggressive mode not supported
NOR_S2_CONNclient_102_0MAC_algorithm_not_supported	0	BOOL	Bit7 :MAC algorithm not supported

Diagnostic Name		Value	Type	Comment
	NOR_S2_CONNclient_102_0Key_wrap_algorithm_not_supported	0	BOOL	Bit8 :Key wrap algorithm not supported
	NOR_S2_CONNclient_102_0authorization_failed	0	BOOL	Bit9 :Authorization failed
	NOR_S2_CONNclient_102_0Update_key_change_method_not_permitted	0	BOOL	Bit101 :Update key change method not permitted
	NOR_S2_CONNclient_102_0Invalid_signature	0	BOOL	Bit11 :Invalid signature
	NOR_S2_CONNclient_102_0Invalid_certification_data	0	BOOL	Bit12 :Invalid certification data
	NOR_S2_CONNclient_102_0Unknown_user	0	BOOL	Bit13 :Unknown user
	NOR_S2_CONNclient_102_0Max_session_key_status_requests_exceed	0	BOOL	Bit14 :Max session key status requests exceeded
	NOR_S2_CONNclient_102_0TLS_error	0	BOOL	Bit15: TLS error

Appendices

What's in This Part

Interoperability

What's in This Chapter

About this Chapter

This chapter describes the specific implementation of protocols with the advanced RTU module.

DNP3 Interoperability

Introduction

The purpose of this information is to describe the specific implementation of the Distributed Network Protocol (DNP3) within the BMENOR2200H module as client and server.

This information, in conjunction with the DNP3 Basic 4 Document Set and the DNP3 Subset Definitions Document, provides detailed information on how to communicate with the BMENOR2200H module as client via the DNP3 protocol.

This implementation of DNP3 is fully compliant with DNP3 Subset Definition Level 3.

DNP3 Device Profile - Client

This table provides a *Device Profile Document* in the standard format defined in the DNP3 Subset Definitions Document. While it is referred to in the DNP3 Subset Definitions as a *Document*, it is only a component of a total interoperability guide. This table uses a BMENOR2200H module as a client as an example. (Your module may be different.)

Parameter	**Capabilities**	**Value**
Device Identification		
Device Function	Client	Client
Vendor Name	–	Schneider Electric Industries SAS
Device Name	Device Name	BMENOR2200H
Device Manufacturer hardware version	Device Manufacturer hardware version	N/A
Device Manufacturer software version	Device Manufacturer software version	1,0 IR14
Device Profile Document Version Number	Device Profile Document Version Number	1
DNP3 Levels Supported	For both requests and responses: None, Levels 1...5	For requests: Level 3
		For responses: Level 3
Supported Function Blocks	Self Address Support	Secure Authentication
	Secure Authentication	
Notable Additions	Refer to Implementation Table	
Methods to set Configurable Parameters	Software	Software (EcoStruxure Control Expert)
	Proprietary file loaded via other transport mechanism	

Parameter	Capabilities	Value
DNP3 XML files available On-line	dnpDP.xml	–
	dnpDPC.xml	
	dnpDPCfg.xml	
External DNP3 XML files available Off-line	dnpDP.xml (read)	dnpDP.xml (read)
Connections Supported	IP Networking	IP Networking
Conformance Testing	N/A	–
Serial Connections		
Not Supported	–	–
IP Networking		
Port Name	–	Ethernet
Type of End Point	TCP Initiating	TCP Initiating
	TCP Datagram	
IP Address of this device	–	0.0.0.0
Subnet Mask	–	255.255.255.255
Gateway IP Address	–	0.0.0.0
Accepts TCP Connections or UDP Datagrams from	Limits based on IP address	IP address
IP Addresses from which TCP Connections or UDP Datagrams are accepted	–	192.168.0.1
TCP Listen Port Number	N/A	N/A
TCP Listen Port Number of remote device	Configurable range 1...65536	20000
TCP Keep-alive timer	Fixed at 75000 ms	75000 ms
Local UDP Port	Configurable range 1...65536	20000
Destination UDP Port for DNP3 Requests	Configurable range 1...65536	20000
Destination UDP Port for initial unsolicited null responses	None	None
Destination UDP Port for DNP3 Responses	Configurable range 1...65536	20000
Multiple server connections	Supports multiple servers	TRUE
Multiple client connections	Not supported	Not supported
Time synchronization support	DNP3 LAN procedure (function code 24)	LAN procedure
	DNP3 Write Time	
	Other	
Link Layer		
Data Link Address	Configurable range 0...65519	4
DNP3 Source Address Validation	Always, single address	Always, single address
DNP3 Source Addresses expected when Validation is Enabled	Configurable range 0...65519	3
Self Address Support using address 0xFFFC	Yes	No
	No	
Sends Confirmed User Data Frames	Never	Never
	Always	

Parameter	Capabilities	Value
	Sometimes	
Data Link Layer Confirmation Timeout	Configurable range 0...2147483647 ms	2000 ms
Maximum Data Link Retries	Configurable range 0...255	3
Maximum number of octets Transmitted in a Data Link Frame	Configurable range 24...292	292
Maximum number of octets that can be Received in a Data Link Frame	Configurable range 24...292	292
Application Layer		
Maximum number of octets Transmitted in an Application Layer Fragment other than File Transfer	Configurable range 0...2048	2048
Maximum number of octets Transmitted in an Application Layer Fragment containing File Transfer	Fixed at 0	0
Maximum number of octets that can be received in an Application Layer Fragment	Configurable range 0...2048	2048
Timeout waiting for Complete Application Layer Fragment	None	None
Maximum number of objects allowed in a single control request for CROB (Group 12)	Fixed at 10	10
Maximum number of objects allowed in a single control request for Analog Outputs (Group 31)	Configurable range 1...512	10
Maximum number of objects allowed in a single control request for Data Sets (Groups 85, 86, 87)	Configurable range 1...128	8
Supports mixed object groups (AOBs, CROBs and Data Sets) in the same control request	Yes	Yes
	No	
Control Status Codes Supported	4 NOT_SUPPORTED	–
	8 TOO_MANY_OBJS	–
Client-Only Properties		
Timeout waiting for Complete Application Layer Responses (ms)	–	–
Maximum Application Layer Retries for Request Messages	–	–
Timeout waiting for First or Next Fragment of an Application Layer Response	–	–
Issuing controls to Off-line devices	–	–
Issuing controls to off-scan devices	–	–
Maximum Application Layer Retries for Control Select Messages (same sequence number)	–	–
Maximum Application Layer Retries for Control Select Messages (new sequence number)	–	–
Security Parameters		
DNP3 device support for secure authentication	Version 2 (IEEE 1815-2010)	–
	Version 5 (IEEE 1815-2012)	

Parameter	Capabilities	Value
Maximum number of users	Configurable range 1...300	Maximum number of user supported: 0
Security message response timeout	Configurable range 1...640 ms	2 ms
Aggressive mode of operation (receive)	Yes No	Yes
Aggressive mode of operation (issuing)	Yes No	No
Session key change interval	Configurable range 60...604800 seconds (when enabled	Enabled at 900 seconds
Session key change message count	Configurable range 0...65535	1000
Maximum error count (SAv2 only)	Configurable range 0...255	2
MAC algorithm requested in a challenge exchange	SHA-1 (truncated to the leftmost 4 octets) SHA-1 (truncated to the leftmost 8 octets) SHA-1 (truncated to the leftmost 10 octets) SHA-256 (truncated to the leftmost 8 octets) SHA-256 (truncated to the leftmost 16 octets)	SHA-256 (16)
Key-wrap algorithm to encrypt session keys	AES-128 AES-256	AES-128
Cipher Suites used with DNP implementations using TLS	TLS is supported	
Change cipher request timeout	TLS is supported	
Number of Certificate Authorities supported	–	–
Certificate Revocation check time	TLS is supported	
Additional critical function codes	None	None
Other critical fragments	None	None
Support for remote update key changes	None	None
Default user credentials are permitted to expire	Yes No	No
Secure Authentication enabled	Configurable: On or Off	Off
Length of the challenge data	Configurable range 4...60 octets	4 octets
Maximum statistic counts (SAv5):		
Max Authentication Failures	Configurable range 4...60	4
Max Reply Timeouts	Configurable range 1...65535	3
Max Authentication Rekeys	Configurable range 1...65535	3
Max Error Messages Sent	Configurable range 1...65535	3
Broadcast Functionality		
Disabled Not configurable	–	–

DNP3 Device Profile - Server

This table provides a *Device Profile Document* in the standard format defined in the DNP3 Subset Definitions Document. While it is referred to in the DNP3 Subset Definitions as a *Document*, it is only a component of a total interoperability guide. This table uses a BMENOR2200H module as a client as an example. (Your module may be different.)

Parameter	Capabilities	Value
Device Identification		
Device Function	Server	Server
Vendor Name	–	Schneider Electric Industries SAS
Device Name	Device Name	BMENOR2200H
Device Manufacturer hardware version	Device Manufacturer hardware version	N/A
Device Manufacturer software version	Device Manufacturer software version	1,0 IR14
Device Profile Document Version Number	Device Profile Document Version Number	1
DNP3 Levels Supported	For both requests and responses: None, Levels 1...5	For requests: Level 3
		For responses: Level 3
Supported Function Blocks	Self Address Support	Secure Authentication
	Secure Authentication	
Notable Additions	Refer to Implementation Table	
Methods to set Configurable Parameters	Software	Software (EcoStruxure Control Expert)
	Proprietary file loaded via other transport mechanism	
DNP3 XML files available On-line	dnpDP.xml	–
	dnpDPC.xml	
	dnpDPCfg.xml	
External DNP3 XML files available Off-line	dnpDP.xml (read)	dnpDP.xml (read)
Connections Supported	IP Networking	IP Networking
Conformance Testing	Independently tested	Independently tested
Serial Connections		
Not Supported	–	–
IP Networking		
Port Name	–	Ethernet
Type of End Point	TCP Listening	TCP Listening
	TCP Datagram	
IP Address of this device	–	0.0.0.0
Subnet Mask	–	255.255.255.255
Gateway IP Address	–	0.0.0.0
Accepts TCP Connections or UDP Datagrams from	Allows All (*.*.*.*)	Allows All
	Limits based on IP address	
	Limits based on list of IP addresses	
IP Addresses from which TCP Connections or UDP Datagrams are accepted	–	*.*.*.*
TCP Listen Port Number	Configurable range 1...65536	20000
TCP Listen Port Number of remote device	N/A	N/A
TCP Keep-alive timer	Fixed at 75000 ms	75000 ms
Local UDP Port	Configurable range 1...65536	20000

Parameter	Capabilities	Value
Destination UDP Port for DNP3 Requests	Configurable range 1...65536	20000
Destination UDP Port for initial unsolicited null responses	None	None
Destination UDP Port for DNP3 Responses	Configurable range 1...65536	20000
Multiple server connections	N/A	N/A
Multiple client connections	Supports multiple clients	IP Address
	Method 1 (based on IP address)	
Time synchronization support	DNP3 LAN procedure (function code 24)	LAN procedure
	DNP3 Write Time	
	Other	
Link Layer		
Data Link Address	Configurable range 0...65519	4
DNP3 Source Address Validation	Never	Never
	Always, single address	
DNP3 Source Addresses expected when Validation is Enabled	Configurable range 0...65519	3
Self Address Support using address 0xFFFC	Yes	No
	No	
Sends Confirmed User Data Frames	Never	Never
	Always	
	Sometimes	
Data Link Layer Confirmation Timeout	Configurable range 0...4294977295 ms	2000 ms
Maximum Data Link Retries	Configurable range 0...255	3
Maximum number of octets Transmitted in a Data Link Frame	Configurable range 24...292	292
Maximum number of octets that can be Received in a Data Link Frame	Configurable range 24...292	292
Application Layer		
Maximum number of octets Transmitted in an Application Layer Fragment other than File Transfer	Configurable range 0...2048	2048
Maximum number of octets Transmitted in an Application Layer Fragment containing File Transfer	–	–
Maximum number of octets that can be received in an Application Layer Fragment	Configurable range 0...2048	2048
Timeout waiting for Complete Application Layer Fragment	Configurable range 0...2147483647	15000 ms
Maximum number of objects allowed in a single control request for CROB (Group 12)	Configurable range1...10	10
Maximum number of objects allowed in a single control request for Analog Outputs (Group 31)	Configurable range1...10	10
Maximum number of objects allowed in a single control request for Data Sets (Groups 85, 86, 87)	–	–
Supports mixed object groups (AOBs, CROBs and Data Sets) in the same control request	Yes	Yes
	No	
Control Status Codes Supported	1 TIMEOUT	–
	2 NO_SELECT	
	3 FORMAT_ERROR	

Parameter	Capabilities	Value
	4 NOT_SUPPORTED	
	5 ALREADY_ACTIVE	
	6 HARDWARE_ERROR	
	7 LOCAL	
	8 TOO_MANY_OBJS	
	9 NOT_AUTHORIZED	
	10 AUTOMATION_INHIBIT	
	11 PROCESSING_LIMITED	
	12 OUT_OF_RANGE	
	13 DOWNSTREAM_LOCAL	
	14 ALREADY_COMPLETE	
	15 BLOCKED	
	16 CANCELLED	
	17 BLOCKED_OTHER_CLIENT	
	18 DOWNSTREAM_FAIL	
	19 UNDEFINED	
Server Only Properties		
Timeout waiting for Application Confirm of solicited response message	Configurable, range 0...2147483647ms	10000 ms
How often is time synchronization required from the client	Never needs time	Periodically, fixed at 1800seconds
	Periodically, fixed at 1800seconds	
Device Trouble Bit IIN1.6	Never used	Never used
File Handle Timeout	Not applicable	Not applicable
Event Buffer Overflow Behavior	Discard the oldest event	Discard the newest event
	Discard the newest event	
Event Buffer Organization	Per object group	Per object group
Semds Multi-Fragment Responses	Yes	Yes
	No	
Last Fragment Confirmation	Sometimes	Sometimes
DNP Command Settings preserved through a device restart	–	–
Supports configuration signature	Not supported	Not supported
Requests application confirmation	For event responses: Yes	Yes
	For non-final fragments: Configurable (Yes/No)	Yes
Supports DNP3 Clock Management	–	–
Server Unsolicited Response Support Properties		
Supports unsolicited reporting	Comfigurable (On/Off)	On
Client Data Link Address	Comfigurable range 0...65519	3
Unsolicited Response Confirmation Timeout	Comfigurable range 0...2147483647	5000 ms
Number of Unsolicited Retries	Comfigurable range 0...65535	3
Server Unsolicited Response Trigger Conditions		
Number of class 1 events	Comfigurable range 1...512	5
Number of class 2 events	Comfigurable range 1...512	5

Parameter	Capabilities	Value
Number of class 3 events	Comfigurable range 1...512	5
Total nuber of events from any class	Total Number of Events not used to trigger Unsolicited Responses	–
Hold time after class 1 event	Configurable range 0...2147483647ms	5000 ms
Hold time after class 2 event	Configurable range 0...2147483647ms	5000 ms
Hold time after class 3 event	Configurable range 0...2147483647ms	5000 ms
Hold time after event assigned to any class	Fixed at 0 ms	0 ms
Retrigger Hold Time	Hold-time timer will not be retriggered for each new event detected (guaranteed update time)	Not retriggered
Other Unsolicited Response Trigger Conditions	–	–
Server Performance Properties		
Maximum Time Base Drift	–	–
When does server set IIN1.4	Never	Never
	Asserted at startup until first Time Synchronization request received	
	Range 1 to 2147483 seconds after last time sync	
Maximum Internal Time Reference Error when set via DNP	–	–
Maximum Delay Measurement Error	–	–
Maximum Response Time	–	–
Maximum time from start-up to IIN 1.4 assertion	–	–
Maximum Event Time-tag error for local Binary and Double Bit I/O	–	–
Maximum Event Time-tag error for local I/O other than Binary and Double Bit data types	–	–
Individual Field Server Parameters		
User-assigned location name or code string (same as g0v245)	–	–
User-assigned ID code/number string (same as g0v246)	–	–
User-assigned name string for the server (same as g0v247)	–	–
Device serial number string (same as g0v248)	–	–
Secondary operator name (same as g0v206)	–	–
Primary operator name (same as g0v207)	–	–
System name (same as g0v208)	–	–
Owner name (same as g0v244)	–	–
Security Parameters		
DNP3 device support for secure authentication	Version 2 (IEEE 1815-2010)	–
	Version 5 (IEEE 1815-2012)	
Maximum number of users	Configurable range 1...300	Maximum number of user supported: 0
Security message response timeout	Configurable range 1...640 ms	2 ms
Aggressive mode of operation (receive)	Yes	Yes
	No	
Aggressive mode of operation (issuing)	Yes	No
	No	

Parameter	**Capabilities**	**Value**
Session key change interval	Configurable range 60...604800 seconds (when enabled	Enabled at 900 seconds
Session key change message count	Configurable range 0...65535	1000
Maximum error count (SAv2 only)	Configurable range 0...255	2
MAC algorithm requested in a challenge exchange	SHA-1 (truncated to the leftmost 4 octets)	SHA-256 (16)
	SHA-1 (truncated to the leftmost 8 octets)	
	SHA-1 (truncated to the leftmost 10 octets)	
	SHA-256 (truncated to the leftmost 8 octets)	
	SHA-256 (truncated to the leftmost 16 octets)	
Key-wrap algorithm to encrypt session keys	AES-128	AES-128
	AES-256	
Cipher Suites used with DNP implementations using TLS	TLS is supported	
Change cipher request timeout	TLS is supported	
Number of Certificate Authorities supported	–	–
Certificate Revocation check time	TLS is not supported	
Additional critical function codes	None	None
Other critical fragments	None	None
Support for remote update key changes	None	None
Default user credentials are permitted to expire	Yes	No
	No	
Secure Authentication enabled	Configurable: On or Off	Off
Length of the challenge data	Configurable range 4...60 octets	4 octets
Maximum statistic counts (SAv5):		
Max Authentication Failures	Configurable range 4...60	4
Max Reply Timeouts	Configurable range 1...65535	3
Max Authentication Rekeys	Configurable range 1...65535	3
Max Error Messages Sent	Configurable range 1...65535	3
Broadcast Functionality		
Disabled Not configurable	–	–

DNP3 Implementation Table

The following table identifies the object groups, variations, function codes, and qualifiers that the BMENOR2200H module supports in both requests and responses. The *Request* columns identify all requests that may be sent by a client or all requests that are parsed by a server. The *Response* columns identify all responses that are parsed by a client or all responses that may be sent by a server

