USER MANUAL

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PACSystems™ RX3i

IEC 104 SERVER MODULE (IC695EIS001)

EMERSON

Contents

Section 1: Introduction 1

1.1 Revisions in this Manual 1
1.2 IEC 104 Overview 3
1.3 Description 4
1.4 Product Overview 4
1.5 Specifications 6
1.6 Controls and Indicators 7
1.7 RX3i IEC 104 Server Specifications and Restrictions 8
1.7.1 ADSU Supported in General Interrogation 8
1.7.2 ADSU Supported without Time Tag and RBE 8
1.7.3 ADSU Supported with 56-Bit Time Tag and RBE 9
1.7.4 ADSU Supported Commands 9
1.7.5 ADSU Supported Commands and Responses 10
1.7.6 General Purpose ADSUs Supported 10
1.8 Performance and Limitation 10
1.8.1 General Restrictions 10
1.8.2 Point Count Restrictions 11
1.8.3 Point Event Count Restrictions 11
1.9 Glossary 12
1.10 References 13

Section 2: Installation 14

2.1 Pre-Installation Check 14
2.2 Installation Location 14
2.3 Installation in Hazardous Areas 15
2.3.1 ATEX Zone 2 15
2.3.2 ATEX Marking 15
2.4 Module Installation 15
2.4.1 Mounting the EIS001 15
2.4.2 EIS001 Module Removal 16
2.5 Spare Parts 16

Section 3: Configuration 17

3.1 Configuration Tools 17
3.2 RX3i Rack/Slot Hardware Configuration 17

3.3 RX3i CPU settings 19
3.4 LAN Interface Status Bits 19
3.5 Ethernet Configuration 21
3.6 IEC 104 Server Configuration 21
3.7 Station Manager Configuration 22

Section 4: System Operation 23
4.1 System Overview 23
4.1.1 Communications 23
4.1.2 Redundancy 23
4.1.3 I/O Scans 24
4.1.4 Alarms 25
4.1.5 Station Manager 25

Section 5: Diagnostics 26
5.1 Status Data 26
5.2 Light-Emitting Diode (LED) Indications 26
5.3 Power-Up 27
5.3.1 Problems during Power-Up 27
5.3.2 Firmware Update Mode 27
5.4 Module Faults in the RX3i I/O Fault Tables 28
5.4.1 Typical Fault Messages during Power-Up 29
5.4.2 Using Status Data for Troubleshooting 30
5.4.3 Clearing the RX3i Fault Tables 31
5.5 Overview 31
5.6 Required Configuration Parameters 33
5.6.1 Standard COMMREQ Command Block Parameters 33
5.6.2 33
5.6.3 Parameters for Client Station-Server Connection 34
5.7 Memory Translation Feature Configuration Parameters 34
5.7.1 Parameters for Read Translation Table 35
5.7.2 Parameters for Command Translation Table 36
5.7.3 Configuration Examples for Address Translation 36
5.8 Optional Configuration Parameters 41
5.8.1 Parameters for Filter Times 42
5.8.2 Parameters for Short and Long Pulse Durations 42
5.8.3 Parameters for Server Status Space 43

5.8.4 IEC 104 Polled Object Parameters, and CPO Setting for ADSUs 43
5.8.5 Option Parameters 48
5.9 Point Push Interface Definition 52
5.9.1 Interface Specification 53
5.9.2 Record Format 53
5.9.3 Interface Collection Mechanism 54
5.9.4 Point Push for Digital and Analog Data 55
5.10 Required COMMREQ Function Block Parameters 55
5.11 Program Download 56
5.12 IEC 104 Communications Start-up 56
5.13 COMMREQ Status Word Codes 56
5.14 Security 57

Appendix A: Definition of the Status Area 58
A-1 General Table View 58
A-2 Specific Areas of Status 59
A-2.1 Status of Read 59
A-2.2 Status of a Client Connection 59
A-2.3 Point Push 59
A-2.4 Events being stored 59

Appendix B: Station Manager Status 60

Appendix C: Log Messages Table 62

Appendix D: Device Profile 63
D-1 Revision History 63
D-2 Introduction 64
D-3 Interoperability 64
D-3.1 System or device 65
D-3.2 Network configuration 65
D-3.3 Physical layer 65
D-3.4 Link layer 66
D-3.5 Application layer 67
D-3.6 Basic Application Functions 76

Appendix E: Control Functions 81
E-1.1 STARTDT & STOPDT 81

E-1.2 TESTFR 82
General Contact Information 84
Technical Support 84

Warnings and Caution Notes as Used in this Publication

⚠ WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

⚠ CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

Note: *Notes merely call attention to information that is especially significant to understanding and operating the equipment.*

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met during installation, operation, and maintenance. The information is supplied for informational purposes only, and Emerson makes no warranty as to the accuracy of the information included herein. Changes, modifications, and/or improvements to equipment and specifications are made periodically and these changes may or may not be reflected herein. It is understood that Emerson may make changes, modifications, or improvements to the equipment referenced herein or to the document itself at any time. This document is intended for trained personnel familiar with the Emerson products referenced herein.

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Section 1: Introduction

This manual describes the RX3i IEC 60870-5-104 Option Parameters Ethernet Server Module, IC695EIS001 (or EIS001 for short). By installing this module in the backplane of an RX3i controller, the controller may be set up as an IEC 104 Server on an IEC 104 Network. This permits RX3i data to be exchanged with the IEC 104 Clients on that network.

Introductory material may be found in this chapter. Section 2: provides installation and set-up information. Section 3: provides configuration instructions. Section 4:describes system operation. Section 5: provides diagnostic information. 0 covers the use and format of ladder logic COMMREQ instructions used to set up and configure the EIS001 module and its interaction with the IEC 104 Clients to which it is connected over Ethernet.

The appendices provide reference material for this application. Appendix D: Device Profile, provides a profile of the IEC 104 Server.

1.1 Revisions in this Manual

Rev	Date	Description
F	Mar 2021	Updated description for the COMMREQ Data Length parameter in Section 5.6.1
E	Nov 2020	Added *Appendix E: Control Functions* to explain usage of STARTDT, STOPDT, and TESTFR commands.
D	Sep 2019	Following Emerson's acquisition of this product, changes have been made to apply appropriate branding and registration of the product with required certification agencies. No changes to material, process, form, fit or functionality.
C	Jul-2017	The IEC-104 communication module IC695EIS001 firmware Release 1.40 provides enhancement to enable Report by Exception of analog data without time stamp through ASDU13 spontaneously instead of ASDU36, this enhancement makes use of unused bit 10 of Option parameter [67] as described in section Option Parameters.
B	Mar-2016	The section, Specifications updated The section, Parameters for Client Station-Server Connection updated The section, Option Parameters updated table and added new subsections Multiple Client Connection Configuration and COMMREQ –Shift RBE on Client Connection Associated with a Specified Port Number. The section, Point Push for Digital Data removed. The section, Point Push for Digital and Analog Datatable updated
A	Apr-2015	Addition of support for Memory Translation Feature and Control Point Offset.

-	Dec-2014	Original Issue

1.2 IEC 104 Overview

IEC 104 is a client/server communications protocol originally developed for use in the electric utility sector for power transmission and distribution systems. It has migrated to other vertical markets and is now a general market protocol based on a 3-layer protocol scheme. IEC 104 is a generational protocol coming from a foundation of the IEC 60870-5-101 protocol.

Figure 1 : IEC 104 Basic System Architecture

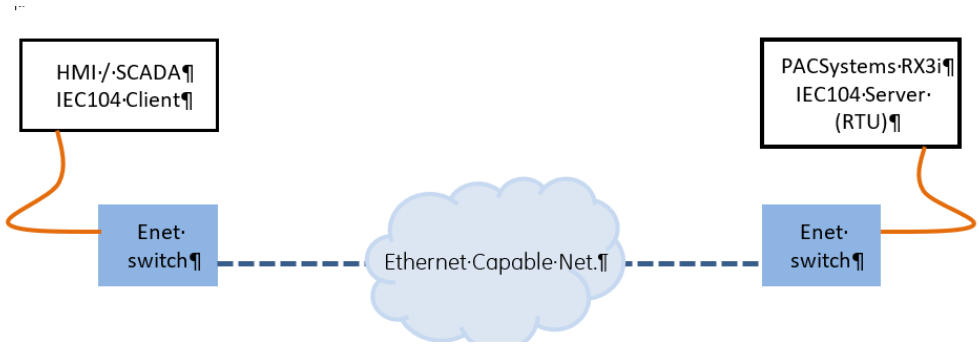
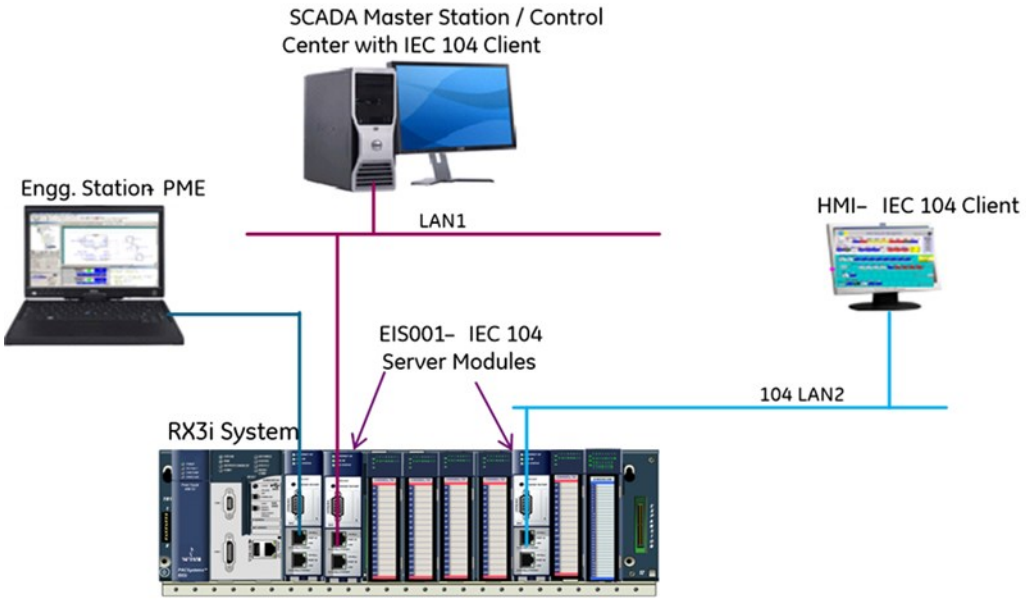


Figure 2: Application Showing two IEC 104 LANs Accessing RX3i through two EIS001 Modules



1.3 Description

The RX3i IEC 104 Server Module, catalog number IC695EIS001 (or EIS001), hosts the IEC

104 Server protocol on a common RX3i ETM001 module hardware platform. Thus, many of the specifications and behaviors are shared with the ETM001 module. IC695EIS001 is an Ethernet-connected module which fits in the RX3i backplane and permits the RX3i to behave as a Server on the IEC 104 network.

The data exchanges between the EIS001 module and one IEC 104 Client are configurable, using a single COMMREQ instruction in the ladder logic or Structured Text program, as detailed in 0, and are limited to exchanging only linear (%) memory. Symbolic references, which represent non-linear use of memory, cannot therefore be specified in this interface. However, the corresponding data may be exchanged as part of a block of memory (%R, for instance).