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
1	0	Binary Input - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
1	0	Binary Input - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
1	1	Binary Input - Single-bit packed	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
1	2	Binary Input - Single-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
2	0	Binary Input Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
2	1	Binary Input Change Event - without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
2	1	Binary Input Change Event - without time			(Unsol. Resp.)	17, 28 (index)
2	2	Binary Input Change Event - with absolute time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
2	2	Binary Input Change Event - with absolute time			(Unsol. Resp.)	17, 28 (index)
2	3	Binary Input Change Event - with relative time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
2	3	Binary Input Change Event - with relative time			(Unsol. Resp.)	17, 28 (index)
3	0	Double-bit Input - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
3	0	Double-bit Input - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
3	1	Double-bit Input - Double-bit packed	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
3	2	Double-bit Input - with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
4	0	Double-bit Input Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
4	1	Double-bit Input Change Event - without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
4	1	Double-bit Input Change Event - without time			(Unsol. Resp.)	17, 28 (index)
4	2	Double-bit Input Change Event - with absolute time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
4	2	Double-bit Input Change Event - with absolute time			(Unsol. Resp.)	17, 28 (index)
4	3	Double-bit Input Change Event - with relative time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
4	3	Double-bit Input Change Event - with relative time			(Unsol. Resp.)	17, 28 (index)
10	0	Binary Output - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 28 (index)		
10	0	Binary Output - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
10	1	Binary Output - packed format	1(read)	00, 01 (start-stop),	(Response)	00, 01 (start-stop),

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
				06 (no range, or all), 07, 08 (limited qty), 17, 28 (index)		17, 28 (index)
10	1	Binary Output - packed format	2(write)	00, 01 (start-stop)		
10	2	Continuous Control - output status with flags	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
11	0	Binary Output Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
11	1	Binary Output Change Event - status without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
11	1	Binary Output Change Event - status without time			(Unsol. Resp.)	17, 28 (index)
11	2	Binary Output Change Event - status with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
11	2	Binary Output Change Event - status with time			(Unsol. Resp.)	17, 28 (index)
12	0	Binary Output Command (CROB) - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
12	1	Binary Output Command (CROB) - control relay output block	3(select)	17, 27, 28 (index)	(Response)	echo of request
12	1	Binary Output Command (CROB) - control relay output block	4(operate)	17, 27, 28 (index)	(Response)	echo of request
12	1	Binary Output Command (CROB) - control relay output block	5(direct op.)	17, 27, 28 (index)	(Response)	echo of request
12	1	Binary Output Command (CROB) - control relay output block	6(direct op, no ack)	17, 27, 28 (index)	(Response)	echo of request
12	2	Binary Output Command - pattern control block	3(select)	07 (limited qty = 1)	(Response)	echo of request
12	2	Binary Output Command - pattern control block	4(operate)	07 (limited qty = 1)	(Response)	echo of request

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
12	2	Binary Output Command - pattern control block	5(direct op.)	07 (limited qty = 1)	(Response)	echo of request
12	2	Binary Output Command - pattern control block	6(direct op, no ack)	07 (limited qty = 1)	(Response)	echo of request
12	3	Binary Output Command - pattern mask	3(select)	00, 01 (start-stop)	(Response)	echo of request
12	3	Binary Output Command - pattern mask	4(operate)	00, 01 (start-stop)	(Response)	echo of request
12	3	Binary Output Command - pattern mask	5(direct op.)	00, 01 (start-stop)	(Response)	echo of request
12	3	Binary Output Command - pattern mask	6(direct op, no ack)	00, 01 (start-stop)	(Response)	echo of request
20	0	Counter - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
20	0	Counter - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
20	0	Counter - any variation	7(freeze)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty)		
20	0	Counter - any variation	8(freeze, no ack)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty)		
20	0	Counter - any variation	9(freeze & clear)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty)		
20	0	Counter - any variation	10(frz & clr, no ack)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty)		
20	1	Counter - 32-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
20	2	Counter - 16-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
20	5	Counter - 32-bit without flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
20	6	Counter - 16-bit without flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
21	0	Frozen Counter - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
21	0	Frozen Counter - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
21	1	Frozen Counter - 32-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
21	2	Frozen Counter - 16-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
21	5	Frozen Counter - 32-bit with flag and time	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27,	(Response)	00, 01 (start-stop), 17, 28 (index)

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
				28 (index)		
21	6	Frozen Counter - 16-bit with flag and time	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
21	9	Frozen Counter - 32-bit without flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
21	10	Frozen Counter - 16-bit without flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
22	0	Counter Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
22	1	Counter Change Event - 32-bit with flag	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
22	1	Counter Change Event - 32-bit with flag			(Unsol. Resp.)	17, 28 (index)
22	2	Counter Change Event - 16-bit with flag	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
22	2	Counter Change Event - 16-bit with flag			(Unsol. Resp.)	17, 28 (index)
22	5	Counter Change Event - 32-bit with flag and time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
22	5	Counter Change Event - 32-bit with flag and time			(Unsol. Resp.)	17, 28 (index)
22	6	Counter Change Event - 16-bit with flag and time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
22	6	Counter Change Event - 16-bit with flag and time			(Unsol. Resp.)	17, 28 (index)
23	0	Frozen Counter Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
23	1	Frozen Counter Change Event - 32-bit with flag	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
23	1	Frozen Counter Change Event - 32-bit with flag			(Unsol. Resp.)	17, 28 (index)
23	2	Frozen Counter Change Event - 16-bit with flag	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
23	2	Frozen Counter Change Event - 16-bit with flag			(Unsol. Resp.)	17, 28 (index)
23	5	Frozen Counter Change Event - 32-bit with flag and time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
23	5	Frozen Counter Change Event - 32-bit with flag and time			(Unsol. Resp.)	17, 28 (index)
23	6	Frozen Counter Change Event - 16-bit with flag and time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
23	6	Frozen Counter Change Event - 16-bit with flag and time			(Unsol. Resp.)	17, 28 (index)
30	0	Analog Input - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all)		
30	0	Analog Input - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
30	1	Analog Input - 32-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
30	2	Analog Input - 16-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
30	3	Analog Input - 32-bit without flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
30	4	Analog Input - 16-bit without flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty),	(Response)	00, 01 (start-stop), 17, 28 (index)

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
				17, 27, 28 (index)		
30	5	Analog Input - single-precision, floating-point with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
32	0	Analog Input Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
32	1	Analog Input Change Event - 32-bit without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
32	1	Analog Input Event 32-bit without time			(Unsol. Resp.)	17, 28 (index)
32	2	Analog Input Change Event - 16-bit without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
32	2	Analog Input Change Event - 16-bit without time			(Unsol. Resp.)	17, 28 (index)
32	3	Analog Input Change Event - 32-bit with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
32	3	Analog Input Change Event - 32-bit with time			(Unsol. Resp.)	17, 28 (index)
32	4	Analog Input Change Event - 16-bit with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
32	4	Analog Input Change Event - 16-bit with time			(Unsol. Resp.)	17, 28 (index)
32	5	Analog Input Change Event - single-precision, floating-point without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
32	5	Analog Input Change Event - single-precision, floating-point without time			(Unsol. Resp.)	17, 28 (index)
32	7	Analog Input Change Event - single-precision, floating-point with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
32	7	Analog Input Change Event - single-precision, floating-point with time			(Unsol. Resp.)	17, 28 (index)
34	0	Analog Input Deadband - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27,		

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
				28 (index)		
34	1	Analog Input Deadband - 16-bit	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
34	1	Analog Input Deadband - 16-bit	2(write)	00, 01 (start-stop), 07, 08 (limited qty), 17, 27, 28 (index)		
34	2	Analog Input Deadband - 32-bit	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
34	2	Analog Input Deadband - 32-bit	2(write)	00, 01 (start-stop), 07, 08 (limited qty), 17, 27, 28 (index)		
34	3	Analog Input Deadband - single-precision, floating-point	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
34	3	Analog Input Deadband - single-precision, floating-point	2(write)	00, 01 (start-stop), 07, 08 (limited qty), 17, 27, 28 (index)		
40	0	Analog Output Status - any variation	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
40	0	Analog Output Status - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
40	1	Analog Output Status - 32-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
40	2	Analog Output Status - 16-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
40	3	Analog Output Status - single-precision, floating-point with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
41	0	Analog Output Block - any variation	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 27, 28 (index)		
41	1	Analog Output Block - 32-bit	3(select)	17, 27, 28 (index)	(Response)	echo of request
41	1	Analog Output Block - 32-bit	4(operate)	17, 27, 28 (index)	(Response)	echo of request
41	1	Analog Output Block - 32-bit	5(direct op.)	17, 27, 28 (index)	(Response)	echo of request
41	1	Analog Output Block - 32-bit	6(direct op, no ack)	17, 27, 28 (index)	(Response)	echo of request
41	2	Analog Output Block - 16-bit	3(select)	17, 27, 28 (index)	(Response)	echo of request
41	2	Analog Output Block - 16-bit	4(operate)	17, 27, 28 (index)	(Response)	echo of request
41	2	Analog Output Block - 16-bit	5(direct op.)	17, 27, 28 (index)	(Response)	echo of request
41	2	Analog Output Block - 16-bit	6(direct op, no ack)	17, 27, 28 (index)	(Response)	echo of request
41	3	Analog Output Block - single-precision, floating-point	3(select)	17, 27, 28 (index)	(Response)	echo of request

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
41	3	Analog Output Block - single-precision, floating-point	4(operate)	17, 27, 28 (index)	(Response)	echo of request
41	3	Analog Output Block - single-precision, floating-point	5(direct op.)	17, 27, 28 (index)	(Response)	echo of request
41	3	Analog Output Block - single-precision, floating-point	6(direct op, no ack)	17, 27, 28 (index)	(Response)	echo of request
42	0	Analog Output Change Event - any variation	1(read)	06 (no range, or all), 07, 08 (limited qty)		
42	1	Analog Output Change Event - 32-bit without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
42	1	Analog Output Change Event - 32-bit without time			(Unsol. Resp.)	17, 28 (index)
42	2	Analog Output Change Event - 16-bit without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
42	2	Analog Output Change Event - 16-bit without time			(Unsol. Resp.)	17, 28 (index)
42	3	Analog Output Change Event - 32-bit with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
42	3	Analog Output Change Event - 32-bit with time			(Unsol. Resp.)	17, 28 (index)
42	4	Analog Output Change Event - 16-bit with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
42	4	Analog Output Change Event - 16-bit with time			(Unsol. Resp.)	17, 28 (index)
42	5	Analog Output Change Event - single-precision, floating-point without time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
42	5	Analog Output Change Event - single-precision, floating-point without time			(Unsol. Resp.)	17, 28 (index)
42	7	Analog Output Change Event - single-precision, floating-point with time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
42	7	Analog Output Change Event - single-precision, floating-point with time			(Unsol. Resp.)	17, 28 (index)
50	1	Time and Date - absolute time	1(read)	07 (limited qty = 1)	(Response)	07 (limited qty = 1)
50	1	Time and Date - absolute time	2(write)	07 (limited qty = 1)		

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
50	3	Time and Date - absolute time at last recorded time	2(write)	07 (limited qty = 1)		
51	1	Time and Date CTO - absolute time, synchronized			(Response)	07 (limited qty = 1)
51	1	Time and Date CTO - absolute time, synchronized			(Unsol. Resp.)	07 (limited qty = 1)
51	2	Time and Date CTO - absolute time, un-synchronized			(Response)	07 (limited qty = 1)
51	2	Time and Date CTO - absolute time, un-synchronized			(Unsol. Resp.)	07 (limited qty = 1)
52	1	Time Delay - coarse			(Response)	07 (limited qty = 1)
52	2	Time Delay - fine			(Response)	07 (limited qty = 1)
60	1	Class Objects - class 0 data	1(read)	06 (no range, or all)		
60	1	Class Objects - class 0 data	22(assign class)	06 (no range, or all)		
60	2	Class Objects - class 1 data	1(read)	06 (no range, or all), 07, 08 (limited qty)		
60	2	Class Objects - class 1 data	20(enable unsol.)	06 (no range, or all)		
60	2	Class Objects - class 1 data	21(disable unsol.)	06 (no range, or all)		
60	2	Class Objects - class 1 data	22(assign class)	06 (no range, or all)		
60	3	Class Objects - class 2 data	1(read)	06 (no range, or all), 07, 08 (limited qty)		
60	3	Class Objects - class 2 data	20(enable unsol.)	06 (no range, or all)		
60	3	Class Objects - class 2 data	21(disable unsol.)	06 (no range, or all)		
60	3	Class Objects - class 2 data	22(assign class)	06 (no range, or all)		
60	4	Class Objects - class 3 data	1(read)	06 (no range, or all), 07, 08 (limited qty)		
60	4	Class Objects - class 3 data	20(enable unsol.)	06 (no range, or all)		
60	4	Class Objects - class 3 data	21(disable unsol.)	06 (no range, or all)		
60	4	Class Objects - class 3 data	22(assign class)	06 (no range, or all)		
80	1	Internal Indications - packed format	1(read)	00, 01 (start-stop)	(Response)	00, 01 (start-stop)
80	1	Internal Indications - packed format	2(write)			

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
91	1	Status of Requested Operation			(Response)	07 (limited qty = 1)
91	1	Status of Requested Operation			(Response)	5B
110	string length	Octet String	1(read)	00, 01 (start-stop), 06 (no range, or all), 07, 08 (limited qty), 17, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
110	string length	Octet String	2(write)	00, 01 (start-stop), 07, 08 (limited qty), 17, 28 (index)		
110	string length	Octet String	31(activate config)	5B		
120	0	Authentication - Assign Class	22(assign class)	06 (no range, or all)		
120	1	Authentication - Challenge	32(auth req)	5B	(Auth. Resp.)	5B
120	2	Authentication - Reply	32(auth req)	5B	(Auth. Resp.)	5B
120	3	Authentication - Aggressive Mode	any of 1 to 31	07 (limited qty = 1)	(Response)	07 (limited qty = 1)
120	3	Authentication - Aggressive Mode			(Unsol. Resp.)	07 (limited qty = 1)
120	4	Authentication - Session Key Status Request	32(auth req)	07 (limited qty = 1)		
120	5	Authentication - Session Key Status			(Auth. Resp.)	5B
120	6	Authentication - Session Key Change	32(auth req)	5B		
120	7	Authentication - Error	33(auth req, no ack)	5B	(Auth. Resp.)	5B
120	8	Authentication - User Certificate	32(auth req)	5B		
120	9	Authentication - MAC	any of 1 to 31	5B	(Response)	5B
120	9	Authentication - MAC			(Unsol. Resp.)	5B
120	10	Authentication - User Status Change	32(auth req)	5B		
120	11	Authentication - Update Key Change Request	32(auth req)	5B		
120	12	Authentication - Update Key Change Reply			(Auth. Resp.)	5B
120	13	Authentication - Update Key Change	32(auth req)	5B		
120	14	Authentication - Update Key Change Signature	32(auth req)	5B		

DNP OBJECT GROUP & VARIATION			REQUEST Client may issue Server parses		RESPONSE Client parses Server may issue	
Object Group Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
120	15	Authentication - Update Key Change Confirmation	32(auth req)	5B	(Auth. Resp.)	5B
121	0	Security Statistic	1(read)	00, 01 (start-stop), 06 (no range, or all), 17, 28 (index)		
121	0	Security Statistic - Assign Class	22(assign class)	00, 01 (start-stop), 06 (no range, or all), 17, 28 (index)		
121	1	Security Statistic	1(read)	00, 01 (start-stop), 06 (no range, or all), 17, 28 (index)	(Response)	00, 01 (start-stop), 17, 28 (index)
122	0	Security Statistic Event - 32-bit with flag	1(read)	00, 01 (start-stop), 06 (no range, or all), 17, 28 (index)		
122	1	Security Statistic Event - 32-bit with flag	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
122	1	Security Statistic Event - 32-bit with flag and time			(Unsol. Resp.)	17, 28 (index)
122	2	Security Statistic Event - 32-bit with flag and time	1(read)	06 (no range, or all), 07, 08 (limited qty)	(Response)	17, 28 (index)
122	2	Security Statistic Event - 32-bit with flag and time			(Unsol. Resp.)	17, 28 (index)

IEC 60870-5-104 Interoperability

Introduction

This companion standard presents sets of parameters and alternatives from which you select subsets to implement particular telecontrol systems. Certain parameter values, such as the choice of structured or unstructured fields of the INFORMATION OBJECT ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers, it is necessary that all partners agree on the selected parameters.

The interoperability list is defined as in IEC 60870-5-101 and extended with parameters used in this standard.

The selected parameters are marked as follows:

-	Function or ASDU is not used
X	Function or ASDU is used

System or Device

-	System definition
-	Controlling station definition (client)
X	Controlled station definition (server)

IEC 60870-5-104 Device Profile – Client

Application Layer

Transmission mode for application data			
Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.			
Common address of ASDU			
X	Two octets		
Information object address			
X	Three octets	-	Structured
		-	Unstructured
Cause of transmission			
X	Two octets (with originator address). Originator address is set to zero if not used.		
Length of APDU			
The maximum length of APDU for both directions is 253. It is a fixed system parameter.			