1.4 Product Overview

The PACSystems RX3i Ethernet IEC 60870-5-104 Server Module, catalog number IC695EIS001 implements the IEC communications protocol. It permits a PACSystems RX3i controller to be connected to an Ethernet network using a standard TCP/IP connection scheme, allowing an IEC 104 Client to poll data from the Server, as well generate unsolicited communications from the Server back to the Client.

Two auto-sensing 10BaseT/100BaseTX RJ-45 shielded twisted-pair Ethernet ports permit direct connection to either a 10BaseT or 100BaseTX IEEE 802.3 network without an external transceiver. Line, Star and Daisy Chain topologies are supported.

The RX3i Ethernet IEC 104 Server Module hosts the IEC104 Server-side protocol on a common RX3i ETM001 module hardware platform. Thus, many of the specifications and behaviors are shared with the ETM001 module including protocol support. IC695EIS001 is an Ethernet-connected module that fits in the RX3i backplane and permits the RX3i to behave as a Server on the IEC104 network. The data exchanges between the EIS001 module and IEC104 Client(s) are configurable, using a single COMMREQ instruction in the ladder logic or Structured Text program.

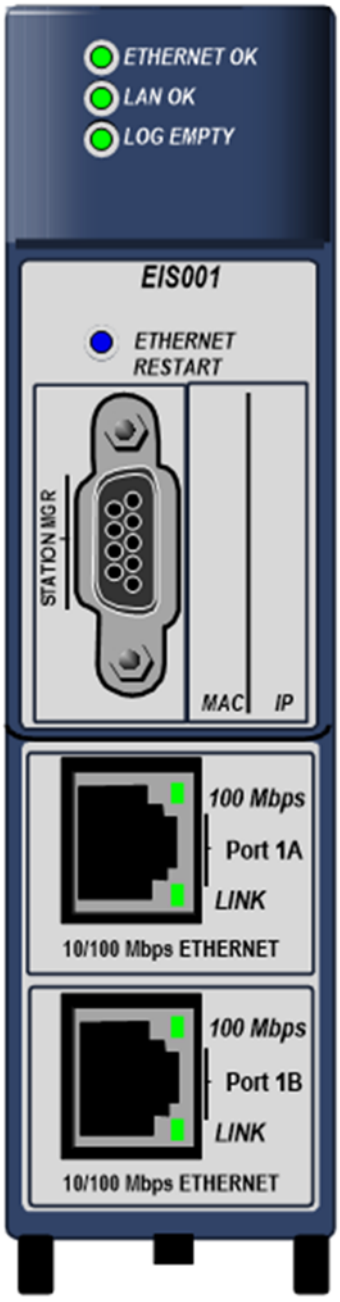
Module Features

The Ethernet 104 Server Module:

- Supports up to eight connections to the RX3i Controller data set specified in the configuration.
- Supports Interrogation and RBE for Single Point and Double Point data.
- Supports Interrogation and RBE for Regulated Step.
- Supports Interrogation and Measured data sets for Scaled, normalized, and single precision Float.

- Supports 56-bit IEC 60870-5-104-time format, with the default being 56-bit time format.
- Supports Time Set, and query of the RX3i Controller CPU Clock in UTC time.
- Cause of Transmission size is two octets.

Figure 3: IC695EIS001 Front View



The Ethernet 104 Server Module specifications:

- Up to four EIS001 per RX3i, as allowed by available power and slots.
- Module can be installed in any available RX3i main rack I/O slot.

- Module supports insertion into and removal from an RX3i backplane which is under power.
- Firmware upgrade through RX3i CPU using WinLoader software utility.

1.5 Specifications

Module Name	PACSystems RX3i Ethernet 104 Server Module.
Catalogue	IC695EIS001-AA.
Protocol Supported	IEC60870-5-104 Server.
Connectors	- Station Manager (RS-232) Port: 9-pin female D-connector - Two 10BaseT / 100BaseTX Ports: 8-pin female shielded RJ-45.
LAN	IEEE 802.2 Logical Link Control Class I IEEE 802.3 CSMA/CD Medium Access Control 10/100 Mbps.
Number of IP addresses	One
Number of Ethernet Ports	Two. Both are 10BaseT / 100BaseTX with auto-sensing. Connectors are RJ-45.
Embedded Ethernet Switch	Yes – Allows daisy-chaining of Ethernet nodes.
Serial Port	Station Manager Port: RS-232 DCE, 1200 – 115,200 bps.
Modules per RX3i CPU	4
Number of 104 Clients supported per module	8 Refer to the sections Multiple Client Connection Configuration and COMMREQ –Shift RBE on Client Connection Associated with a Specified Port Number
Number of 104 Sectors supported per module	One
Number of 104 Clients supported per RX3i CPU	4 per RX3i CPU
Number of 104 points per module	6144[1]
Network Topology supported	Star, Line, Daisy Chain.
Hot Swappable	Yes
Time Synchronization	SNTP Client
Power Requirements	3.3Vdc: 0.840 A maximum
	5 Vdc: 0.614 A maximum.

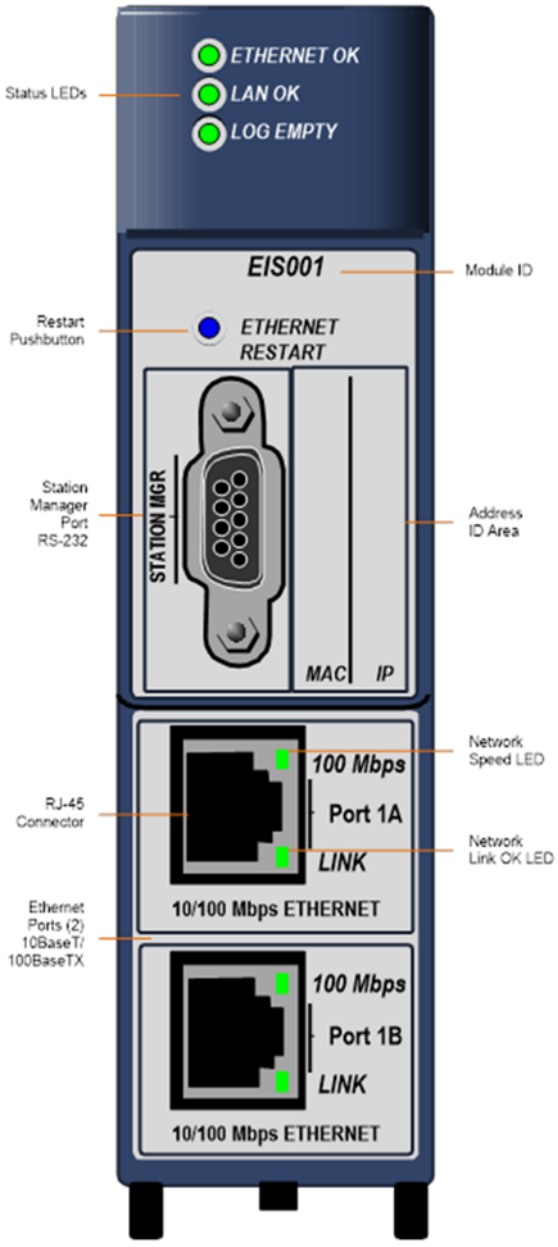
For system standards, general operating specifications, and installation requirements, refer to PACSystems RX3i System Manual, GFK-2314.

[1] Two Protection objects (M_EP_TB_1 and M_EP_TC_1) are only accessible through Point Push and not as Controller points. This constitutes 2048 points (1024 each) and is included in the total number of Points per Module.

1.6 Controls and Indicators

Figure 4 shows the front of the module and identifies its controls and indicators.

Figure 4: IEC 104 Server Module EIS001 Features at a Glance



1.7 RX3i IEC 104 Server Specifications and Restrictions

The following tables document the IEC 104 Server capabilities of the EIS001 module. Refer to the IEC 104 standard for details.

Interrogation Types	Description
General	General Interrogation is a full request of all point data on the Server from the client.
RBE	Whenever a point changes state, an exception report is sent to the Client of this event. Refer to Report by Exception Shutter Time mComreq_Setup [12] in Parameters for Filter Times for details. The IEC 104 Server does not buffer events, so a constant connection is required in order to receive a report.

1.7.1 ADSU Supported in General Interrogation

ADSU[2] supported in General Interrogation

Mnemonic	Number	Description
M_SP_NA_1	1	Single-point information
M_DP_NA_1	3	Double-point information
M_ST_NA_1	5	Step position information
M_BO_NA_1	7	Bit string of 32-bit
M_ME_NA_1	9	Measured value, normalized value
M_ME_NB_1	11	Measured value, scaled value
M_ME_NC_1	13	Measured value, scaled value (Short Float)
M_EP_TB_1	18	Packed start events of protection equipment with time tag
M_EP_TC_1	19	Packed output circuit information of protection equipment with time tag

1.7.2 ADSU Supported without Time Tag and RBE

ADSU supported without time tag, and Report by Exception (RBE).

Mnemonic	Number	Description
M_ME_NC_1	13	Measured value, scaled value (Short Float) without time tag

[2] For definition of ADSU, refer to Glossary.

1.7.3 ADSU Supported with 56-Bit Time Tag and RBE

ADSU supported with 56-bit time tag, and Report by Exception (RBE)

Mnemonic	Number	Description
M_SP_TB_1	30	Single-point information with time tag CP56Time2a
M_DP_TB_1	31	Double-point information with time tag CP56Time2a
M_ST_TB_1	32	Step position information with time tag CP56Time2a
M_BO_TB_1	33	Bit String of 32-bit with time tag CP56Time2a
M_ME_TD_1	34	Measured value, normalized value with time tag CP56Time2a
M_ME_TE_1	35	Measured value, scaled value with time tag CP56Time2a
M_ME_TF_1	36	Measured value, scaled value with time tag CP56Time2a
M_EP_TE_1	39	Packed start events of protection equipment with time tag CP56Time2a
M_EP_TF_1	40	Packed output circuit information of protection equipment with time tag CP56Time2a

1.7.4 ADSU Supported Commands

ADSU Commands

Mnemonic	Number	Description
C_SC_NA_1	45	Single command
C_DC_NA_1	46	Double command
C_RC_NA_1	47	Regulating step command
C_BO_NA_1	51	Bit String set command
C_SE_NA_1	48	Set-point Command, normalized value
C_SE_NB_1	49	Set-point Command, scaled value
C_SE_NC_1	50	Set-point Command, short floating-point number

1.7.5 ADSU Supported Commands and Responses

ADSU Command and Responses

Mnemonic	Number	Description
C_SC_TA_1	58	Single command with time tag CP56Time2a
C_DC_TA_1	59	Double command with time tag CP56Time2a
C_RC_TA_1	60	Regulating step command with time tag CP56Time2a
C_BO_TA_1	64	Bit String Response with time tag CP56Time2a
C_SE_TA_1	61	Measured value, normalized value command with time tag CP56Time2a
C_SE_TB_1	62	Measured value, scaled value command with time tag CP56Time2a
C_SE_TC_1	63	Measured value, short floating-point number command with time tag CP56Time2a

Note: The commands are time tagged and only valid for the Command Age time.