Process information in monitor direction			
X	<1>	Single-point information	M_SP_NA_1
X	<3>	Double-point information	M_DP_NA_1
X	<5>	Step position information	M_ST_NA_1
X	<7>	Bit string of 32 bit	M_BO_NA_1
X	<9>	Measured value, normalized value	M_ME_NA_1
X	<11>	Measured value, scaled value	M_ME_NB_1
X	<13>	Measured value, short floating point value	M_ME_NC_I
X	<15>	Integrated totals	M_IT_NA_1
-	<20>	Packed single-point information with status change detection	M_PS_NA_1
-	<21>	Measured value, normalized value without quality descriptor	M_ME_ND_1
X	<30>	Single-point information with time tag CP56Time2a	M_SP_TB_1
X	<31>	Double-point information with time tag CP56Time2a	M_DP_TB_1
X	<32>	Step position information with time tag CP56Time2a	M_ST_TB_1
X	<33>	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
X	<34>	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
X	<35>	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
X	<36>	Measured value, short floating point value with time tag CP56Time2A	M_ME_TF_1
X	<37>	Integrated totals with time tag CP56Time2a	M_IT_TB_1
-	<38>	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1

Process information in monitor direction			
-	<39>	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
-	<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

Process information in control direction			
X	<45>	Single command	C_SC_NA_1
X	<46>	Double command	C_DC_NA_1
X	<47>	Regulating step command	C_RC_NA_1
X	<48>	Set point command, normalized value	C_SE_NA_1
X	<49>	Set point command, scaled value	C_SE_NB_1
X	<50>	Set point command, short floating point value	C_SE_NC_1
X	<51>	Bitstring of 32-bit	C_BO_NA_1
X	<58>	Single command with time tag CP56Time2a	C_SC_TA_1
X	<59>	Double command with time tag CP56Time2a	C_DC_TA_1
X	<60>	Regulating step command with time tag CP56Time2a	C_RC_TA_1
X	<61>	Setpoint command, normalized value with time tag CP56Time2a	C_SE_TA_1
X	<62>	Setpoint command, scaled value with time tag CP56Time2a	C_SE_TB_1
X	<63>	Setpoint command, short floating point value with time tag CP56Time2a	C_SE_TC_1
X	<64>	Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1

System information in monitor direction			
X	<70>	End of initialization	M_EI_NA_1

System information in control direction			
X	<100>	Interrogation command	C_IC_NA_1
X	<101>	Counter interrogation command	C_CI_NA_1
X	<102>	Read command	C_RD_NA_1
X	<103>	Clock synchronization command	C_CS_NA_1
X	<105>	Reset process command	C_RP_NA_1
X	<107>	Test command with time tag CP56Time2a	C_TS_TA_1

Parameter in control direction			
X	<110>	Parameter of measured value, normalized value	P_ME_NA_1
X	<111>	Parameter of measured value, scaled value	P_ME_NB_1
X	<112>	Parameter of measured value, short floating point value	P_ME_NC_1
X	<113>	Parameter activation	PC_AC_NA_1

File transfer			
-	<120>	File ready	F_FR_NA_1
-	<121>	Section ready	F_SR_NA_1

File transfer			
-	<122>	Call directory, select file, call file, call section	F_SC_NA_1
-	<123>	Last section, last segment	F_LS_NA_1
-	<124>	Ack file, ack section	F_AF_NA_1
-	<125>	Segment	F_SG_NA_1
-	<126>	Directory	F_DR_TA_1
-	<127>	Query log - Request archive file	F_SC_NB_1

Type identification		Cause of transmission																		
		Periodic, cyclic	Background scan	Spontaneous	Initialized	Request or requested	Activation	Activation confirmation	Deactivation	Deactivation confirmation	Activation termination	Return info caused by a remote cmd	Return info caused by a local cmd	File transfer	Interrogated by group <number>	Request by group <n> counter request	unknown type identification	Unknown cause of transmission	Unknown common address of ASDU	Unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20...36	37...41	44	45	46	47
<1>	M_SP_NA_1		X	X		X						X	X		X					
<3>	M_DP_NA_1		X	X		X						X	X		X					
<5>	M_ST_NA_1		X	X		X						X	X		X					
<7>	M_BO_NA_1		X	X		X									X					
<9>	M_ME_NA_1	X	X	X		X									X					
<11>	M_ME_NB_1	X	X	X		X									X					
<13>	M_ME_NC_1	X	X	X		X									X					
<15>	M_IT_NA_1			X												X				
<30>	M_SP_TB_1			X		X						X	X							
<31>	M_DP_TB_1			X		X						X	X							
<32>	M_ST_TB_1			X		X						X	X							
<33>	M_BO_TB_1			X		X														
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														

Type identification		Cause of transmission																		
		Periodic, cyclic	Background scan	Spontaneous	Initialized	Request or requested	Activation	Activation confirmation	Deactivation	Deactivation confirmation	Activation termination	Return info caused by a remote cmd	Return info caused by a local cmd	File transfer	Interrogated by group <number>	Request by group <n> counter request	unknown type identification	Unknown cause of transmission	Unknown common address of ASDU	Unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20...36	37...41	44	45	46	47
<36>	M_ME_TF_1			X		X														
<37>	M_IT_TB_1			X																
<45>	C_SC_NA_1						X	X	X	X	X						X	X	X	X
<46>	C_DC_NA_1						X	X	X	X	X						X	X	X	X
<47>	C_RC_NA_1						X	X	X	X	X						X	X	X	X
<48>	C_SE_NA_1						X	X	X	X	X						X	X	X	X
<49>	C_SE_NB_1						X	X	X	X	X						X	X	X	X
<50>	C_SE_NC_1						X	X	X	X	X						X	X	X	X
<51>	C_BO_NA_1						X	X			X						X	X	X	X
<58>	C_SC_TA_1						X	X	X	X	X						X	X	X	X
<59>	C_DC_TA_1						X	X	X	X	X						X	X	X	X
<60>	C_RC_TA_1						X	X	X	X	X						X	X	X	X
<61>	C_SE_TA_1						X	X	X	X	X						X	X	X	X
<62>	C_SE_TB_1						X	X	X	X	X						X	X	X	X
<63>	C_SE_TC_1						X	X	X	X	X						X	X	X	X
<64>	C_BO_TA_1						X	X			X						X	X	X	X
<70>	M_EI_NA_1				X															
<100>	C_IC_NA_1						X	X	X	X	X						X	X	X	X
<101>	C_CI_NA_1						X	X			X						X	X	X	X
<102>	C_RD_NA_1					X											X	X	X	X
<103>	C_CS_NA_1						X	X									X	X	X	X

Type identification		Cause of transmission																		
		Periodic, cyclic	Background scan	Spontaneous	Initialized	Request or requested	Activation	Activation confirmation	Deactivation	Deactivation confirmation	Activation termination	Return info caused by a remote cmd	Return info caused by a local cmd	File transfer	Interrogated by group <number>	Request by group <n> counter request	unknown type identification	Unknown cause of transmission	Unknown common address of ASDU	Unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20...36	37...41	44	45	46	47
<105>	C_RP_NA_1						X	X									X	X	X	X
<110>	P_ME_NA_1						X	X							X		X	X	X	X
<111>	P_ME_NB_1						X	X							X		X	X	X	X
<112>	P_ME_NC_1						X	X							X		X	X	X	X
<113>	P_AC_NA_1						X	X	X	X							X	X	X	X

Basic Application Functions

Station initialization					
X	Remote initialization				
Cyclic data transmission					
X	Cyclic data transmission				
Read procedure					
X	Read procedure				
Spontaneous transmission					
X	Spontaneous transmission				
Double transmission of information objects with cause of transmission, spontaneous supports these types					
-	Single-point information				
-	Double-point information				
-	Step position information				
-	Bitstring of 32 bit				
-	Measure value, normalized value				
-	Measure value, scaled value				
-	Measure value, short floating point number				
Station interrogation					
X	Global				
X	Group 1	X	Group 7	X	Group 13
X	Group 2	X	Group 8	X	Group 14
X	Group 3	X	Group 9	X	Group 15
X	Group 4	X	Group 10	X	Group 16

X	Group 5	X	Group 11	
X	Group 6	X	Group 12	
Clock synchronization				
X	Clock synchronization			
X	Day of week used			
X	RES1, GEN (time tag substituted/ not substituted) used			
X	SU-bit (summertime) used			
Command transmission				
X	Direct command transmission	X	Select and execute command	
X	Direct set point command transmission	X	Select and execute set point command	
		X	C-SE-ACTTERM used	
X	No additional definition			
X	Short pulse duration (duration determined by a system parameter in the server)			
X	Long pulse duration (duration determined by a system parameter in the server)			
X	Persistent output			
-	Supervision of maximum delay in command direction of commands and set point commands			
Configurable	Maximum allowable delay of commands and set point commands			
Transmission of integrated totals				
X	Mode A: Local freeze with spontaneous transmission			
X	Mode B: Local freeze with counter interrogation			
X	Mode C: Freeze and transmit by counter-interrogation commands			
-	Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously			
X	Counter read			
X	Counter freeze without reset			
X	Counter freeze with reset			
X	Counter reset			
X	General request counter			
X	Request counter group 1...4			
Parameter loading				
X	Threshold value			
-	Smoothing factor			
X	Low limit for transmission of measured values			
X	High limit for transmission of measured values			
Parameter activation				
X	Activation/deactivation of persistent cyclic or periodic transmission of the addressed object			
Test procedure				
X	Test procedure			
File transfer				
File transfer in monitor direction				
-	Transparent file			
-	Transmission of disturbance data of protection equipment			

-	Transmission of sequences of events		
-	Transmission of sequences of recorded analog values		
File transfer in control direction			
-	Transparent file		
Background scan			
X	Background scan		
Definition of timeouts			
Parameters	**Default Value**	**Remarks**	**Selected Value**
t_0	30s	Timeout of connection establishment	Configurable
t_1	15s	Timeout of send or test APDUs	Configurable
t_2	10s	Timeout for acknowledges in case of no data messages $t_2 < t_1$	Configurable
t_3	20s	Timeout for sending test frames in case of a long idle state	Configurable
Maximum range for timeouts: t_0 to t_2 1...255s, accuracy: 1s Recommended range for timeout t_3: 1s to 48h, resolution: 1s Long timeouts for t_3 may be necessary in cases where satellite links or dial-up connections are used (for instance, to establish connection and collect values only once per day/week).			
Maximum number of outstanding I format APDUs *(k)* and latest acknowledge APDUs *(w)*			
Parameters	**Default Value**	**Remarks**	**Selected Value**
k	12 APDUs	Maximum difference receive sequence number to send state variable	Configurable
w	8 APDUs	Latest acknowledge after receiving w I-format APDUs	Configurable
Maximum range of values *k*: 1...12 (12) APDUs, accuracy: 1 APDU			
Maximum range of values *w*: 1...32767 APDUs, accuracy: 1 APDU Recommendation: *w* should not exceed two-thirds of *k*			
Port number			
Parameter	**Default Value**	**Remarks**	
Port number	2404	Configurable	
Redundant connections			
Configurable	Number N of redundancy group connections used		
RFC 2200 suite			
RFC 2200 is an official Internet Standard which describes the state of standardization of protocols used in the Internet as determined by the Internet Architecture Board (IAB). It offers a broad spectrum of actual standards used in the Internet. The suitable selection of documents from RFC 2200 defined in this standard for given projects has to be chosen by the user of this standard.			
X	Ethernet 802.3		
-	Serial X.21 interface		
-	Other selection from RFC 2200		

IEC 60870-5-104 Device Profile – Server

Transmission mode for application data
Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard

Common address of ASDU			
X	Two octets		
Information object address			
X	Three octets	X	Structured
		X	Unstructured
Cause of transmission			
X	Two octets (with originator address). Set to zero in case of no originator address		

Process information in monitor direction			
X	<1>	Single-point information	`M_SP_NA_1`
X	<3>	Double-point information	`M_DP_NA_1`
X	<5>	Step position information	`M_ST_NA_1`
X	<7>	Bitstring of 32 bit	`M_BO_NA_1`
X	<9>	Measured value, normalized value	`M_ME_NA_1`
X	<11>	Measured value, scaled value	`M_ME_NB_1`
X	<13>	Measured value, short floating point value	`M_ME_NC_1`
X	<15>	Integrated totals	`M_IT_NA_1`
-	<20>	Packed single-point information with status change detection	`M_SP_NA_1`
-	<21>	Measured value, normalized value without quality descriptor	`M_ME_ND_1`
X	<30>	Single-point information with time tag CP56Time2a	`M_SP_TB_1`
X	<31>	Double-point information with time tag CP56Time2a	`M_DP_TB_1`
X	<32>	Step position information with time tag CP56Time2a	`M_ST_TB_1`
X	<33>	Bitstring of 32 bit with time tag CP56Time2a	`M_BO_TB_1`
X	<34>	Measured value, normalized value with time tag CP56Time2a	`M_ME_TD_1`
X	<35>	Measured value, scaled value with time tag CP56Time2a	`M_ME_TE_1`
X	<36>	Measured value, short floating point value with time tag CP56Time2a	`M_ME_TF_1`
X	<37>	Integrated totals with time tag CP56Time2a	`M_IT_TB_1`
-	<38>	Event of protection equipment with time tag CP56Time2a	`M_EP_TD_1`
-	<39>	Packed start events of protection equipment with time tag CP56Time2A	`M_EP_TE_1`
-	<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	`M_EP_TF_1`

Process information in control direction			
X	<45>	Single command	`C_SC_NA_1`
X	<46>	Double command	`C_DC_NA_1`
X	<47>	Regulating step command	`C_RC_NA_1`
X	<48>	Set point command, normalized value	`C_SE_NA_1`
X	<49>	Set point command, scaled value	`C_SE_NB_1`
X	<50>	Set point command, short floating point value	`C_SE_NC_1`
X	<51>	Bitstring of 32-bit	`C_BO_NA_1`
X	<58>	Single command with time tag CP56Time2a	`C_SC_TA_1`
X	<59>	Double command with time tag CP56Time2a	`C_DC_TA_1`
X	<60>	Regulating step command with time tag CP56Time 2a	`C_RC_TA_1`
X	<61>	Set point command, normalized value with time tag CP56Time2a	`C_SE_TA_1`
X	<62>	Set point command, scaled value with time tag CP56Time2a	`C_SE_TB_1`

Process information in control direction			
X	<63>	Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1
X	<64>	Bitstring of 32-bit with time tag CP56Time2a	C_BO_TA_1

System information in monitor direction			
X	<70>	End of initialization	M_EI_NA_1

System information in control direction			
X	<100->	Interrogation command	C_IC_NA_1
X	<101->	Counter interrogation command	C_CI_NA_1
X	<102->	Read command	C_RD_NA_1
X	<103->	Clock synchronization command	C_CS_NA_1
X	<105->	Reset process command	C_RP_NA_1
X	<107->	Test command with time tag CP56Time2a	C_TS_TA_1

Parameter in control direction			
X	<110->	Parameter of measured value, normalized value	P_ME_NA_1
X	<111>	Parameter of measured value, scaled value	P_ME_NB_1
X	<112->	Parameter of measured value, short floating point value	P_ME_NC_1
X	<113->	Parameter activation	PC_AC_NA_1

File transfer			
-	<120->	File ready	F_FR_NA_1
-	<121->	Section ready	F_SR_NA_1
-	<122->	Call directory, select file, call file, call section	F_SC_NA_1
-	<123->	Last section, last segment	F_LS_NA_1
-	<124->	Ack file, ack section	F_AF_NA_1
-	<125->	Segment	F_SG_NA_1
-	<126->	Directory	F_DR_TA_1
-	<127->	Query log - Request archive file	F_SC_NB_1

Type identification		Cause of transmission																		
		Periodic, cyclic	Background scan	Spontaneous	Initialized	Request or requested	Activation	Activation confirmation	Deactivation	Deactivation confirmation	Activation termination	Return info caused by a remote cmd	Return info caused by a local cmd	File transfer	Interrogated by group <number>	Request by group <n> counter request	Unknown type identification	Unknown cause of transmission	Unknown common address of ASDU	Unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20..-.36	37..-.41	44	45	46	47
<1>	M_SP_NA_1		X	X		X									X					
<3>	M_DP_NA_1		X	X		X									X					
<5>	M_ST_NA_1		X	X		X									X					
<7>	M_BO_NA_1		X	X		X									X					
<9>	M_ME_NA_1	X	X	X		X									X					
<11>	M_ME_NB_1	X	X	X		X									X					
<13>	M_ME_NC_1	X	X	X		X									X					
<15>	M_IT_NA_1			X												X				
<30>	M_SP_TB_1			X		X														
<31>	M_DP_TB_1			X		X														
<32>	M_ST_TB_1			X		X														
<33>	M_BO_TB_1			X		X														
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														
<36>	M_ME_TF_1			X		X														
<37>	M_IT_TB_1			X																
<45>	C_SC_NA_1						X	X	X	X	X						X	X	X	X
<46>	C_DC_NA_1						X	X	X	X	X						X	X	X	X
<47>	C_RC_NA_1						X	X	X	X	X						X	X	X	X
<48>	C_SE_NA_1						X	X	X	X	X						X	X	X	X
<49>	C_SE_NB_1						X	X	X	X	X						X	X	X	X
<50>	C_SE_NC_1						X	X	X	X	X						X	X	X	X
<51>	C_BO_NA_1						X	X			X						X	X	X	X
<58>	C_SC_TA_1						X	X	X	X	X						X	X	X	X
<59>	C_DC_TA_1						X	X	X	X	X						X	X	X	X
<60>	C_RC_TA_1						X	X	X	X	X						X	X	X	X
<61>	C_SE_TA_1						X	X	X	X	X						X	X	X	X
<62>	C_SE_TB_1						X	X	X	X	X						X	X	X	X
<63>	C_SE_TC_1						X	X	X	X	X						X	X	X	X
<64>	C_BO_TA_1						X	X			X						X	X	X	X
<70>	M_EI_NA_1				X															

Type identification		Cause of transmission																		
		Periodic, cyclic	Background scan	Spontaneous	Initialized	Request or requested	Activation	Activation confirmation	Deactivation	Deactivation confirmation	Activation termination	Return info caused by a remote cmd	Return info caused by a local cmd	File transfer	Interrogated by group <number>	Request by group <n> counter request	Unknown type identification	Unknown cause of transmission	Unknown common address of ASDU	Unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20..-.36	37..-.41	44	45	46	47
<100>	C_IC_NA_1						X	X	X	X	X						X	X	X	X
<101>	C_CI_NA_1						X	X			X						X	X	X	X
<102>	C_RD_NA_1					X											X	X	X	X
<103>	C_CS_NA_1						X	X									X	X	X	X
<105>	C_RP_NA_1						X	X									X	X	X	X
<107>	C_TS_TA_1						X	X									X	X	X	X
<110>	P_ME_NA_1						X	X							X		X	X	X	X
<111>	P_ME_NB_1						X	X							X		X	X	X	X
<112>	P_ME_NC_1						X	X							X		X	X	X	X
<113>	P_AC_NA_1						X	X	X	X							X	X	X	X

Basic Application Functions

Station initialization					
X	Remote initialization				
Cyclic data transmission					
X	Cyclic data transmission				
Read procedure					
X	Read procedure				
Spontaneous transmission					
X	Spontaneous transmission				
Double transmission is support for these types					
-	Single-point information				
-	Double-point information				
-	Step position information				
-	Bitstring of 32 bit				
-	Measure value, normalized value				
-	Measure value, scaled value				
-	Measure value, short floating point number				
Station interrogation					
X	Global				
X	Group 1	X	Group 7	X	Group 13
X	Group 2	X	Group 8	X	Group 14

X	Group 3	X	Group 9	X	Group 15
X	Group 4	X	Group 10	X	Group 16
X	Group 5	X	Group 11		
X	Group 6	X	Group 12		
Clock synchronization					
X	Clock synchronization				
X	Day of week used				
X	RES1, GEN (time tag substituted/ not substituted) used				
X	SU-bit (summertime) used				
Command transmission					
X	Direct command transmission	X	Select and execute command		
X	Direct set point command transmission	X	Select and execute set point command		
		X	C-SE-ACTTERM used		
X	No additional definition				
X	Short pulse duration (duration determined by a system parameter in the server)				
X	Long pulse duration (duration determined by a system parameter in the server)				
X	Persistent output				
–	Supervision of maximum delay in command direction of commands and set point commands				
Configurable	Maximum allowable delay of commands and set point commands				
Transmission of integrated totals					
X	Mode A: Local freeze with spontaneous transmission				
X	Mode B: Local freeze with counter interrogation				
X	Mode C: Freeze and transmit by counter-interrogation commands				
–	Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously				
X	Counter read				
X	Counter freeze without reset				
X	Counter freeze with reset				
X	Counter reset				
X	General request counter				
X	Request counter group 1...4				
Parameter loading					
X	Threshold value				
-	Smoothing factor				
X	Low limit for transmission of measured values				
X	High limit for transmission of measured values				
Parameter activation					
X	Act/Deact of persistent cyclic or periodic transmission of the addressed object				
Test procedure					
X	Test procedure				
File transfer					
File transfer in monitor direction					

-	Transparent file
-	Transmission of disturbance data of protection equipment
-	Transmission of sequences of events
-	Transmission of sequences of recorded analog values
File transfer in control direction	
-	Transparent file
Background scan	
X	Background scan

Definition of timeouts			
Parameter	**Default Value**	**Remarks**	**Selected Value**
t_0	30s	Timeout of connection establishment	Configurable
t_1	15s	Timeout of send or test APDUs	Configurable
t_2	10s	Timeout for acknowledges in case of no data messages $t_2 < t_1$	Configurable
t_3	20s	Timeout for sending test frames in case of a long idle state	Configurable
Maximum range for timeouts: t_0 to t_2 1...255s, accuracy: 1s Recommended range for timeout t_3: 1s to 48h, resolution: 1s Long timeouts for t_3 may be necessary in cases where satellite links or dial-up connections are used (for instance, to establish connection and collect values only once per day/week.)			