Command Age: The value for this field is fixed to 5000 milliseconds. Time tagged commands must have a time tag no older than this period or the control operation will not take place.

1.7.6 General Purpose ADSUs Supported

General Purpose ADSUs supported

Mnemonic	Number	Description
C_IC_NA_1	100	Interrogation command
C_CS_NA_1	103	Clock synchronization command

1.8 Performance and Limitation

1.8.1 General Restrictions

Topic	Notes
Ethernet parameters	The IEC 104 server application code is developed on top of the RX3i ETM001 platform and is configured as an IC695EIS001 in the PAC Machine Edition E hardware configuration. The module is limited to IPV4 addressing and can accept AUP file settings for module parameters. Refer to the PACSystems RX7i & RX3i TCP/IP Ethernet Communications User Manual, GFK-2224 for more information.

1.8.2 Point Count Restrictions

Table 1: Maximum Point Counts

ADSU	Maximum Point Count (in a Demo Mode)	Maximum Point Count (when licensed)	Memory Restriction
M_SP_NA_1	16	1024	Digital Memory Only.
M_DP_NA_1	8	512	Digital Memory, where each 2 points is a byte.
M_ST_NA_1	8	512	Analog Memory, 16-bit width per point.
M_BO_NA_1	8	512	Word Memory, 32-bit width per point.
M_ME_NA_1	8	512	Analog Memory, 16-bit width per point.
M_ME_NB_1	8	512	Analog Memory, 16-bit width per point.
M_ME_NC_1	8	512	Word Memory, 32-bit width per point, “REAL” type.
M_EP_TB_1	16	1024	Only accessible through Point Push.
M_EP_TC_1	16	1024	Only accessible through Point Push.

1.8.3 Point Event Count Restrictions

Table 2: Maximum Event Counts

ADSU	When SOE for this ADSU is enabled	Memory Restriction
M_SP_NA_1	2000 (Default -1024)	Digital Memory Only.
M_DP_NA_1	2000 (Default -1024)	Digital Memory, where each 2 points takes a byte.
M_ST_NA_1	2000 (Default - 512)	Analog Memory, 16-bit width per point.
M_BO_NA_1	2000 (Default -1024)	Word Memory, 32-bit width per point.
M_ME_NA_1	2000 (Default - 512)	Analog Memory, 16-bit width per point.
M_ME_NB_1	2000 (Default - 512)	Analog Memory, 16-bit width per point.
M_ME_NC_1	2000 (Default - 512)	Word Memory, 32-bit width per point, “REAL” type.
M_EP_TB_1	2000 (Default - 512)	Digital Memory Only (Only accessible through Point Push).

ADSU	When SOE for this ADSU is enabled	Memory Restriction
M_EP_TC_1	2000 (Default - 512)	Digital Memory Only (Only accessible through Point Push)

1.9 Glossary

ADSU	A generic term used for referring to a collection of data points, or a single data point, on an IEC 104 device. An object can have a specific action on a Server and all objects are defined in the IEC 104 Specification.
ASDU	Application Service Data Unit.
AUP	Advanced User Parameters for Ethernet configuration, a file which contains specific parameter overrides and options for the Ethernet Module.
COMMREQ	A Communications Request Instruction supported by RX3i CPUs. Conveys data from the RX3i CPU to a designated target device. In this application, a single COMMREQ conveys all the IEC 104 Server parameters to the EIS001.
CPO	Control Point Offset, a point index scheme by which the Server can protect data from being over-written. It does so by only allowing points above a given index value to be written to. Points at or below the index are read-only.
CRS	COMMREQ Status word.
CRU	A Controller (CPU) configured for Redundancy application.
IEC 104	The document term for the IEC60870-5-104 protocol specification.
IOA	Item of Activation, a term for a point which is the target object of a command.
IPv4	Internet Protocol version 4 (IPv4) is the fourth version in the development of the Internet Protocol (IP), and routes most traffic on the Internet. IPv4 is described in IETF publication RFC 791.
LAN	Local Area Network.
LED	Light Emitting Diode.
LIS	LAN Interface Status Bits are data provided by the module concerning the health and status of its Ethernet interface. The status includes that of the physical module as well as of the attached network.
PAC Machine Edition	PAC Machine Edition – used to configure, program and monitor RX3i Systems.
RBE	Report by Exception.
Segment	This term refers to the instance of data, the IEC 104 plug-in only supports one data segment, as the Controller has only one memory space.
Sessions	This term refers to the number of clients that can connect to the IEC 104 server. The IEC 104 plug-in supports up to one.
ST	Structured Text: a programing language supported by RX3i CPUs.
SOE	Sequence of Events: a generic term used to describe a mechanism that can detect data change, then time-stamping each change for the purpose of establishing the sequence in which the changes were detected.
TCP/IP	The Transmission Control Protocol (TCP) is one of the core protocols of the Internet Protocol suite (IP), and is so common that the entire suite is often called TCP/IP. TCP

	provides reliable, ordered and error-checked delivery of a stream of octets between programs running on computers connected to a local area network, intranet or the public Internet. It resides at the transport layer.
ST Block	A program block within ST. In this application one uses a single ST Block to convey a COMMREQ from the RX3i CPU to the EIS001 in order to set up all its IEC 104 parameters.

1.10 References

PACSystems RX7i and RX3i CPU Reference Manual	GFK-2222
PACSystems RX7i and RX3i CPU Programmer's Reference Manual	GFK-2950
PACSystems RX7i & RX3i TCP/IP Ethernet Communications User Manual	GFK-2224
PACSystems TCP/IP Ethernet Communications Station Manager User Manual	GFK-2225
PACSystems RX3i System Manual	GFK-2314
PACSystems RX3i Ethernet 104 Server IC695EIS001 Quick Start Guide	GFK-2948
PACSystems RX3i Ethernet 104 Server IC695EIS001 Important Product Information	GFK-2947

User manuals, product updates and other information sources are available on the Support website,https://www.emerson.com/Industrial-Automation-Controls/support Controllers and IO, RX3i Controllers

Section 2: Installation

This chapter provides instructions for installing the module. The following topics are covered.

- Pre-Installation check.
- Module installation and removal.
- Port connections.
- LED indications.
- Firmware updates.

For additional information about RX3i system installation, refer to PACSystems RX3i System Manual, GFK-2314. For all EIS001 module installation procedures, use ETM001 as a reference since EIS001 is constructed on the ETM001 hardware platform.

You will also need PAC Machine Edition configuration and programming software, version 8.50 SIM 9 or later.

2.1 Pre-Installation Check

Upon receiving your RX3i equipment, carefully inspect all shipping containers for damage. If any part of the system is damaged, notify the carrier immediately. The damaged shipping container should be saved as evidence for inspection by the carrier.

As the consignee, it is your responsibility to register a claim with the carrier for damage incurred during shipment. Emerson will cooperate fully with you, however, should such action be necessary.

After unpacking the RX3i equipment, record all serial numbers. Serial numbers are required if you should need to contact Customer Care during the warranty period. All shipping containers and all packing material should be saved should it be necessary to transport or ship any part of the system.

Verify that all components of the system have been received and that they agree with your order. If the system received does not agree with your order, contact Customer Care.

If need technical help, contact Technical Supporthttps://www.emerson.com/Industrial-Automation-Controls/support.

2.2 Installation Location

This product is intended for use with the RX3i system. Its components are considered open equipment (having live electrical parts that may be accessible to users) and must be installed in an ultimate enclosure that is manufactured to provide safety. At a minimum, the enclosure shall provide a degree of protection against solid objects as small as 12 mm (for example fingers). This equates to a NEMA/UL Type 1 enclosure or an IP20 rating (IEC60529)

providing at least a pollution degree 2 environment. For details about installing RX3i rack systems, refer to PACSystems RX3i System Manual, GFK-2314.

2.3 Installation in Hazardous Areas

The following information is for products bearing the UL marking for Hazardous Areas or ATEX marking for explosive atmospheres:

CLASS 1 DIVISION 2 GROUPS ABCD

- This equipment is an open-type device and is meant to be installed in an enclosure suitable for the environment that is only accessible with the use of a tool.
- Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations, or nonhazardous locations only.

⚠ WARNING

- EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.
- WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES; AND
- DO NOT CONNECT OR DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.

2.3.1 ATEX Zone 2

The module must be mounted in an enclosure certified in accordance with EN60079-15 for use in Zone 2, Group IIC and rated IP54. The enclosure shall only be able to be opened with the use of a tool.

2.3.2 ATEX Marking

Ex II 3 G Ex nA IIC T5 X Ta: 0 - 60C

2.4 Module Installation

2.4.1 Mounting the EIS001

The EIS001 mounts in any suitable main rack I/O slot of the RX3i backplane. Refer to PACSystems RX3i *System Manual,* GFK-2314 Chapters 2 and 3 for details on how to mount/dismount RX3i modules and slot choices available.

The EIS001 may be installed while the rack is under power. Refer to *PACSystems RX3i System Manual,* GFK-2314 Chapter 2 for hot-swap details.

At least 75 mm (3”) must remain clear above and below the module to allow for convection cooling.

Power Connection

Once the module has been mounted in the RX3i rack, it will receive power from the installed power supply through the RX3i backplane.

Grounding

Note that the EIS001 is fitted with a metal shroud which needs to be secured to the lower rail of the RX3i rack in order to provide a path to ground for noise immunity. Two screws are provided for this purpose. Failure to attach the shroud to the RX3i rack will likely lead to degraded product performance in the presence of electrical noise.

Also refer to the grounding instructions for the RX3i Rack and associated hardware in PACSystems RX3i System Manual, GFK-2314, Chapter 2.

Cable Connection

Attach shielded twisted pair cables to one or both RJ-45 connectors. Optionally, attach the Station Manager to the RS-232 port.

⚠CAUTION

Some Ethernet cables come equipped with RJ-45 connectors that are oversized. Do not exert pressure to insert oversized connectors into the RJ-45 jacks as this may result in damage to the module.

2.4.2 EIS001 Module Removal

The EIS001 may be removed from its RX3i rack while the rack is still under power.

Follow the standard procedure for removing an RX3i module from its slot position, as detailed in PACSystems RX3i System Manual, GFK-2314 Chapter 2.

Once removed from the rack, the Ethernet connection(s) will become inactive. The RS-232 Station Manager Port will also cease to operate.

2.5 Spare Parts

There are no spare parts specific to IC695EIS001.

Section 3: Configuration

The RX3i EIS001 IEC 104 Server Module receives three different types of configuration:

a. Its rack/slot location is determined through the hardware configuration tool in PAC Machine Edition and is downloaded to the RX3i CPU.

b. Its Ethernet parameters are set through PAC Machine Edition, as documented in PACSystems RX7i & RX3i TCP/IP Ethernet Communications User Manual, GFK-2224 Chapter 4. Similarly, its Station Manager parameters are set through PAC Machine Edition, as documented in PACSystems TCP/IP Ethernet Communications Station Manager User Manual, GFK-2225.

c. The IEC 104 Server profile is determined by a COMMREQ instruction that is used to initialize it. The COMMREQ is executed only once following power-up or restart of the RX3i system.