Maximum number of outstanding I format APDUs *k and latest acknowledge APDUs k*			
Parameter	**Default Value**	**Remarks**	**Selected Value**
k	12 APDUs	Maximum difference receive sequence number to send state variable	Configurable
w	8 APDUs	Latest acknowledge after receiving w I-format APDUs	Configurable
Maximum range of values *k*: 1...12 (12) APDUs, accuracy: 1 APDU			
Maximum range of values *w*: 1...32767 APDUs, accuracy: 1 APDU Recommendation: *w* should not exceed two-thirds of *k*			

Port number)		
Parameter	**Default Value**	**Remarks**
Port number	2404	Configurable

Redundant connections	
4	Number of redundancy group connections used
RFC 2200 suite	
RFC 2200 is an official Internet Standard which describes the state of standardization of protocols used in the Internet as determined by the Internet Architecture Board (IAB). It offers a broad spectrum of actual standards used in the Internet. The suitable selection of documents from RFC 2200 defined in this standard for given projects has to be chosen by the user of this standard.	
X	Ethernet 802.3
-	Serial X.21 interface
-	Other selection from RFC 2200

Project Migration

What’s in This Chapter

Introduction

Observe the considerations in this chapter when you migrate a configuration file from a BMXNOR0200H module in an M340 network to a BMENOR2200H module in an M580 network.

XML File Migration

Introduction

You can migrate the configuration file from a BMXNOR0200H module to a BMENOR2200H module.

> **NOTE:** Refer to the general instructions to export and import .xml files with the Control Expert DTM, page 104.

Project Migration Use Case

Migrate the configuration file from a BMXNOR0200H module to a BMENOR2200H module:

Stage	Description
1	Export the .xml configuration file from a BMXNOR0200H module in an M340 PAC controller application.
2	Import the .xml configuration file to a BMENOR2200H module in an M580 PAC controller application.

> **NOTE:** All located addresses are lost after you import .xml files from the BMENOR2200H module. The type and length of the name are changed according to the new format, page 170.

DNP3 Data Type Migration

Introduction

When you migrate an RTU application from a BMXNOR0200H RTU module to a BMENOR2200H RTU module, note the conversion of some specific data types and variable names.

These tables follow:

- DNP3 Server RTU Point Data Type Migration, page 170
- DNP3 Client RTU Point Data Type Migration, page 171

Apply this information when you configure DNP3 communications in the BMENOR2200H DTM, page 75.

DNP3 Server RTU Point Data Type Migration

The data types that change in the migration are shown in `red`:

Object Type (Default Variable Name)	Object Element	BMXNOR0200H		BMENOR2200H	
		Parameter	Data Type	Parameter	Data Type
Binary Input (BI_Px)	Value	.value	WORD	.value	BYTE
	Flag	.flags	WORD	.flags	BYTE
	Time	.timestamp	CP56	.Timestamp	CP56
Double_Input (DI_Px)	Value	.value	WORD	.value	BYTE
	Flag	.flags	WORD	.flags	BYTE
	Time	.timestamp	CP56	.Timestamp	CP56
Binary_Output (BO_Px)	Value	.value	WORD	.value	BYTE
					INT (**Sync On Demand** mode, page 90 only)
Binary_Counter (BCnt_Px)	Value - 16 bit	.value	DWORD	.value	INT
	Value - 32 bit	.value	DWORD	.value	DINT
	Flag	.flags	DWORD	.flags	BYTE
	Time	.timestamp	CP56	.Timestamp	CP56
Analog_Input (AI_Px)	Value - 16 bit	.value	INT	.Value	INT
	Value - 32 bit	.value	DINT	.Value	DINT
	Value - Short	.value	REAL	.Value	REAL
	Flag - 16 bit	.flags	WORD	.Flags	BYTE
	Flag - 32 bit/Short	.flags	DWORD	.Flags	BYTE
	Time	.timestamp	CP56	.Timestamp	CP56
Analog_Output (AO_Px)	Value - 16 bit	.value	INT	.Value	INT
	Value - 32 bit	.value	DINT	.Value	DINT
	Value - Short	.value	REAL	.Value	REAL
Analog_Input_Deadband (AI_Px_Dband)	Value	.Value	DWORD	.Value	DWORD
Binary_Output_Flags (BO_Px_Flag)	—	— None Structure	WORD	.Flag	BYTE
Analog_Output_Flags (AO_Px_Flag)	—	— None Structure	WORD	.Flag	BYTE
Gen_Event (GE_xxxx)	—	.Command	WORD	.Command	BYTE
	—	.Status	WORD	.Status	WORD
Clear_Event (CE_xxxx_CB)	—	.Command	WORD	.Command	BYTE
	—	.Status	WORD	.Status	WORD
Octet String (Str_Px)		—	—	.Value	STRING [0-255]

DNP3 Client RTU Point Data Type Migration

The data types that change in the migration are shown in red:

Object Type (Default Variable Name)	Object Element	BMXNOR0200H		BMENOR2200H	
		Parameter	Data Type	Parameter	Data Type
Binary_Input (BI_Px)	Value	.value	WORD	.value	BYTE
	Flag	.flags	WORD	.flags	BYTE
	Time	.timestamp	CP56	.Timestamp	CP56

Object Type (Default Variable Name)	Object Element	BMXNOR0200H		BMENOR2200H	
		Parameter	Data Type	Parameter	Data Type
Double_Input (DI_Px)	Value	`.value`	`WORD`	`.value`	`BYTE`
	Flag	`.flags`	`WORD`	`.flags`	`BYTE`
	Time	`.timestamp`	`CP56`	`.Timestamp`	`CP56`
Binary_Output (BO_Px)	—	`.value`	`WORD`	`.value`	`BYTE`
	Command Status	`.Status`	`WORD`	`.Status`	`WORD`
Binary_Output_Status (BO_Px_Sts)	Value	`.value`	`WORD`	`.value`	`BYTE`
	Flag	`.flags`	`WORD`	`.flags`	`BYTE`
	Time	`.timestamp`	`CP56`	`.Timestamp`	`CP56`
Octet String (Str_Px)		—	—	`.Value`	`STRING [0-255]`
Write Octet String (WOctStr_I_Px) (Str_Px_Wrt)		—	—	`.Value`	`STRING [0-255]`
		—	—	`.Status`	`WORD`
Binary_Counter (BCnt_Px)	Value - 16 bit	`.value`	`DWORD`	`.counter`	`WORD`
	Value - 32 bit	`.value`	`DWORD`	`.counter`	`DWORD`
	Flag - 16 bit/32 bit	`.flags`	`DWORD`	`.flag`	`BYTE`
	Time	`.timestamp`	`CP56`	`.timestamp`	`CP56`
Frozen_Counter (FrozCnt_xxxx)	Value - 16 bit	`.value`	`DWORD`	`.counter`	`WORD`
	Value - 32 bit	`.value`	`DWORD`	`.counter`	`DWORD`
	Flag - 16 bit/32 bit	`.flags`	`DWORD`	`.flag`	`BYTE`
	Time	`.timestamp`	`CP56`	`.timestamp`	`CP56`
Analog_Input (AI_Px)	Value - 16 bit	`.value`	`INT`	`.Value`	`INT`
	Value - 32 bit	`.value`	`DINT`	`.Value`	`DINT`
	Value - Short	`.value`	`REAL`	`.Value`	`REAL`
	Flag - 16 bit	`.flags`	`WORD`	`.Flags`	`BYTE`
	Flag - 32 bit/Short	`.flags`	`DWORD`	`.Flags`	`BYTE`
	Time	`.timestamp`	`CP56`	`.Timestamp`	`CP56`
Analog_Input_Deadband (AI_Px_Dband)	Value - 16 bit	`.value`	`WORD`	`.Value`	`WORD`
	Value - 32 bit	`.value`	`DWORD`	`.Value`	`DWORD`
Analog_Input_Deadband_Control (AIDBCtrl_Px)	Value - 16 bit	`.Value`	`WORD`	`.Value`	`WORD`
	Value - 32 bit	`.Value`	`DWORD`	`.Value`	`DWORD`
	Value - Short	`.Value`	`REAL`	`.Value`	`REAL`
	Command Status	`.Status`	`WORD`	`.Status`	`WORD`
	Command Status	`.Status`	`DWORD`	`.Status`	`WORD`
Analog_Output (AO_Px)	Value - 16 bit	`.Value`	`INT`	`.Value`	`INT`
	Value - 32 bit	`.Value`	`DINT`	`.Value`	`DINT`
	Value - short	`.Value`	`REAL`	`.Value`	`REAL`
	Command Status	`.Status`	`WORD`	`.Status`	`WORD`
	Command Status	`.Status`	`DWORD`	`.Status`	`WORD`
Analog_Output_Status (AO_Px_Sts)	Value - 16 bit	`.value`	`INT`	`.Value`	`INT`
	Value - 32 bit	`.value`	`DINT`	`.Value`	`DINT`
	Value - short	`.value`	`REAL`	`.Value`	`REAL`
	Flag - 16 bit	`.flags`	`WORD`	`.Flags`	`BYTE`

Object Type (Default Variable Name)	Object Element	BMXNOR0200H		BMENOR2200H	
		Parameter	Data Type	Parameter	Data Type
	Flag - 32 bit	.flags	DWORD	.Flags	BYTE
	Time	.timestamp	CP56	.Timestamp	CP56
Read_Class	—	.Value	WORD	.Value	BYTE
(RC_xxxx)	Command Status	.Status	WORD	.Status	WORD
Freeze_Counter	—	.Value	WORD	.Value	BYTE
(FrezCnt_xxxx)	Command Status	.Status	WORD	.Status	WORD
Unsolicited_Class	—	.Value	WORD	.Value	BYTE
(UnsC_xxxx)	Command Status	.Status	WORD	.Status	WORD
Time_Sync	—	.Value	WORD	.Value	BYTE
(TS_xxxx)	Command Status	.Status	WORD	.Status	WORD
Restart	—	.Value	WORD	.Value	BYTE
(Rst_xxxx)	Command Status	.Status	WORD	.Status	WORD
Integrity_Poll	—	.Value	WORD	.Value	BYTE
(IP_xxxx)	Command Status	.Status	WORD	.Status	WORD
Read_Group	—	.Value	WORD	.Value	BYTE
(RG_xxxx)	Command Status	.Status	WORD	.Status	WORD
Connect Status		.Status	DWORD	Device_State	BYTE

IEC 60870-5-104 Data Type Migration

Introduction

When you migrate and RTU application from a BMXNOR0200H module to a BMENOR2200H module, note the conversion of some data types and variable names.

These tables follow:

- IEC 60870-5-104 Server RTU Point Data Type Migration
- IEC 60870-5-104 Client RTU Point Data Type Migration

Apply this information when you configure IEC 60870-5-104 communications in the BMENOR2200H module.

IEC 60870-5-104 Client RTU Point Data Type Migration

The client RTU point data types that may change in the migration:

Object Type	CPU Register Type	Data Type	Parameter Name	Data Type in BMXNOR0200	Parameter Name in BMENOR2200H	Data Type in BMENOR2200H
M_SP	%M	Value	.value	WORD	.value	BYTE
	%MW	Flag	.quality	WORD	.flags	BYTE
	Unlocated	Time	.timestamp	CP56	.timestamp	CP56
M_DP	%MW	Value	.value	WORD	.value	BYTE
	Unlocated	Flag	.quality	WORD	.flags	BYTE

Object Type	CPU Register Type	Data Type	Parameter Name	Data Type in BMXNOR0200	Parameter Name in BMENOR2200H	Data Type in BMENOR2200H
		Time	.timestamp	CP56	.timestamp	CP56
M_ST	%MW Unlocated	Value	.value	WORD	.value	BYTE
		Flag	.quality	WORD	.flags	BYTE
		Time	.timestamp	CP56	.timestamp	CP56
M_BO	%MW Unlocated	Value	.value	DWORD	.value	DWORD
		Flag	.quality	DWORD	.flags	BYTE
		Time	.timestamp	CP56	.timestamp	CP56
M_ME_A	%MW Unlocated	Value	.value	INT	.Value	INT
		Flag	.quality	WORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
M_ME_B	%MW Unlocated	Value	.value	INT	.Value	INT
		Flag	.quality	WORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
M_ME_C	%MW Unlocated	Value	.value	REAL	.Value	REAL
		Flag	.quality	DWORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
M_IT	%MW Unlocated	Value	.value	DINT	.Value	DINT
		Flag	.quality	DWORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
C_SC	%MW	Value	.value	WORD	.value	BYTE
		Flag	.status	WORD	.status	BYTE
C_DC	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
C_RC	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
C_SE_A	%MW		.value	INT	.value	INT
			.status	WORD	.status	WORD
C_SE_B	%MW		.value	INT	.value	INT
			.status	WORD	.status	WORD
C_SE_C	%MW		.value	REAL	.value	REAL
			.status	DWORD	.status	WORD
C_BO	%MW		.value	DWORD	.value	DWORD
			.status	DWORD	.status	WORD
C_IC	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
C_CI	%MW		.value	WORD	.value	BYTE

Object Type	CPU Register Type	Data Type	Parameter Name	Data Type in BMXNOR0200	Parameter Name in BMENOR2200H	Data Type in BMENOR2200H
			.status	WORD	.status	WORD
C_RD	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
C_CS	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
C_TS	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
C_RP	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
P_ME_A	%MW		.value	WORD	.value	INT
			.status	WORD	.status	WORD
P_ME_B	%MW		.value	WORD	.value	INT
			.status	WORD	.status	WORD
P_ME_C	%MW		.value	REAL	.value	REAL
			.status	DWORD	.status	WORD
P_AC	%MW		.value	WORD	.value	BYTE
			.status	WORD	.status	WORD
M_IT_D			.value0	INT	.value0	INT
			.value1	INT	.value1	INT
			.value2	INT	.value2	INT
			.value3	INT	.value3	INT
			.flag	BYTE	.flag	BYTE
			.timestamp	CP56	.timestamp	CP56

IEC 60870-5-104 Server RTU Point Data Type Migration

The server RTU point data types that may change in the migration:

Object Type	CPU Register Type	Data Type	Parameter Name	Data Type in BMXNOR0200	Parameter Name in BMENOR2200H	Data Type in BMENOR2200H
M_SP	%M %M %S Unlocated	Value	.value	WORD	.value	BYTE
		Flag	.quality	WORD	.flags	BYTE
		Time	.timestamp	CP56	.timestamp	CP56
M_DP	%MW Unlocated	Value	.value	WORD	.value	BYTE
		Flag	.quality	WORD	.flags	BYTE
		Time	.timestamp	CP56	.timestamp	CP56
M_ST	%MW Unlocated	Value	.value	WORD	.value	BYTE
		Flag	.quality	WORD	.flags	BYTE
		Time	.timestamp	CP56	.timestamp	CP56
M_BO	%MW Unlocated	Value	.value	DWORD	.value	DWORD
		Flag	.quality	DWORD	.flags	BYTE
		Time	.timestamp	CP56	.timestamp	CP56

Object Type	CPU Register Type	Data Type	Parameter Name	Data Type in BMXNO-R0200	Parameter Name in BME-NOR2200H	Data Type in BME-NOR2200H
M_ME_A	%MW %SW Unlocated	Value	.value	INT	.Value	INT
		Flag	.quality	WORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
M_ME_B	%MW Unlocated	Value	.value	INT	.Value	INT
		Flag	.quality	WORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
M_ME_C	%MW Unlocated	Value	.value	REAL	.Value	REAL
		Flag	.quality	DWORD	.Flags	BYTE
		Time	.timestamp	CP56	.Timestamp	CP56
M_IT	%MW Unlocated	Value	.value	DINT	.Value	DINT
		Time	.timestamp	CP56	.Timestamp	CP56
C_SC	%MW %M Unlocated	—	.value	WORD	.value	BYTE
C_DC	%MW Unlocated	Value	.value	WORD	.value	BYTE
C_RC	%MW Unlocated	Value	.value	WORD	.value	BYTE
C_SE_A	%MW Unlocated	Value	.value	INT	.value	INT
C_SE_B	%MW Unlocated	Value	.value	INT	.value	INT
C_SE_C	%MW Unlocated	Value	.value	REAL	.value	REAL
C_BO	%MW Unlocated	Value	.value	DWORD	.value	DWORD
P_ME_A	%MW Unlocated	Value	—	WORD	.value	INT
P_ME_B	%MW Unlocated	Value	—	WORD	.value	INT
P_ME_C	%MW Unlocated	Value	—	REAL	.value	REAL
P_AC	%MW Unlocated	Value	—	WORD	.value	BYTE
Clear Events	%MW	—	.cmd	WORD	.cmd	BYTE
			.status	WORD	.status	WORD

Object Type	**CPU Register Type**	**Data Type**	**Parameter Name**	**Data Type in BMXNOR0200**	**Parameter Name in BMENOR2200H**	**Data Type in BMENOR2200H**
CUSTOM_ CMD	%MW Unlocated	FreezeCyclic (auto freeze)	Cmd	WORD	cmd	BYTE
			Status	WORD	.status	WORD
		freeze Trigger (local freeze)	Cmd	WORD	.cmd	BYTE
			Status	WORD	.status	WORD
CMD_ QUALITY	%MW Unlocated				.cmd	byte

Logged Events and Secure Statistics

What’s in This Chapter

Introduction

This chapter describes the logged events and secured statistics for the BMENOR2200H module.