3.1 Configuration Tools

- PACSystems RX3i CPU Firmware 8.00 or later. Refer to PACSystems RX3i Ethernet 104 Server IC695EIS001 Important Product Information, GFK-2947 for firmware compatibility.
- PAC Machine Edition configuration and programming software, version 8.50 SIM 9 or later.
- Serial or Ethernet cable for connecting the PAC Machine Edition programmer computer to the RX3i CPU.

3.2 RX3i Rack/Slot Hardware Configuration

Use PAC Machine Edition to configure the EIS001 within the host RX3i System. Select a suitable rack and slot location (Figure 5) and install EIS001 at that location (Figure 6) with the PAC Machine Edition hardware configuration tool. PAC Machine Edition will check whether the installed power supply can handle the combined load of the EIS001 and all other installed modules. All other configuration details, such as which I/O points and registers to be read or written by the EIS001, are handled as part of the IEC 104 Server Configuration discussed in Section 3.6 below.

There are no RX3i memory locations explicitly reserved for the use of the EIS001 module. However, the example logic will use the LAN status bits.

Figure 5: Adding Module to Rack/Slot location

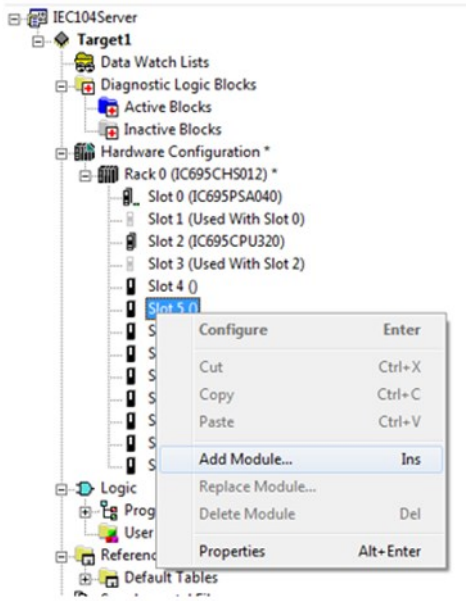
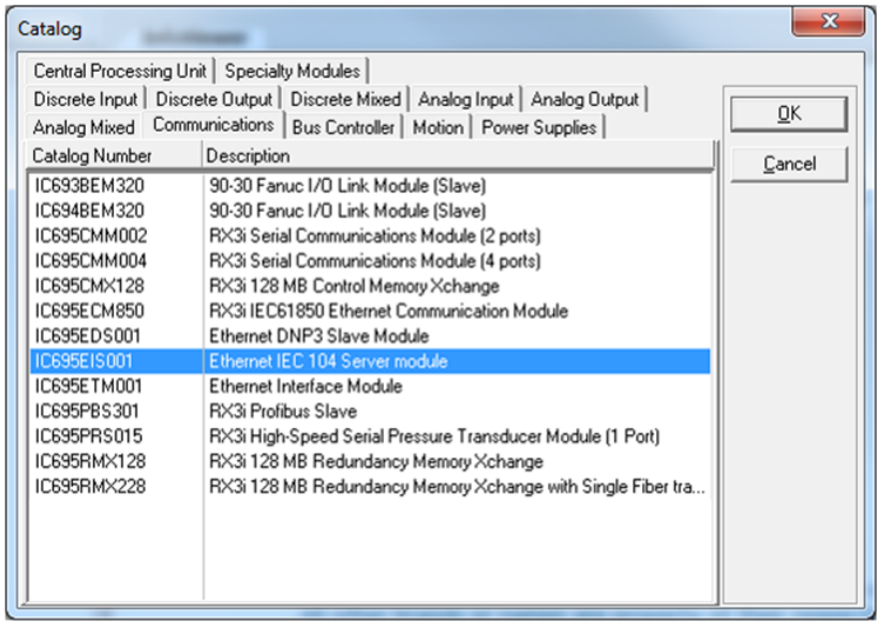


Figure 6: Selection of EIS001 for Installation



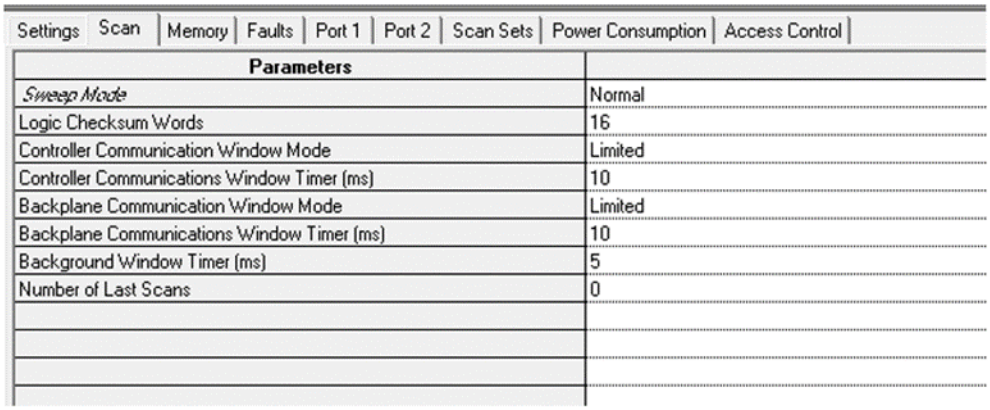
Note: *That any I/O or registers selected for EIS001 write operations should not be assigned to any other modules, as they will be overwritten. PAC Machine Edition does not check for such potential conflicts. For example, the %I space allocated to an input module should not be assigned to any IEC 104 object configured to an EIS001 module. Similarly, where multiple EIS001 modules are present in the same RX3i system, their configuration ought not to overlap as far as write operations to the CPU is concerned.*

The Emerson provided examples use variable mode on the EIS001 module to identify the terminals and prevent un-intended overlap using symbolic variables.