Event Log Descriptions

Event Log Items

The following collection of messages can be included in the BMENOR2200H event log:

Severity	Service	Message Type	Message
Info	HTTPS	Li1: Successful connection (MNT_ENG_MSG_TYP_CNCTN_SUCCESS)	“”Successful login””
	HTTPS		“”Successful login””
	DNP3 / IEC 60870-5-104	Successful connection	
Warning	HTTPS	Li2: Failed connection (wrong credential) (MNT_ENG_MSG_TYP_CNCTN_FAILURE)	“”Failed login””
	HTTPS		“”Failed login””
	DNP3 / IEC 60870-5-104	Failed connection	
Info	HTTPS	Li5: disconnection triggered by the peer/user (MNT_ENG_MSG_TYP_DISCONNECTION)	“”Disconnection””
	HTTPS		“”Disconnection””
Info	HTTPS	Li6: Disconnection triggered by a timeout (MNT_ENG_MSG_TYP_DSCNCT_TIMEOUT)	“”Auto logout””
Info	Device_Manager	Li9: Upload of a configuration file (CID) into the device (MNT_ENG_MSG_TYP_CONF_UL)	XXX upload”” where XXX= Application or Configuration
Info	HTTPS	Li10: Upload of a new firmware in the device MNT_ENG_MSG_TYP_FIRMWARE_UPDATE	“”Firmware upload””
Warning	Device_Manager	Li18: Any port, either physical (Serial, USB) or logical (telnet, FTP) activation/deactivation? (MNT_ENG_MSG_TYP_PORT_MANAGEMENT)	“”Major Communication parameter update: XXXX YYYYY”“ (with XXXX = communication parameter ID, YYYY= value) Example:””Major Communication parameter update: SNMP enable””
Warning	Device_Manager	LI19: Any network physical port status change. Can be the simple status of a Ethernet port, or information gathered from RSTP / HSR / PRP algorithm for redundant systems (MNT_ENG_MSG_TYP_NETWK_PORT_CHG)	“”Major network physical port status change: XXXX link YYYY”” (with XXXX= port ID, YYYY= status value) Example: “”Major network physical port status change: port 1 link Up/Down)
Warning	Device_Manager	LI20: PORT CONTROL Change (MNT_ENG_MSG_TYP_NTWK_TPLGY_CHG)	“”Topology change detected”“

Severity	Service	Message Type	Message
Error	Device_Manager	LI84: Data Integrity Error MNT_ENG_MSG_DATA_INTEGRITY_ERROR	“”Firmware Integrity error”error””
Error	Device_Manager	LI84: Data Integrity Error MNT_ENG_MSG_DATA_INTEGRITY_ERROR	“”Data Integrity error””
Info	Device_Manager	LI26: Hardware change MNT_ENG_MSG_HARDWARE_CHANGE	“”XXXX hardware update: YYYY”” (with XXXX that identifies the hardware object which changes and YYYY that describes the update) EXAMPLE: hardware update: Secure Mode
Warning	HTTPS	Li11: MNT_ENG_MSG_TYP_RBAC_UPDATE	Update RBAC
Warning	HTTPS	Li12: MNT_ENG_MSG_TYP_SECURITY_UPDATE_UPDATE	“”Major Cyber Security parameter update: network services”“ ””Major Cyber Security parameter update: event log”“ “”Major Cyber Security parameter update: security policy”“
Warning	Device_Manager	Li86??: Failed authorization (MNT_ENG_MSG_TYP_AUTHORIZATION_FAILURE) OR Li21: MNT_ENG_MSG_TYP_AUTH_REQ?	“”Failed authorization””
Warning	Device_Manager	Li89: Certificate Management (MNT_ENG_MSG_TYP_CERT_MGT)	“”Add Client Certificate”” “”Remove Client Certificate””
Warning	HTTPS	Li13: MNT_ENG_MSG_TYP_DSS_UPDATE	“”Major Cyber Security parameter update: ipsec”“ ””Major Cyber Security parameter update: OPC UA”“
Warning	DNP3_Client / DNP3_Server	Li90:MNT_ENG_MSG_TYPE_AUTHENTICATION_FAILUE	“”channel[“”+channel name+””] authentication failed”“
Warning	DNP3_Client / DNP3_Server	Li91:MNT_ENG_MSG_TYPE_UNEXPECTED_RESPONSE	“”channel[“”+channel name+””] unexpected response””
Warning	DNP3_Client / DNP3_Server	Li92:MNT_ENG_MSG_TYPE_NO_RESPONSE	“”channel[“”+channel name+””] no response””
Warning	DNP3_Client / DNP3_Server	Li93:MNT_ENG_MSG_TYPE_AGGRESSIVE_MODE_NOT_SUPPORTED	“”channel[“”+channel name+””] aggressive mode not supported””
Warning	DNP3_Client / DNP3_Server	Li94:MNT_ENG_MSG_TYPE_MAC_ALGORITHM_NOT_SUPPORTED	“”channel[“”+channel name+””] MAC algorithm not supported””
Warning	DNP3_Client / DNP3_Server	Li95:MNT_ENG_MSG_TYPE_KEYWRAP_ALGORITHM_NOT_SUPPORTED	“”channel[“”+channel name+””] key wrap algorithm not supported””
Warning	DNP3_Client / DNP3_Server	Li86:MNT_ENG_MSG_TYP_AUTHORIZATION_FAILURE)	“”channel[“”+channel name+””] authorization failed””
Warning	DNP3_Client / DNP3_Server	Li96:MNT_ENG_MSG_TYPE_UPDATE_KEY_CHANGE_METHOD_NOT_PERMITTED	“”channel[“”+channel name+] update key change method not permitted””
Warning	DNP3_Client / DNP3_Server	Li97:MNT_ENG_MSG_TYPE_INVALID_SIGNATURE	“”channel[“”+channel name+””] invalid signature
Warning	DNP3_Client / DNP3_Server	Li98:MNT_ENG_MSG_TYPE_INVALID_CERTIFICATION_DATA	“”channel[“”+channel name+””] invalid certification data””
Warning	DNP3_Client / DNP3_Server	Li99:MNT_ENG_MSG_TYPE_UNKNOWN_USER	“”channel[“”+channel name+””] unknown user””

Severity	Service	Message Type	Message
Warning	DNP3_Client / DNP3_Server	Li100:MNT_ENG_MSG_TYPE_MAX_SESSION_KEY_STATUS_REQ_EXCEED	“”channel[“”+channel name+””] max session key status request exceed””
Info	DNP3_Client / DNP3_Server	Li101:MNT_ENG_MSG_TYPE_SESSION_KEY_CHANGE_SUCCESS	“”channel[“”+channel name+””] session key change success””

Secure Statistics

Secure Statistics

The following statistics are recorded for DNP3 secure connections to the BMENOR2200H RTU:

This Statistic ...	Describes the number of:
unexpectedMessages	Unexpected messages
authorizationFailures	Detected authorization failures
authenticationFailures	Detected authentication failures
replyTimeout	Reply timeouts
rekeyDueToAuthenticationFailure	Re-keys due to detected authentication failure
totalMessageSent	Total messages sent
totalMessageReceived	Total messages received
criticalMessageSent	Critical messages sent
criticalMessageReceived	Critical messages received
disCardedMessages	Discarded messages
errorMessageSent	Detected error message sent
errorMessageRxed	Detected error message received
successfulAuthentications	Successful authentications
sessionKeyChanges	Session key changes
sessionKeyChangesFailed	Detected failed session key changes
updatekeyChanges	Update key changes
updateKeyChangesFailed	Detected failed update key changes
rekeysDueToRestart	Re-keys due to restart

Modbus Diagnostic Codes

What’s in This Chapter

Data Mapping for Modbus Function Code 3 with Unit ID 100

Function Code 3

Some module diagnostics (I/O connection, extended health, redundancy status, FDR server, etc.) are available to Modbus clients that read the local Modbus server area. Use Modbus function code 3 with the unit ID set to 100 for register mapping:

Type	**Offset Modbus Address**	**Size (Words)**
Basic Networks Diagnostic Data	0	39
Ethernet Port Diagnostic Data (Internal port)	39	103
Ethernet Port Diagnostic Data (Eth 1)	142	103
Ethernet Port Diagnostic Data (Eth 2)	245	103
Ethernet Port Diagnostic Data (Eth 3)	348	103
Ethernet Port Diagnostic Data (Eth 4 backplane port)	451	103
Modbus TCP/Port 502 Diagnostic Data	554	114
Modbus TCP/Port 502 Connection Table Data	668	515
SMTP Diagnostic Data	1183	130
SNTP Diagnostic Data	1313	43
DNP/IEC Connection Information	1356	6
DNP/IEC Server Diagnostic	1362	1141
DNP/IEC Client Diagnostic	2503	1281
DNP Server Security Diagnostic	3784	157
DNP Client Security Diagnostic	3961	2497
Clock Diagnostic	6458	13
SNMP Diagnostic	6471	1
Web Service Diagnostic	6472	1
LLDP Service Diagnostic	6473	1
Firmware Upgrade Service Diagnostic	6474	1
Syslog Service Diagnostic	6475	1
SD Diagnostic	6476	1
ipAddrStatus Diagnostic	6477	1
Reserved	6478	13
HSBY Diagnostic	6491	35
Datalogging Diagnostic	6526	304

Basic Networks Diagnostic Data

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Basic network diagnostic validity
Offset + 1	MS Byte	LS Byte	
Offset + 2	MS Byte	LS Byte	Communication global status
Offset + 3	MS Byte	LS Byte	Supported communication services
Offset + 4	MS Byte	LS Byte	Status of communication services
Offset + 5	IP 1	IP 2	IP address
Offset + 6	IP 3	IP 4	
Offset + 7	SN mask 1	SN mask 2	Subnet mask
Offset + 8	SN mask 3	SN mask 4	
Offset + 9	GW IP 1	GW IP 2	Default gateway
Offset + 10	GW IP 3	GW IP 4	
Offset + 11	MAC 00	MAC 01	MAC address
Offset + 12	MAC 02	MAC 03	
Offset + 13	MAC 04	MAC 05	
Offset + 14	MS Byte 00	01	Ether frame format capability / configuration / operational
Offset + 15	02	03	
Offset + 16	04	LS Byte 05	
Offset + 17	C00	C01	Ethernet receive frames OK
Offset + 18	C02	C03	
Offset + 19	C00	C01	Ethernet transmit frames OK
Offset + 20	C02	C03	
Offset + 21	MS Byte	LS Byte	Number open client connections
Offset + 22	MS Byte	LS Byte	Number open server connections
Offset + 23	C00	C01	Number of Modbus error messages sent
Offset + 24	C02	C03	
Offset + 25	C00	C01	Number of Modbus messages sent
Offset + 26	C02	C03	
Offset + 27	C00	C01	Number of Modbus messages received
Offset + 28	C02	C03	
Offset + 29	Char 1	Char 2	Device name
Offset + 30	Char 3	Char 4	
Offset + 31	Char 5	Char 6	
Offset + 32	Char 7	Char 8	
Offset + 33	Char 9	Char 10	
Offset + 34	Char 11	Char 12	
Offset + 35	Char 13	Char 14	
Offset + 36	Char 15	Char 16	
Offset + 37	MS Byte 00	01	IP assignment mode capability / operational
Offset + 38	02	LS Byte 03	

Ethernet Port Diagnostic Data

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Port diagnostics data validity
Offset + 1	MS Byte	LS Byte	Logical/physical port number
Offset + 2	MS Byte	LS Byte	Ether control capability
Offset + 3	MS Byte	LS Byte	Link speed capability
Offset + 4	MS Byte	LS Byte	Ether control configuration
Offset + 5	MS Byte	LS Byte	Link speed configuration
Offset + 6	MS Byte	LS Byte	Ether control operational
Offset + 7	MS Byte	LS Byte	Link speed operational
Offset + 8	MAC 00	MAC 01	Port MAC address
Offset + 9	MAC 02	MAC 03	
Offset + 10	MAC 04	MAC 05	
Offset + 11	MSB - C00	C01	Media counters data validity
Offset + 12	C02	LSB - C03	
Offset + 13	MSB - C00	C01	Number frames transmitted OK
Offset + 14	C02	LSB - C03	
Offset + 15	MSB - C00	C01	Number frames received OK
Offset + 16	C02	LSB - C03	
Offset + 17	MSB - C00	C01	Number Ether collisions
Offset + 18	C02	LSB - C03	
Offset + 19	MSB - C00	C01	Carrier sense errors
Offset + 20	C02	LSB - C03	
Offset + 21	MSB - C00	C01	Number Ether excessive collisions
Offset + 22	C02	LSB - C03	
Offset + 23	MSB - C00	C01	CRC errors
Offset + 24	C02	LSB - C03	
Offset + 25	MSB - C00	C01	FSC errors
Offset + 26	C02	LSB - C03	
Offset + 27	MSB - C00	C01	Alignment errors
Offset + 28	C02	LSB - C03	
Offset + 29	MSB - C00	C01	Number internal MAC transmit errors
Offset + 30	C02	LSB - C03	
Offset + 31	MSB - C00	C01	Late collisions
Offset + 32	C02	LSB - C03	
Offset + 33	MSB - C00	C01	Number internal MAC transmit errors
Offset + 34	C02	LSB - C03	
Offset + 35	MSB - C00	C01	Multiple collisions
Offset + 36	C02	LSB - C03	
Offset + 37	MSB - C00	C01	Single collisions
Offset + 38	C02	LSB - C03	
Offset + 39	MSB - C00	C01	Deferred transmissions
Offset + 40	C02	LSB - C03	
Offset + 41	MSB - C00	C01	Frames too long
Offset + 42	C02	LSB - C03	
Offset + 43	MSB - C00	C01	Frames too short

Address	MS Byte	LS Byte	Comments
Offset + 44	C02	LSB - C03	
Offset + 45	MSB - C00	C01	SQE test error
Offset + 46	C02	LSB - C03	
Offset + 47	MS Byte	LS Byte	Interface label length
Offset + 48	IL_char64	IL_char63	Interface label characters
Offset + ...	...	...	
Offset + 79	IL_char2	IL_char1	
Offset + 80	MS Byte	LS Byte	Interface counters diagnostic validity
Offset + 81	MSB - C00	C01	Number octets received
Offset + 82	C02	LSB - C03	
Offset + 83	MSB - C00	C01	Number unicast packets received
Offset + 84	C02	LSB - C03	
Offset + 85	MSB - C00	C01	Number non-unicast packets received
Offset + 86	C02	LSB - C03	
Offset + 87	MSB - C00	C01	Number inbound packets discard
Offset + 88	C02	LSB - C03	
Offset + 89	MSB - C00	C01	Number inbound packets error
Offset + 90	C02	LSB - C03	
Offset + 91	MSB - C00	C01	Number inbound packets unknown
Offset + 92	C02	LSB - C03	
Offset + 93	MSB - C00	C01	Number octets sent
Offset + 94	C02	LSB - C03	
Offset + 95	MSB - C00	C01	Number unicast packets sent
Offset + 96	C02	LSB - C03	
Offset + 97	MSB - C00	C01	Number non-unicast packets sent
Offset + 98	C02	LSB - C03	
Offset + 99	MSB - C00	C01	Number outbound packets discard
Offset + 100	C02	LSB - C03	
Offset + 101	MSB - C00	C01	Number outbound packets error
Offset + 102	C02	LSB - C03	
Offset + 103			Port 2
			103 words per port
Offset + 206			Port 3
			103 words per port
Offset + 309			Port 4
			103 words per port

Modbus TCP/Port 502 Diagnostic Data

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Modbus TCP/Port 502 diagnostic data validity
Offset + 1	MS Byte	LS Byte	
Offset + 2	MS Byte	LS Byte	Port 502 status
Offset + 3	MS Byte	LS Byte	Number open connections
Offset + 4	MSB - C00	C01	Number Modbus messages sent

Address	MS Byte	LS Byte	Comments
Offset + 5	C02	LSB - C03	
Offset + 6	MSB - C00	C01	Number Modbus messages received
Offset + 7	C02	LSB - C03	
Offset + 8	MS Byte	LS Byte	Number Modbus open client connections
Offset + 9	MS Byte	LS Byte	Number Modbus open server connections
Offset + 10	MS Byte	LS Byte	Maximum number connections
Offset + 11	MS Byte	LS Byte	Maximum number client connections
Offset + 12	MS Byte	LS Byte	Maximum number server connections
Offset + 13	MSB - C00	C01	Number Modbus error messages sent
Offset + 14	C02	LSB - C03	
Offset + 15	MS Byte	LS Byte	Number open priority connections
Offset + 16	MS Byte	LS Byte	Maximum number priority connections
Offset + 17	MS Byte	LS Byte	Number entries in unauthorized table
Offset + 18	MSB - IP1	IP2	Remote IP address 1
Offset + 19	IP3	LSB - IP4	
Offset + 20	MS Byte	LS Byte	Number attempts to open unauthorized connection 1
...			
Offset + 111	MSB - IP1	IP2	Remote IP address 32
Offset + 112	IP3	LSB - IP4	
Offset + 113	MS Byte	LS Byte	Number attempts to open unauthorized connection 32

Modbus TCP/Port 502 Connection Table Data

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Connection table validity
Offset + 1	MS Byte	LS Byte	Number of entries
Offset + 2	MS Byte	LS Byte	Starting entry index
Offset + 3	MS Byte	LS Byte	Connection index
Offset + 4	IP 1	IP 2	Remote IP address
Offset + 5	IP 3	IP 4	
Offset + 6	MS Byte	LS Byte	Remote port number
Offset + 7	MS Byte	LS Byte	Local port number
Offset + 8	MS Byte	LS Byte	Number Modbus messages sent on Connex
Offset + 9	MS Byte	LS Byte	Number Modbus messages received on Connex
Offset + 10	MS Byte	LS Byte	Number Modbus error messages sent on Connex

SMTP Diagnostic Data

Address	MS Byte	LS Byte	CIP Type	Comments
Offset	MS Byte	LS Byte	UDINT	SMTP server IP address
Offset + 1	MS Byte	LS Byte		
Offset + 2	MS Byte	LS Byte	UDINT	Email service status

Address	MS Byte	LS Byte	CIP Type	Comments
Offset + 3	MS Byte	LS Byte		
Offset + 4	MS Byte	LS Byte	UDINT	Link to SMTP server status
Offset + 5	MS Byte	LS Byte		
Offset + 6	MS Byte	LS Byte	UDINT	Number of emails sent
Offset + 7	MS Byte	LS Byte		
Offset + 8	MS Byte	LS Byte	UDINT	Number of responses from the server
Offset + 9	MS Byte	LS Byte		
Offset + 10	MS Byte	LS Byte	UDINT	Number of errors
Offset + 11	MS Byte	LS Byte		
Offset + 12	MS Byte	LS Byte	UDINT	Last error
Offset + 13	MS Byte	LS Byte		
Offset + 14	SenderAddress [0]	SenderAddress [1]	ARRAY of octets	Last email header used
Offset + 15	SenderAddress [2]	SenderAddress [3]		
...				
Offset + 45	SenderAddress [62]	SenderAddress [63]		
Offset + 46	SenderAddress [0]	SenderAddress [1]		
Offset + 47	SenderAddress [2]	SenderAddress [3]		
...				
Offset + 109	SenderAddress [126]	SenderAddress [127]		
Offset + 110	MailSubject[0]	MailSubject[1]		
Offset + 111	MailSubject[2]	MailSubject[3]		
...				
Offset + 125	MailSubject[30]	MailSubject[31]		
Offset + 126	MSW - MSB	MSW - LSB	DINT	Time elapsed from the last email
Offset + 127	LSW - MSB	LSW - LSB		
Offset + 128	MSW - MSB	MSW - LSB	UDINT	Number of time server was not reachable
Offset + 129	LSW - MSB	LSW - LSB		

SNTP Diagnostic Data

Address	MS Byte	LS Byte	CIP Type	Comments
Offset	MSW - MSB	MSW - LSB	UDINT	Enabled/disabled
Offset + 1	LSW - MSB	LSW - LSB		
Offset + 2	MSW - MSB	MSW - LSB	UDINT	Primary NTP server IP address
Offset + 3	LSW - MSB	LSW - LSB		
Offset + 4	MSW - MSB	MSW - LSB	UDINT	Secondary NTP server IP address
Offset + 5	LSW - MSB	LSW - LSB		
Offset + 6	Unused	LS Byte	USINT	Polling period
Offset + 7	Unused	LS Byte	USINT	Daylight saving auto adjustment
Offset + 8	Unused	LS Byte	USINT	Update CPU with module time

Address	MS Byte	LS Byte	CIP Type	Comments
Offset + 9	Unused	LS Byte	USINT	Reserved
Offset + 10	MSW - MSB	MSW - LSB	UDINT	Time zone
Offset + 11	LSW - MSB	LSW - LSB		
Offset + 12	MS Byte	LS Byte	INT	Time zone offset
Offset + 13	Unused	Unused	USINT	Reserved
Offset + 14	Unused	Unused	USINT	Reserved
Offset + 15	Unused	LS Byte	USINT	Daylight saving start date - month
Offset + 16	Unused	LS Byte	USINT	Daylight saving start date - week #, day of week
Offset + 17	Unused	LS Byte	USINT	Daylight saving end date - month
Offset + 18	Unused	LS Byte	USINT	Daylight saving end date - week #, day of week
Offset + 19	MSW - MSB	MSW - LSB	UDINT	Network time service status
Offset + 20	LSW - MSB	LSW - LSB		
Offset + 21	MSW - MSB	MSW - LSB	UDINT	Link to NTP server status
Offset + 22	LSW - MSB	LSW - LSB		
Offset + 23	MSW - MSB	MSW - LSB	UDINT	Current NTP server IP address
Offset + 24	LSW - MSB	LSW - LSB		
Offset + 25	MSW - MSB	MSW - LSB	UDINT	NTP server type
Offset + 26	LSW - MSB	LSW - LSB		
Offset + 27	MSW - MSB	MSW - LSB	UDINT	NTP server time quality
Offset + 28	LSW - MSB	LSW - LSB		
Offset + 29	MSW - MSB	MSW - LSB	UDINT	Reserved
Offset + 30	LSW - MSB	LSW - LSB		
Offset + 31	MSW - MSB	MSW - LSB	UDINT	Reserved
Offset + 32	LSW - MSB	LSW - LSB		
Offset + 33	MSW - MSB	MSW - LSB	UDINT	Reserved
Offset + 34	LSW - MSB	LSW - LSB		
Offset + 35	MS Byte	LS Byte	UINT	Reserved
Offset + 36	MSW - MSB	MSW - LSB	UDINT	Current time
Offset + 37	LSW - MSB	LSW - LSB		
Offset + 38	MS Byte	LS Byte		Current date
Offset + 39	MSW - MSB	MSW - LSB	UDINT	Daylight savings status
Offset + 40	LSW - MSB	LSW - LSB		
Offset + 41	MSW - MSB	MSW - LSB	UINT	Time since last update
Offset + 42	LSW - MSB	LSW - LSB		

DNP/IEC Connection Information

Address	MS Byte	LS Byte	Comments
Offset	Client Connected Count	Client Configured Count	DNP3/IEC Client Count
Offset + 1	Server Connected Count	Server Configured Count	DNP3/IEC Server Count

Address	MS Byte	LS Byte	Comments
Offset + 2			Reserved
Offset + 3			Reserved
Offset + 4			Reserved
Offset + 5			Reserved

DNP/IEC Server Connection Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Number of entries
Offset + 1	MS Byte	LS Byte	MS byte: Event USED/CONFIGURED 0-100% LS byte: CONFIGURED/TOTAL 0-100%
Offset + 2	MSB - C03	C02	Module total Configured event Buffer size
Offset + 3	C01	LSB - C00	
Offset + 4	MSB - C03	C02	Module total Current event buffer used
Offset + 5	C01	LSB - C00	
Offset + 6	MSB - C03	C02	Module total current overflow
Offset + 7	C01	LSB - C00	
Offset + 8	MS Byte	LS Byte	MS Byte: Event buffer overflow LS Byte: Event backup status
Offset + 9	MS Byte	LS Byte	Channel index
Offset + 10	MS Byte reserved	LS Byte 1: DNP3 serial 3: DNP3 NET 5: IEC 101 7: IEC 104	Protocol: DNP3 serial server DNP3 NET server IEC 101 server IEC 104 server
Offset + 11	MS Byte	LS Byte	LS Byte connection state 0: disconnected 1: connected 2: connecting 3: active 4: inactive MS Byte authentication type 0: none 1: SAv2 2: SAv5 3: TLS_ONLY 4: TLS_SAv2 5: T:LS_SAv5
Offset + 12	Char 1	Char 2	Channel name
Offset + 13	Char 3	Char 4	
Offset + 14	Char 5	Char 6	
Offset + 15	Char 7	Char 8	
Offset + 16	Char 9	Char 10	

Address	MS Byte	LS Byte	Comments
Offset + 17	Char 11	Char 12	
Offset + 18	Char 13	Char 14	
Offset + 19	Char 15	Char 16	
Offset + 20	IP 1	IP 2	Remote IP address
Offset + 21	IP 3	IP 4	
Offset + 22	MS Byte	LS Byte	Remote port number
Offset + 23	MS Byte	LS Byte	Local port number
Offset + 24	MS Byte	LS Byte	Error code: Bit 0: Channel security not configured Bit 1: Unlocated variable initialize error Bit 2: Internal error (pipe create error, IPC init error, etc.) Bits 3-14: Reserved Bit 15: TLS error
Offset + 25	C03	C02	Channel total Configured event Buffer size
Offset + 26	C01	C00	
Offset + 27	C03	C02	Channel total Current event Buffer used
Offset + 28	C01	C00	
Offset + 29	C03	C02	Channel total Current overflow
Offset + 30	C01	C00	
Offset + 31	MS Byte	LS Byte	MS Byte: Reserved LS Byte: Event buffer overflow
Offset + 32	C01	C00	TLS error code
Offset + 33	MS Byte	LS Byte	Reserved 2
Offset + 34	MS Byte	LS Byte	Reserved 3
Offset + 35	MS Byte	LS Byte	Number of data type Event status Always 16
Offset + 36	MS Byte	LS Byte	MS Byte Bit 0: Validity Bit 1: Event buffer overflow Bits 2-7: Reserved LS Byte: Index
Offset + 37	MS Byte	LS Byte	DNP data type: 1. Binary input 2. Double input 3. Binary output 4. Binary counter 5. Frozen counter 6: Analog input 7. Analog output 8-16. For extended

Address	MS Byte	LS Byte	Comments
			IEC data type: 1. M_SP 2. M_DP 3. M_ST 4. M_BO 5. M_ME_A 6. M_ME_B 7. M_ME_C 8. M_IT 9. Custom_M_IT_D 10-16. For extended
Offset + 38	Char 1	Char 2	Data type name
Offset + 39	Char 3	Char 4	
Offset + 40	Char 5	Char 6	
Offset + 41	Char 7	Char 8	
Offset + 42	Char 9	Char 10	
Offset + 43	Char 11	Char 12	
Offset + 44	Char 13	Char 14	
Offset + 45	Char 15	Char 16	
Offset + 46	C03	C02	Configured event
Offset + 47	C01	C00	Buffer size
Offset + 48	C03	C02	Current event
Offset + 49	C01	C00	Buffer used
Offset + 50	C03	C02	Current overflow
Offset + 51	C01	C00	
Offset + 36 + (X-1)*16	MB Byte	LS Byte	MS Byte: Bit 0: Validity Bit 1: Event buffer overflow Bits 2-7: Reserved LS Byte: Index
Offset + 37 + (X-1)*16	MS Byte	LS Byte	DNP data type: 1. Binary input 2. Double input 3. Binary output 4. Binary counter 5. Frozen counter 6. Analog input 7. Analog output 8-16. For extended IEC data type: 1. M_SP 2. M_DP 3. M_ST 4. M_BO

Address	MS Byte	LS Byte	Comments
			5. M_ME_A 6. M_ME_B 7. M_ME_C 8. M_IT 9. Custom_M_IT_D 10-16. For extended
Offset + 38 + (X-1)*16	Char 1	Char 2	Data type name
Offset + 39 + (X-1)*16	Char 3	Char 4	
Offset + 40 + (X-1)*16	Char 5	Char 6	
Offset + 41 + (X-1)*16	Char 7	Char 8	
Offset + 42 + (X-1)*16	Char 9	Char 10	
Offset + 43 + (X-1)*16	Char 11	Char 12	
Offset + 44 + (X-1)*16	Char 13	Char 14	
Offset + 45 + (X-1)*16	Char 15	Char 16	
Offset + 46 + (X-1)*16	Char 03	Char 02	Configured event Buffer size
Offset + 47 + (X-1)*16	Char 01	Char 00	
Offset + 48 + (X-1)*16	Char 03	Char 02	Current event Buffer used
Offset + 49 + (X-1)*16	Char 01	Char 00	
Offset + 50 + (X-1)*16	Char 03	Char 02	Current overflow
Offset + 51 + (X-1)*16	Char 01	Char 00	
Offset + 09 + (N-1)*(27 + 16*16)	MB Byte	LS Byte	Channel index
Offset + (N-1)*283 + 10	MB Byte	LS Byte	Channel index
Offset + (N-1)*283 + 11	MB Byte	LS Byte	LS Byte Connection State 0: Disconnected 1: Connected 2: Connecting 3: Active 4: Inactive MS Byte Authentication type 5: None 6: SAv2 7: SAv5

Address	MS Byte	LS Byte	Comments
			8: TLS_ONLY 9: TLS_SAv2 10: TLS_SAv5
Offset + (N-1)*283 + 12	Char 1	Char 2	Channel name
Offset + (N-1)*283 + 13	Char 3	Char 4	
Offset + (N-1)*283 + 14	Char 5	Char 2	
Offset + (N-1)*283 + 15	Char 7	Char 6	
Offset + (N-1)*283 + 16	Char 9	Char 2	
Offset + (N-1)*283 + 17	Char 11	Char 8	
Offset + (N-1)*283 + 18	Char 13	Char 10	
Offset + (N-1)*283 + 19	Char 15	Char 12	
Offset + (N-1)*283 + 20	IP 1	IP 2	Remote IP address
Offset + (N-1)*283 + 21	IP 3	IP 4	
Offset + (N-1)*283 + 22	MS Byte	LS Byte	Remote port number
Offset + (N-1)*283 + 23	MS Byte	LS Byte	Local port number
Offset + (N-1)*283 + 24	MS Byte	LS Byte	Error code: Bit 0: Channel security not configured Bit 1: Unlocated variable initialize error Bit 2: Internal error (pipe create error, IPC init error, etc.) Bits 3-14: Reserved Bit 15: TLS error
Offset + (N-1)*283 + 25	C03	C02	Channel total Configured event Buffer size
Offset + (N-1)*283 + 26	C01	C02	
Offset + (N-1)*283 + 27	C03	C02	Channel total Current event Buffer used
Offset + (N-1)*283 + 28	C01	C02	
Offset + (N-1)*283 + 29	C03	C02	Channel total Current overflow
Offset + (N-1)*283 + 30	C01	C02	
Offset + (N-1)*283 + 31	MS Byte	LS Byte	MS Byte: Reserved LS Byte: Event buffer overflow
Offset + (N-1)*283 + 32	C01	C00	TLS error code
Offset + (N-1)*283 + 33	MS Byte	LS Byte	Reserved 2

Address	MS Byte	LS Byte	Comments
Offset + (N-1)*283 + 34	MS Byte	LS Byte	Reserved 3
Offset + (N-1)*283 + 35	MS Byte	LS Byte	Number of data type Event status Always 16
Offset + (N-1)*283 + 36	MS Byte	LS Byte	MS Byte: Bit 0: Validity Bit 1: Event buffer overflow Bits 2-7: Reserved LS Byte: Index
Offset + (N-1)*283 + 37	MS Byte	LS Byte	Data type name
Offset + (N-1)*283 + 38	Char 1	Char 2	
Offset + (N-1)*283 + 39	Char 3	Char 4	
Offset + (N-1)*283 + 40	Char 5	Char 6	
Offset + (N-1)*283 + 41	Char 7	Char 8	
Offset + (N-1)*283 + 42	Char 9	Char 10	
Offset + (N-1)*283 + 43	Char 11	Char 12	
Offset + (N-1)*283 + 44	Char 13	Char 14	
Offset + (N-1)*283 + 45	Char 17	Char 16	
Offset + (N-1)*283 + 46	C03	C02	Configured event Buffer size
Offset + (N-1)*283 + 47	C01	C00	
Offset + (N-1)*283 + 48	C03	C02	Current event Buffer used
Offset + (N-1)*283 + 49	C01	C00	
Offset + (N-1)*283 + 50	C03	C02	Current overflow
Offset + (N-1)*283 + 51	C01	C00	
Offset + (N-1)*283 + 36 + (X-1)*16	MS Byte	LS Byte	MS Byte: Bit 0: Validity Bit 1: Event buffer overflow Bits 2-7: Reserved LS Byte: Index
Offset + (N-1)*283 + 37 + (X-1)*16	MS Byte	LS Byte	DNP data type: 1. Binary input 2. Double input 3. Binary output 4. Binary counter 5. Frozen counter

Address	MS Byte	LS Byte	Comments
			6. Analog output 7. Analog output 8-16. For extended IEC data type: 1. M_SP 2. M_DP 3. M_ST 4. M_BO 5. M_ME_A 6. M_ME_B 7. M_ME_C 8. M_IT 9. Custom_M_IT_D 10-16. For extended
Offset + (N-1)*283 + 38 + (X-1)*16	Char 1	Char 2	Data type name
Offset + (N-1)*283 + 39 + (X-1)*16	Char 3	Char 4	
Offset + (N-1)*283 + 40 + (X-1)*16	Char 5	Char 6	
Offset + (N-1)*283 + 41 + (X-1)*16	Char 7	Char 8	
Offset + (N-1)*283 + 42 + (X-1)*16	Char 9	Char 10	
Offset + (N-1)*283 + 43 + (X-1)*16	Char 11	Char 12	
Offset + (N-1)*283 + 44 + (X-1)*16	Char 13	Char 14	
Offset + (N-1)*283 + 45 + (X-1)*16	Char 15	Char 16	
Offset + (N-1)*283 + 46 + (X-1)*16	C03	C02	Configured event Buffer size
Offset + (N-1)*283 + 47 + (X-1)*16	C01	C00	
Offset + (N-1)*283 + 48 + (X-1)*16	C03	C02	Current event Buffer used
Offset + (N-1)*283 + 49 + (X-1)*16	C01	C00	
Offset + (N-1)*283 + 50 + (X-1)*16	C03	C02	Current overflow
Offset + (N-1)*283 + 51 + (X-1)*16	C01	C00	

DNP/IEC Client Connection Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Number of entries
Offset + 1	MS Byte	LS Byte	Channel index
Offset + 2	MS Byte reserved	LS Byte	Protocol:
		2: DNP3 serial	DNP3 serial client
		4: DNP3 NET	DNP3 NET client
		6: IEC 101	IEC 101 client
		8: IEC 104	IEC 104 client
Offset + 3	MS Byte	LS Byte	LS Byte connection state: 0: Disconnected 1: Connected 2: Connecting 3: Active 4: Inactive MS Byte authentication type: 5: None 6: SAv2 7: SAv5 8: TLS_ONLY 9: TLS_SAv2 10: TLS_SAv5
Offset + 4	Char 1	Char 2	Channel name
Offset + 5	Char 3	Char 4	
Offset + 6	Char 5	Char 6	
Offset + 7	Char 7	Char 8	
Offset + 8	Char 9	Char 10	
Offset + 9	Char 11	Char 12	
Offset + 10	Char 13	Char 14	
Offset + 11	Char 15	Char 16	
Offset + 12	IP 1	IP 2	Remote IP address
Offset + 13	IP 3	IP 4	
Offset + 14	MS Byte	LS Byte	Remote port number
Offset + 15	MS Byte	LS Byte	Local port number
Offset + 16	Bit 15~8	Bit 7~0	Error code Bit 0: Channel security not configured Bit 1: Unlocated variable initialize error Bit 2: Internal error (pipe create error, IPC init error, etc.) Bit 3: authentication failed Bit 4: Unexpected response Bit 5: No response Bit 6: Aggressive mode not supported Bit 7: MAC algorithm not supported Bit 8: Key wrap algorithm not supported

Address	MS Byte	LS Byte	Comments
			Bit 9: Authorization failed Bit 10: Update key change method not permitted Bit 11: Invalid signature Bit 12: Invalid certification data Bit 13: Unknown user Bit 14: Max session key status requests exceed Bit 15: TLS error
Offset + 17	C01	C02	TLS error code
Offset + 18	MS Byte	LS Byte	Reserved 1
Offset + 19	MS Byte	LS Byte	Reserved 2
Offset + 20	MS Byte	LS Byte	Reserved 3
Offset + 01 + (N-1)*20	MS Byte	LS Byte	Channel index
Offset + 02 + (N-1)*20	MS Byte reserved	LS Byte: 2: DNP3 serial 4: DNP3 NET 6: IEC 101 8: IEC 104	Protocol: DNP3 serial client DNP3 NET client IEC 101 client IEC 104 client
Offset + 03 + (N-1)*20	MS Byte	LS Byte	LS Byte connection state: 0: Disconnected 1: Connected 2: Connecting 3: Active 4: Inactive MS Byte authentication type: 5: None 6: SAv2 7: SAv5 8: TLS_ONLY 9: TLS_SAv2 10: TLS_SAv5
Offset + 04 + (N-1)*20	Char 1	Char 2	Channel name
Offset + 05 + (N-1)*20	Char 3	Char 4	
Offset + 06 + (N-1)*20	Char 5	Char 6	
Offset + 07 + (N-1)*20	Char 7	Char 8	
Offset + 08 + (N-1)*20	Char 9	Char 10	
Offset + 09 + (N-1)*20	Char 11	Char 12	
Offset + 10 + (N-1)*20	Char 13	Char 14	

Address	MS Byte	LS Byte	Comments
Offset + 11 + (N-1)*20	Char 15	Char 16	
Offset + 12 + (N-1)*20	IP 1	IP 2	Remote IP address
Offset + 13 + (N-1)*20	IP 3	IP 4	
Offset + 14 + (N-1)*20	MS Byte	LS Byte	Remote port number
Offset + 15 + (N-1)*20	MS Byte	LS Byte	Local port number
Offset + 16 + (N-1)*20	Bit 15~8	Bit7~0	Error code: Bit 0: Channel security not configured Bit 1: Unlocated variable initialize error Bit 2: Internal error (pipe create error, IPC init error, etc.) Bit 3: Authentication failed Bit 4: Unexpected response Bit 5: No response Bit 6: Aggressive mode not supported Bit 7: MAC algorithm not supported Bit 8: Key wrap algorithm not supported Bit 9: Authorization failed Bit 10: Update key change method not permitted Bit 11: Invalid signature Bit 12: Invalid certification data Bit 13: Unknown user Bit 14: Max session key status requests exceed Bit 15: TLS error
Offset + 17 + (N-1)*20	C01	C00	TLS error code
Offset + 18 + (N-1)*20	MS Byte	LS Byte	Reserved 1
Offset + 19 + (N-1)*20	MS Byte	LS Byte	Reserved 2
Offset + 20 + (N-1)*20	MS Byte	LS Byte	Reserved 3

DNP Server Security Diagnostic

Address	MS Byte	LS Byte	Comments
Offset			Number of entries
Offset + 1	MS Byte reserved	LS Byte channel index	Channel index
Offset + 2	C03	C02	Unexpected messages (SAv2, SAv5)
Offset + 3	C01	C00	
Offset + 4	C03	C02	Authorization failures (SAv2, SAv5)
Offset + 5	C01	C00	
Offset + 6	C03	C02	Authentication failures (SAv2, SAv5)

Address	MS Byte	LS Byte	Comments
Offset + 7	C01	C00	
Offset + 8	C03	C02	Reply timeout (SAv2, SAv5)
Offset + 9	C01	C00	
Offset + 10	C03	C02	Re-keys due to authentication failure (SAv5 only)
Offset + 11	C01	C00	
Offset + 12	C03	C02	Total message sent (SAv5 only)
Offset + 13	C01	C00	
Offset + 14	C03	C02	Total messages received (SAv5 only)
Offset + 15	C01	C00	
Offset + 16	C03	C02	Critical message sent (SAv2, SAv5)
Offset + 17	C01	C00	
Offset + 18	C03	C02	Critical message received (SAv2, SAv5)
Offset + 19	C01	C00	
Offset + 20	C03	C02	Discarded messages (SAv5 only)
Offset + 21	C01	C00	
Offset + 22	C03	C02	Error message sent (SAv2, SAv5)
Offset + 23	C01	C00	
Offset + 24	C03	C02	Error message transmitted (SAv2, SAv5)
Offset + 25	C01	C00	
Offset + 26	C03	C02	Successful authentications (SAv2, SAv5)
Offset + 27	C01	C00	
Offset + 28	C03	C02	Session key changes (SAv2, SAv5)
Offset + 29	C01	C00	
Offset + 30	C03	C02	Failed session key changes (SAv2, SAv5)
Offset + 31	C01	C00	
Offset + 32	C03	C02	Update key changes (SAv5 only)
Offset + 33	C01	C00	
Offset + 34	C03	C02	Failed update key changes (SAv5 only)
Offset + 35	C01	C00	
Offset + 36	C03	C02	Re-keys due to restart (SAv5 only)
Offset + 37	C01	C00	

Address	MS Byte	LS Byte	Comments
Offset + 38	C01	C00	Reserved 0
Offset + 39	C01	C00	Reserved 1
Offset + (N-1)*39 + 01	MS Byte reserved	LS Byte Channel index	Channel index
Offset + (N-1)*39 + 02	C03	C02	Unexpected messages (SAv2, SAv5)
Offset + (N-1)*39 + 03	C01	C00	
Offset + (N-1)*39 + 04	C03	C02	Authorization failures (SAv2, SAv5)
Offset + (N-1)*39 + 05	C01	C00	
Offset + (N-1)*39 + 06	C03	C02	Authentication failures (SAv2, SAv5)
Offset + (N-1)*39 + 07	C01	C00	
Offset + (N-1)*39 + 08	C03	C02	Reply time out (SAv2, SAv5)
Offset + (N-1)*39 + 09	C01	C00	
Offset + (N-1)*39 + 10	C03	C02	Re-keys due to authentication failure (SAv5 only)
Offset + (N-1)*39 + 11	C01	C00	
Offset + (N-1)*39 + 12	C03	C02	Total messages sent (SAv5 only)
Offset + (N-1)*39 + 13	C01	C00	
Offset + (N-1)*39 + 14	C03	C02	Total messages received (SAv2, SAv5)
Offset + (N-1)*39 + 15	C01	C00	
Offset + (N-1)*39 + 16	C03	C02	Critical messages sent (SAv2, SAv5)
Offset + (N-1)*39 + 17	C01	C00	
Offset + (N-1)*39 + 18	C03	C02	Critical messages received (SAv2, SAv5)
Offset + (N-1)*39 + 19	C01	C00	
Offset + (N-1)*39 + 20	C03	C02	Discarded messages (SAv2, SAv5)

Address	MS Byte	LS Byte	Comments
Offset + (N-1)*39 + 21	C01	C00	
Offset + (N-1)*39 + 22	C03	C02	Error messages sent (SAv2, SAv5)
Offset + (N-1)*39 + 23	C01	C00	
Offset + (N-1)*39 + 24	C03	C02	Error messages received (SAv2, SAv5)
Offset + (N-1)*39 + 25	C01	C00	
Offset + (N-1)*39 + 26	C03	C02	Successful authentications (SAv2, SAv5)
Offset + (N-1)*39 + 27	C01	C00	
Offset + (N-1)*39 + 28	C03	C02	Session key changes (SAv2, SAv5)
Offset + (N-1)*39 + 29	C01	C00	
Offset + (N-1)*39 + 30	C03	C02	Failed session key changes (SAv2, SAv5)
Offset + (N-1)*39 + 31	C01	C00	
Offset + (N-1)*39 + 32	C03	C02	Update key changes (SAv5 only)
Offset + (N-1)*39 + 33	C01	C00	
Offset + (N-1)*39 + 34	C03	C02	Failed update key changes (SAv5 only)
Offset + (N-1)*39 + 35	C01	C00	
Offset + (N-1)*39 + 36	C03	C02	Re-keys due to restart (SAv5 only)
Offset + (N-1)*39 + 37	C01	C00	
Offset + (N-1)*39 + 38	C03	C02	Reserved 0
Offset + (N-1)*39 + 39	C01	C00	Reserved 1

DNP Client Security Diagnostic

Address	MS Byte	LS Byte	Comments
Offset			Number of entries
Offset + 01	MS Byte reserved	LS Byte	Channel index

Address	MS Byte	LS Byte	Comments
		Channel index	
Offset + 02	C03	C02	Unexpected messages (SAv2, SAv5)
Offset + 03	C01	C00	
Offset + 04	C03	C02	Authorization failures (SAv2, SAv5)
Offset + 05	C01	C00	
Offset + 06	C03	C02	Authentication failures (SAv2, SAv5)
Offset + 07	C01	C00	
Offset + 08	C03	C02	Reply timeout (SAv2, SAv5)
Offset + 09	C01	C00	
Offset + 10	C03	C02	Re-keys due to authentication failure (SAv5 only)
Offset + 11	C01	C00	
Offset + 12	C03	C02	Total message sent (SAv5 only)
Offset + 13	C01	C00	
Offset + 14	C03	C02	Total messages received (SAv5 only)
Offset + 15	C01	C00	
Offset + 16	C03	C02	Critical message sent (SAv2, SAv5)
Offset + 17	C01	C00	
Offset + 18	C03	C02	Critical messages received (SAv2, SAv5)
Offset + 19	C01	C00	
Offset + 20	C03	C02	Discarded messages (SAv5 only)
Offset + 21	C01	C00	
Offset + 22	C03	C02	Error message sent (SAv2, SAv5)
Offset + 23	C01	C00	
Offset + 24	C03	C02	Error message transmitted (SAv2, SAv5)
Offset + 25	C01	C00	
Offset + 26	C03	C02	Successful authentications (SAv2, SAv5)
Offset + 27	C01	C00	
Offset + 28	C03	C02	Session key changes (SAv2, SAv5)
Offset + 29	C01	C00	
Offset + 30	C03	C02	Failed session key changes (SAv2, SAv5)
Offset + 31	C01	C00	
Offset + 32	C03	C02	Update key changes (SAv5 only)
Offset + 33	C01	C00	
Offset + 34	C03	C02	Failed update key changes (SAv5 only)
Offset + 35	C01	C00	
Offset + 36	C03	C02	Re-keys due to restart (SAv5 only)
Offset + 37	C01	C00	
Offset + 38	C01	C00	Reserved 0
Offset + 39	C01	C00	Reserved 1
Offset = (N-1)*39 + 01	MS Byte reserved	LS Byte Channel index	Channel index
Offset = (N-1)*39 + 02	C03	C02	Unexpected messages (SAv2, SAv5)
Offset = (N-1)*39 + 03	C01	C00	
Offset = (N-1)*39 + 04	C03	C02	Authorization failures (SAv2, SAv5)

Address	MS Byte	LS Byte	Comments
Offset = (N-1)*39 + 05	C01	C00	
Offset = (N-1)*39 + 06	C03	C02	Authentication failures (SAv2, SAv5)
Offset = (N-1)*39 + 07	C01	C00	
Offset = (N-1)*39 + 08	C03	C02	Reply timeout (SAv2, SAv5)
Offset = (N-1)*39 + 09	C01	C00	
Offset = (N-1)*39 + 10	C03	C02	Re-keys due to authentication failure (SAv5 only)
Offset = (N-1)*39 + 11	C01	C00	
Offset = (N-1)*39 + 12	C03	C02	Total messages sent (SAv5 only)
Offset = (N-1)*39 + 13	C01	C00	
Offset =3 (N-1)*39 + 14	C03	C02	Total messages received (SAv5 only)
Offset = (N-1)*39 + 15	C01	C00	
Offset = (N-1)*39 + 16	C03	C02	Critical messages sent (SAv2, SAv5)
Offset = (N-1)*39 + 17	C01	C00	
Offset = (N-1)*39 + 18	C03	C02	Critical messages received (SAv2, SAv5)
Offset = (N-1)*39 + 19	C01	C00	
Offset = (N-1)*39 + 20	C03	C02	Discarded messages (SAv5 only)
Offset = (N-1)*39 + 21	C01	C00	
Offset = (N-1)*39 + 22	C03	C02	Error messages sent (SAv2, SAv5)
Offset = (N-1)*39 + 23	C01	C00	
Offset = (N-1)*39 + 24	C03	C02	Error messages transmitted (SAv2, SAv5)
Offset = (N-1)*39 + 25	C01	C00	
Offset = (N-1)*39 + 26	C03	C02	Successful authentication (SAv2, SAv5)
Offset = (N-1)*39 + 27	C01	C00	
Offset = (N-1)*39 + 28	C03	C02	Session key changes (SAv2, SAv5)
Offset = (N-1)*39 + 29	C01	C00	
Offset = (N-1)*39 + 30	C03	C02	Failed session key changes (SAv2, SAv5)
Offset = (N-1)*39 + 31	C01	C00	

Address	MS Byte	LS Byte	Comments
Offset = (N-1)*39 + 32	C03	C02	Update key changes (SAv5 only)
Offset = (N-1)*39 + 33	C01	C00	
Offset = (N-1)*39 + 34	C03	C02	Failed update key changes (SAv5 only)
Offset = (N-1)*39 + 35	C01	C00	
Offset = (N-1)*39 + 36	C03	C02	Re-keys due to restart (SAv5 only)
Offset = (N-1)*39 + 37	C01	C00	
Offset = (N-1)*39 + 38	C03	C02	Reserved 0
Offset = (N-1)*39 + 39	C01	C00	Reserved 1

Clock Diagnostic

Address	MS Byte	LS Byte	Comments
Offset			Number of entries
Offset + 01	MS Byte reserved	LS Byte clock status 1: Synchronized 0: Unsynchronized	Clock status
Offset + 02	C03	C02	Current time
Offset + 03	C01	C00	
Offset + 04	C01	C00	Current date
Offset + 05			Reserved
Offset + 06	C03	C02	Time zone
Offset + 07	C01	C00	
Offset + 08	C03	C02	Time of last time synchronization
Offset + 09	C01	C00	
Offset + 10	C01	C00	Date of last time synchronization
Offset + 11			Reserved
Offset + 12	MS Byte reserved	LS Byte time source 1: SNTP 2: DNP3	Time source of last time synchronization

SNMP Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	SNMP_service 0: Service not operating normally 1: Service operating normally or disabled

Web Service Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	Web_service 0: Service not operating normally 1: Service operating normally or disabled

LLDP Service Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	LLDP_service status FW_upgrade service status 0: Service not operating normally 1: Service operating normally or disabled

Firmware Upgrade Service Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	FW_upgrade service status 0: Service not operating normally 1: Service operating normally or disabled

Syslog Service Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	MS Byte: Syslog service status: 0: Syslog service not operating normally 1: Syslog service operating normally or disabled LS Byte: Syslog server not reachable: 1: No acknowledgment received from the syslog server 0: Otherwise

SD Service Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	SD status: 0: SD card missing or unusable 1: SD card normal

IP Address Status Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte	LS Byte	IP address status: 0: Duplicate or no IP 1: Normal IP configured

HSBY Diagnostic

Address	MS Byte	LS Byte	Comments
Offset	MS Byte HSBY function state	LS Byte HSBY service	HSBY function: 0: Disabled 1: Enabled (If it is disabled, other diagnostic data are all zero; the web page will not show HSBY diagnostics.) HSBY Service: 0: FAULT 1: Running
Offset + 01	MS Byte Sync Status	LS Byte Internal HSBY state	Sync Status: 0: In progress 1: OK Internal HSBY state: 0: Init 1: Link established 2: Reserved 3: Integrity 4: Wait Sync 5. Synced (not shown on the web page)
Offset + 02	MS Byte Partner validity	LS Byte reserved	Partner validity: 0: Not reachable 1: OK
Offset + 03	Bit 31 - Bit 24	Bit 23 - Bit 16	Error code
Offset + 04	Bit 15 - Bit 8	Bit 7 - Bit 0	Bit 0: Firmware mismatch Bit 1: DTM config mismatch Bit 2: Security mode mismatch Bit 3: Certification error Bit 4: CS config mismatch (reserved) Bit 5-31: Reserved
Offset + 05	C03	C02	Sync Counter
Offset + 06	C01	C00	
Offset + 07	C03	C02	Time of last time synchronization
Offset + 08	C01	C00	
Offset + 09	C01	C00	Date of last time synchronization
Offset + 10	C01	C00	Reserved
Offset + 11	C03	C02	HSBY input packets
Offset + 12	C01	C00	

Address	MS Byte	LS Byte	Comments
Offset + 13	C03	C02	HSBY input error packets
Offset + 14	C01	C00	
Offset + 15	C03	C02	HSBY output packets
Offset + 16	C01	C00	
Offset + 17	C03	C02	HSBY output error packets
Offset + 18	C01	C00	
Offset + 19	IP 1	IP 2	Local IP address
Offset + 20	IP 3	IP 4	
Offset + 21	C03 Reserved	C02 Major version	Local FW version
Offset + 22	C01 Minor version	C00 Internal revision	
Offset + 23	MS Byte Remote Role	LS Byte Reserved	Local role: 0: Unknown 1: Primary 2: Standby
Offset + 24	C1	C0	Reserved
Offset + 25	C1	C0	Reserved
Offset + 26	IP 1	IP 2	Remote IP address
Offset + 27	IP 3	IP 4	
Offset + 28	C03 Reserved	C02 Major version	Remote FW version
Offset + 29	C01 Minor version	C00 Internal revision	
Offset + 30	MS Byte Remote Role	LS Byte Reserved	Remote role: 0: Primary 1: Standby
Offset + 31	C01	C00	Reserved
Offset + 32	C01	C00	Reserved
Offset + 33	C01	C00	Reserved
Offset + 34	C01	C00	Reserved

Datalogging Service Diagnostic

Address	MS Byte	LS Byte	Comments
Offset + 0	MB Byte	LS Byte	Configured table count: 0: Service disabled, otherwise service running
Offset + 1	MS Byte	LS Byte	Enabled table count
Offset + 2	C03	C02	SD card free space in byte
Offset + 3	C01	C00	
Offset + 4	Char 1	Char 0	Table name, up to 32 characters include ending null character
Offset + 5	Char 3	Char 2	
Offset + 6	Char 5	Char 4	
Offset + 7	Char 7	Char 6	

Address	MS Byte	LS Byte	Comments
Offset + 8	Char 9	Char 8	
Offset + 9	Char 11	Char 10	
Offset + 10	Char 13	Char 12	
Offset + 11	Char 15	Char 14	
Offset + 12	Char 17	Char 16	
Offset + 13	Char 19	Char 18	
Offset + 14	Char 21	Char 20	
Offset + 15	Char 23	Char 22	
Offset + 16	Char 25	Char 24	
Offset + 17	Char 27	Char 26	
Offset + 18	Char 29	Char 28	
Offset + 19	Char 31	Char 30	
Offset + 20	MS Byte	LS Byte	Log status 0: No error 4: No memory space 5: Variable not available 6: Table filled 7: Transfer error 8: System error
Offset + 21	MS Byte	LS Byte	Backup status: 0: No error 1: No SD card 2: File system error 3: Not enough space in SD card 8: System error
Offset + 22	Char 1	Char 0	Last backup time, fixed at 20 characters include ending null character. In format: yyyy-mm-dd hh:mm:ss
Offset + 23	Char 3	Char 2	
Offset + 24	Char 5	Char 4	
Offset + 25	Char 7	Char 6	
Offset + 26	Char 9	Char 8	
Offset + 27	Char 11	Char 10	
Offset + 28	Char 13	Char 12	
Offset + 29	Char 15	Char 14	
Offset + 30	Char 17	Char 16	
Offset + 31	Char 19	Char 18	
Offset + 32	MS Byte	LS Byte	Records count in RAM
Offset + 33	MS Byte	LS Byte	Backup count in SD
Offset + 34 to Offset + 63			Same structure with table 0
Offset + 64 to Offset + 93			Same structure with table 0
Offset + 94 to Offset + 123			Same structure with table 0
Offset + 124 to Offset + 153			Same structure with table 0
Offset + 154 to Offset + 183			Same structure with table 0

Address	MS Byte	LS Byte	Comments
Offset + 184 to Offset + 213			Same structure with table 0
Offset + 214 to Offset + 243			Same structure with table 0
Offset + 244 to Offset + 273			Same structure with table 0
Offset + 274 to Offset + 303			Same structure with table 0

Modbus Function Code 8, Sub-Function Code 21

Get Status Summary (Op Code 0x76)

This function returns information about the LEDs and various services running on the BMENOR2200H module.

Request

Field	Length (bytes)	Value (hex)
Function code	1	08
Sub-function code hi	1	00
Sub-function code low	1	15
Operation code hi	1	00
Operation code low	1	76

Response

Field	Length (bytes)	Value (hex)
Function code	**1**	**08**
Sub-function code hi	**1**	**00**
Sub-function code low	**1**	**15**
Operation code hi	**1**	**00**
Operation code low	**1**	**76**
Byte count	**1**	**206**
Number of LEDs	**2**	**7**
LED 1 color	2	Off (default): byte0=0, byte1=0 On (green): byte0=1, byte1=0 Flashing (green): byte0=1, byte1=1
LED 1 status	2	0
LED 1 name string	4	RUN
LED 2 color	2	Off (default): byte0=0 On (red): byte0=2, byte 1=0 Flashing (red): byte0=2, byte1=1
LED 2 status	2	0
LED 2 name string	4	ERR
LED 3 color	2	Off (default): byte0=0, byte1=0 On (red): byte0=2, byte1=0

Field	Length (bytes)	Value (hex)
Function code	**1**	**08**
Sub-function code hi	**1**	**00**
Sub-function code low	**1**	**15**
Operation code hi	**1**	**00**
Operation code low	**1**	**76**
Byte count	**1**	**206**
LED 3 status	2	0
LED 3 name string	3	DL
LED 4 color	2	Off (default): byte0=0, byte1=0 On (green): byte0=1, byte1=0 Flashing (green): byte0=1, byte1=1 On (red): byte0=2, byte1=0
LED 4 status	2	0
LED 4 name string	8	ETH STS
LED 5 color	2	Off (default): byte0=0, byte1=0 On (red): byte0=2, byte1=0
LED 5 status	2	0
LED 5 name string	9	CARD ERR
LED 6 color	2	Off (default): byte0=0, byte1=0 On (green): byte0=1, byte1=0 On (red): byte0=2, byte1=0
LED 6 status	2	0
LED 6 name string	7	SECURE
LED 7 color	2	Off (default): byte0=0, byte1=0 Flashing (yellow): byte0=3, byte1=1
LED 7 status	2	0
LED 7 name string	8	SER COM
Number of services	**2**	**9**
Service 1 color	2	0 = off or n/a 1 = green 2 = red
Service 1 status	2	4 (corresponds to LED color 0) (default) 2 (corresponds to LED color 1) 5 (corresponds to LED color 2)
Service 1 name string	12	DNP3 Client
Service 2 color	2	0 = off or n/a 1 = green 2 = red
Service 2 status	2	4 (corresponds to LED color 0) (default) 2 (corresponds to LED color 1) 5 (corresponds to LED color 2)
Service 2 name string	11	IEC Client
Service 3 color	2	0 = off (default) 1 = green

Field	Length (bytes)	Value (hex)
Function code	**1**	**08**
Sub-function code hi	**1**	**00**
Sub-function code low	**1**	**15**
Operation code hi	**1**	**00**
Operation code low	**1**	**76**
Byte count	**1**	**206**
Service 3 status	2	1 (corresponds to LED color 1) 3 (corresponds to LED color 0) (default)
Service 3 name string	12	DNP3 Server
Service 4 color	2	0 = off (default) 1 = green
Service 4 status	2	1 (corresponds to LED color 1) 3 (corresponds to LED color 0) (default)
Service 4 name string	11	IEC Server
Service 5 color	2	0 = off (default) 1 = green
Service 5 status	2	1 (corresponds to LED color 1) 3 (corresponds to LED color 0) (default)
Service 5 name string	15	Access Control
Service 6 color	2	0 = off (default) 1 = on green 2 = on red
Service 6 status	2	4 (corresponds to LED color 0) (default) 2 (corresponds to LED color 1) 5 (corresponds to LED color 2 - link to server is down))
Service 6 name string	12	SNTP Status
Service 7 color	2	0 = off (default) 1 = on green 2 = on red
Service 7 status	2	4 (corresponds to LED color 0) (default) 2 (corresponds to LED color 1) 5 (corresponds to LED color 2 - link to server is down))
Service 7 name string	14	E-mail Status
Service 8 color	2	0 = off (default) 1 = green
Service 8 status	2	1 (corresponds to LED color 1) 3 (corresponds to LED color 0) (default)
Service 8 name string	14	Modbus Server
Service 9 color	2	0 = off (default) 1 = green

Field	Length (bytes)	Value (hex)
Function code	**1**	**08**
Sub-function code hi	**1**	**00**
Sub-function code low	**1**	**15**
Operation code hi	**1**	**00**
Operation code low	**1**	**76**
Byte count	**1**	**206**
Service 9 status	2	1 (corresponds to LED color 1) 3 (corresponds to LED color 0) (default)
Service 9 name string	12	FTP Server

LED Status

Refer to the Module LED Indicators topic, page 19 for LED descriptions.

LED Status Number (hex)	Description
1	Ready for operation.
2	Not ready for operation.
3	Fault detected.
4	No fault detected.
5	In operation.
6	Duplicate IP address.
7	Waiting for address server response.
8	Default IP address in use.
9	IP address configuration conflict detected.
A	Not configured.
B	Recoverable fault detected.
C	Connectors established.
D	No EtherNet/IP or RTU connections.
E	Connections error.
F	Running.
10	Error present.
11	Ethernet link established.
12	No Ethernet link established.
13	Connected to 100 Mbps link.
14	Not connected to 100 Mbps link.
15	Connected to full duplex link.
16	Not connected to full duplex line.
17	Configuration error.
18	Memory card is missing.
19	Memory card is not usable (bad format, unrecognized type).
20	Data exchange (send/receive) on the serial connection is in progress.
21	No data exchange on the serial connection.
22	Firmware download in progress.
23	Firmware download not in progress.

LED Status Number (hex)	Description
24	Module and communication are secure.
25	Module is secure, and communication is not secure.
26	Module is not secure.

Services Status

Service Status Number	Description
1	Enabled.
2	Working properly.
3	Disabled.
4	Not configured.
5	One connection or more are bad.
6	Enabled on.
7	Enabled off.

Get Firmware Version (Op Code 0x70)

This function returns the firmware version of the BMENOR2200H module.

Request

Field	Length (bytes)	Value (hex)
Function code	1	08
Sub-function code hi	1	00
Sub-function code low	1	15
Operation code hi	1	00
Operation code low	1	70

Response

Field	Length (bytes)	Value (hex)
Function code	1	08
Sub-function code hi	1	00
Sub-function code low	1	15
Operation code hi	1	00
Operation code low	1	70
Byte count	1	
PV version	1	xx
RL version	1	xx
SV major version	1	xx
SV minor version	1	xx
Web server version	1	xx
Rack	1	xx
Slot	1	xx
MAC	6	xx.xx.xx.xx.xx.xx
SN	n	xxxxxxxxxxx

Detected Error Codes

What’s in This Chapter

Overview

This chapter contains a list of codes that describe the status of Ethernet communication module messages.

Explicit Messaging: Communication and Operation Reports

Overview

Communication and operation reports are part of the management parameters.

NOTE: It is recommended that communication function reports be tested at the end of their execution and before the next activation. On cold start-up, confirm that all communication function management parameters are checked and reset to 0.

It may be helpful to use the%S21 (see EcoStruxure™ Control Expert, System Bits and Words, Reference Manual) to examine the first cycle after a cold or warm start.

Communication Report

This report is common to every explicit messaging function. It is significant when the value of the activity bit switches from 1 to 0. The reports with a value between 16#01 and 16#FE concern errors detected by the processor that executed the function.

The different values of this report are indicated in the following table:

Value	Communication report (least significant byte)
16#00	Correct exchange
16#01	Exchange stop on timeout
16#02	Exchange stop on user request (CANCEL)
16#03	Incorrect address format
16#04	Incorrect destination address
16#05	Incorrect management parameter format
16#06	Incorrect specific parameters
16#07	Error detected in sending to the destination
16#08	Reserved
16#09	Insufficient receive buffer size
16#0A	Insufficient send buffer size
16#0B	No system resources: the number of simultaneous communication EFs exceeds the maximum that can be managed by the processor
16#0C	Incorrect exchange number
16#0D	No telegram received
16#0E	Incorrect length
16#0F	Telegram service not configured

Value	Communication report (least significant byte)
16#10	Network module missing
16#11	Request missing
16#12	Application server already active
16#13	UNI-TE V2 transaction number incorrect
16#FF	Message refused

NOTE: The function can detect a parameter error before activating the exchange. In this case the activity bit remains at 0, and the report is initialized with values corresponding to the detected error.

Operation Report

This report byte is specific to each function, and specifies the result of the operation on the remote application:

Value	Operation report (most significant byte)
16#05	Length mismatch (CIP)
16#07	Bad IP address
16#08	Application error
16#09	Network is down
16#0A	Connection reset by peer
16#0C	Communication function not active
16#0D	• Modbus TCP: transaction timed out • EtherNet/IP: request timeout
16#0F	No route to remote host
16#13	Connection refused
16#15	• Modbus TCP: no resources • EtherNet/IP: no resources to handle the message; or an internal detected error; or no buffer available; or no link available; or cannot send message
16#16	Remote address not allowed
16#18	• Modbus TCP: concurrent connections or transactions limit reached • EtherNet/IP: TCP connection or encapsulation session in progress
16#19	Connection timed out
16#22	Modbus TCP: invalid response
16#23	Modbus TCP: invalid device ID response
16#30	• Modbus TCP: remote host is down • EtherNet/IP: connection open timed out
16#80...16#87: Forward_Open response detected errors:	
16#80	Internal detected error
16#81	Configuration detected error: the length of the explicit message, or the RPI rate, needs to be adjusted
16#82	Device detected error: target device does not support this service
16#83	Device resource detected error: no resource is available to open the connection
16#84	System resource event: unable to reach the device
16#85	Data sheet detected error: incorrect EDS file
16#86	Invalid connection size
16#90...16#9F: Register session response detected errors:	
16#90	Target device does not have sufficient resources

Value	Operation report (most significant byte)
16#98	Target device does not recognize message encapsulation header
16#9F	Unknown detected error from target

DNP3 Communication Detected Error Codes

What's in This Chapter

DNP3 Communication Detected Error Codes

DNP3 Detected Error Codes

Detected Error Code	Description
0x0000	No detected error
0x0001	Security not configured
0x0002	Unlocated variable initialize detected error
0x0004	Internal detected error
0X0008	Detected authentication failure
0x0010	Unexpected response
0x0020	No response
0x0040	Aggressive mode not supported
0x0080	MAC algorithm not supported
0x0100	Key Wrap algorithm not supported
0x0200	Detected authorization failure
0x0400	Update key change method not permitted
0x0800	Invalid signature
0x1000	Invalid certification data
0x2000	Unknown user
0x4000	Max session key status requests exceed
0x8000	TLS error

Open SSL/TLS Detected Error Codes

What’s in This Chapter

Introduction

This chapter describes the Open SSL/TLS error codes that can be detected in an M580 system with a BMENOR2200H RTU module.

Open SSL/TLS Detected Error Codes

Detected Error Codes

Detected Error	Code
SSL_R_APP_DATA_IN_HANDSHAKE	100
SSL_R_ATTEMPT_TO_REUSE_SESSION_IN_DIFFERENT_CONTEXT	272
SSL_R_BAD_ALERT_RECORD	101
SSL_R_BAD_AUTHENTICATION_TYPE	102
SSL_R_BAD_CHANGE_CIPHER_SPEC	103
SSL_R_BAD_CHECKSUM	104
SSL_R_BAD_DATA	390
SSL_R_BAD_DATA_RETURNED_BY_CALLBACK	106
SSL_R_BAD_DECOMPRESSION	107
SSL_R_BAD_DH_G_LENGTH	108
SSL_R_BAD_DH_G_VALUE	375
SSL_R_BAD_DH_PUB_KEY_LENGTH	109
SSL_R_BAD_DH_PUB_KEY_VALUE	393
SSL_R_BAD_DH_P_LENGTH	110
SSL_R_BAD_DH_P_VALUE	395
SSL_R_BAD_DIGEST_LENGTH	111
SSL_R_BAD_DSA_SIGNATURE	112
SSL_R_BAD_ECC_CERT	304
SSL_R_BAD_ECDSA_SIGNATURE	305
SSL_R_BAD_ECPOINT	306
SSL_R_BAD_HANDSHAKE_LENGTH	332
SSL_R_BAD_HELLO_REQUEST	105
SSL_R_BAD_LENGTH	271
SSL_R_BAD_MAC_DECODE	113
SSL_R_BAD_MAC_LENGTH	333
SSL_R_BAD_MESSAGE_TYPE	114
SSL_R_BAD_PACKET_LENGTH	115
SSL_R_BAD_PROTOCOL_VERSION_NUMBER	116
SSL_R_BAD_PSK_IDENTITY_HINT_LENGTH	316

Detected Error	Code
SSL_R_BAD_RESPONSE_ARGUMENT	117
SSL_R_BAD_RSA_DECRYPT	118
SSL_R_BAD_RSA_ENCRYPT	119
SSL_R_BAD_RSA_E_LENGTH	120
SSL_R_BAD_RSA_MODULUS_LENGTH	121
SSL_R_BAD_RSA_SIGNATURE	122
SSL_R_BAD_SIGNATURE	123
SSL_R_BAD_SRP_A_LENGTH	347
SSL_R_BAD_SRP_B_LENGTH	348
SSL_R_BAD_SRP_G_LENGTH	349
SSL_R_BAD_SRP_N_LENGTH	350
SSL_R_BAD_SRP_PARAMETERS	371
SSL_R_BAD_SRP_S_LENGTH	351
SSL_R_BAD_SRTP_MKI_VALUE	352
SSL_R_BAD_SRTP_PROTECTION_PROFILE_LIST	353
SSL_R_BAD_SSL_FILETYPE	124
SSL_R_BAD_SSL_SESSION_ID_LENGTH	125
SSL_R_BAD_STATE	126
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Firmware Version Compatibility

What’s in This Chapter

Introduction

This chapter describes the history of firmware versions for the BMENOR2200H module and their compatibility with Control Expert.

Firmware Version Compatibility

Compatibility

The following table describes the firmware versions of the BMENOR2200H module and their compatibility with Control Expert:

	Control Expert 14.0	**Control Expert 15.0**
SV 1.00 and later	Support	Legacy feature only
SV 2.01 and later	NOK	Support

Glossary

B

bridge:

A bridge device connects two or more physical networks that use the same protocol. Bridges read frames and decide whether to transmit or block them based on their destination address.

D

DFB:

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

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

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

DTM:

(*device type manager*) A DTM is a device driver running on the host PC. It provides a unified structure for accessing device parameters, configuring and operating the devices, and troubleshooting devices. 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

EFB:

(*elementary function block*) This is a block used in a program which performs a predefined logical function.

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

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.

Ethernet:

A LAN cabling and signaling specification used to connect devices within a defined area, e.g., a building. Ethernet uses a bus or a star topology to connect different nodes on a network.

F

FDR:

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

G

gateway:

A device that connects networks with dissimilar network architectures and which operates at the Application Layer of the OSI model. This term may refer to a router.

gateway:

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

H

Hot Standby:

A Hot Standby system uses a primary PAC (PLC) and a standby PAC. The two PAC racks have identical hardware and software configurations. The standby PAC monitors the current system status of the primary PAC. If the primary PAC becomes inoperable, high-availability control is maintained when the standby PAC takes control of the system.

HTTP server:

The installed HTTP server transmits Web pages between a server and a browser, providing Ethernet communications modules with easy access to devices anywhere in the world from standard browsers such as Internet Explorer or Netscape Navigator.

I

IP address:

Internet protocol address. This 32-bit address is assigned to hosts that use TCP/IP.

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:

An M580 rack containing the CPU and a power supply. A local rack consists of one or two racks: the main rack and the extended rack, which belongs to the same family as the main rack. The extended rack is optional.

M

MAC address:

media access control address. A 48-bit number, unique on a network, that is programmed into each network card or device when it is manufactured.

MB/TCP:

(*Modbus over TCP protocol*) This is a Modbus variant used for communications over TCP/IP networks.

P

PLC:

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

port 502:

TCP/IP reserves specific server ports for specific applications through IANA (Internet Assigned Numbers Authority). Modbus requests are sent to registered software port 502.

R

RIO network:

An Ethernet-based network that contains 3 types of RIO devices: a local rack, an RIO drop, and a ConneXium extended dual-ring switch (DRS). Distributed equipment may also participate in an RIO network via connection to DRSs or BMENOS0300 network option switch modules.

router:

A router device connects two or more sections of a network and allows information to flow between them. A router examines every packet it receives and decides whether to block the packet from the rest of the network or transmit it. The router attempts to send the packet through the network on an efficient path.

S

SNMP agent:

The SNMP application that runs on a network device.

SNMP:

(*simple network management protocol*) Protocol used in network management systems to monitor network-attached devices. 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.

SNMP:

simple network management protocol. The UDP/IP standard protocol used to monitor and manage devices on an IP network.

SNTP:

(*simple network time protocol*) See NTP.

SOE:

(*sequence of events*) SOE software helps users understand a chain of occurrences that can lead to unsafe process conditions and possible shutdowns. SOEs can be critical to resolving or preventing such conditions.

subnet mask:

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

subnet mask:

The subnet mask is a bit mask that identifies or determines which bits in an IP address correspond to the network address and which correspond to the subnet portions of the address. The subnet mask comprises the network address plus the bits reserved for identifying the subnetwork.

subnet:

The subnet is that portion of the network that shares a network address with the other parts of the network. A subnet may be physically or logically independent from the rest of the network. A part of an Internet address called a subnet number, which is ignored in IP routing, distinguishes the subnet.

switch:

A network switch connects two or more separate network segments and allows traffic to be passed between them. A switch determines whether a frame should be blocked or transmitted based on its destination address.

T

Transparent Ready:

Schneider Electric's Transparent Ready products (based on universal Ethernet TCP/IP and Web technologies) can be integrated into real-time, data sharing systems, with no need for interfaces.

U

UDP:

user datagram protocol. UDP is an Internet communications protocol defined by IETF RFC 768. This protocol facilitates the direct transmission of datagrams on IP networks. UDP/IP messages do not expect a response, and are therefore ideal for applications in which dropped packets do not require retransmission (such as streaming video and networks that demand real-time performance).

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please ask for confirmation of the information given in this publication.