3.3 RX3i CPU settings

EIS001 modules require some amount of background scan time to efficiently transfer point data to and from the RX3i CPU. The minimum 5ms setting needs to be set in the Background Window Timer parameter in the CPU Scan tab of the hardware configuration screen for the CPU. More background scan time may be needed if multiple EIS001 modules are used.

Figure 7: CPU Configuration Showing Example of Scan Settings (Scan Tab)



Parameters	
Sweep Mode	Normal
Logic Checksum Words	16
Controller Communication Window Mode	Limited
Controller Communications Window Timer (ms)	10
Backplane Communication Window Mode	Limited
Backplane Communications Window Timer (ms)	10
Background Window Timer (ms)	5
Number of Last Scans	0

3.4 LAN Interface Status Bits

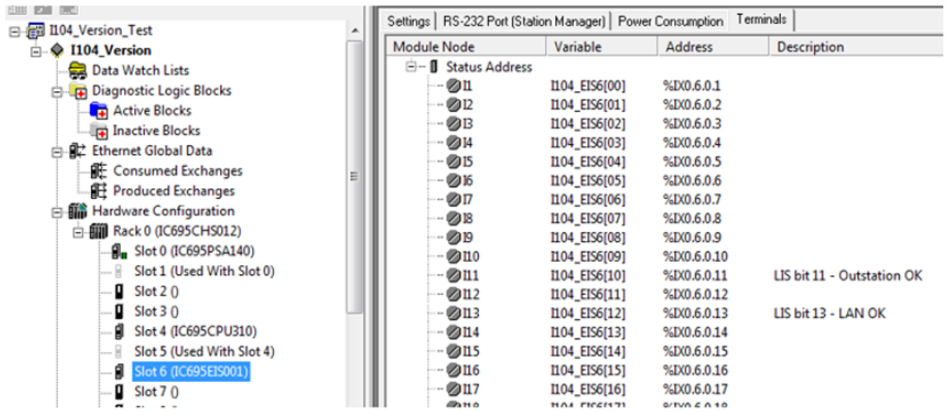
There are 80 LAN Status bits; the EIS001 module will typically use two of the LSI bits to control parameterization, as follows:

a. The EIS001 will signal that it is ready to accept parameterization by asserting Bit 11. and

b. The CPU should typically not communicate with the EIS001 until such time as Bit 13 has been asserted.

Note: *Should there be a failure of the EIS001 during parameterization, these bits may remain in a 1 or 0 state.*

Figure 8: EIS001 LAN Status Bits (Bits 11 & 13)



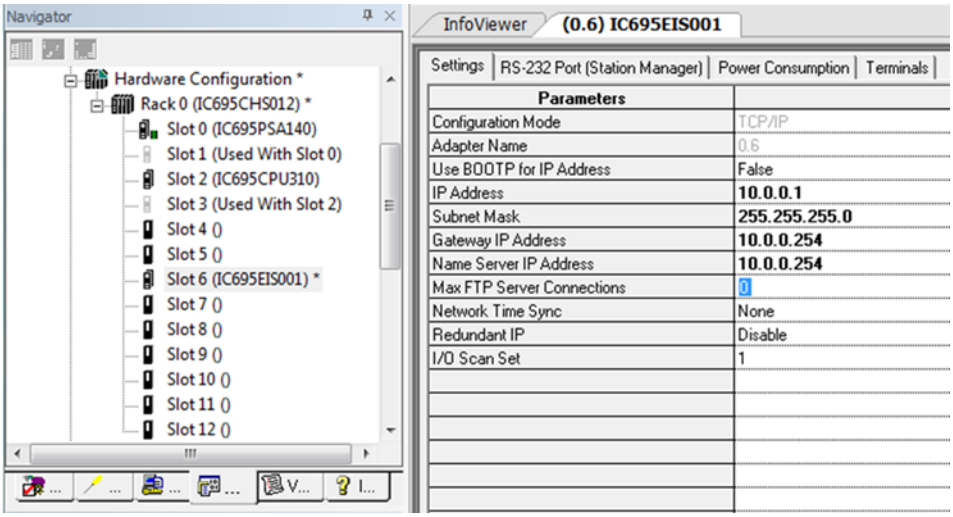
3.5 Ethernet Configuration

Refer to PACSystems RX7i & RX3i TCP/IP Ethernet Communications User Manual, GFK-2224 Chapter 4. There is a section dealing with Ethernet Configuration for rack-based modules.

EIS001 is limited to IPv4 addressing and can accept Advanced User Parameters (AUP) file settings for module parameters.

In PAC Machine Edition, click on the EIS001 module; open the parameter configuration window. On the Settings tab, enter the IP Address, subnet mask, and gateway IP Address for the EIS001 Ethernet interface as required by the IEC 104 network configuration. Note: there is only one MAC Address and one IP Address for the module. Values are shown in the example below:

Figure 9: PME Tab for Entering Ethernet Settings to be used by EIS001



3.6 IEC 104 Server Configuration

The IEC 104 configuration settings determine how the EIS001 will be expected to interact with its IEC 104 Client(s). The IEC 104 Server has only one instance of data that it serves.

As an IEC 104 Server, the EIS001 will have one profile, and it must be configured through the RX3i CPU before it can operate on the IEC 104 network. The COMMREQ outlined in 0 0is used for this purpose. It conveys all IEC 104 Server parameters from the RX3i CPU to the EIS001. The COMMREQ is executed only once to initialize the EIS001. Refer to Appendix A: for the status area definition for diagnostics information for the IEC 104 Server module. Also refer to Appendix D: for the IEC 104 Server device profile as applicable to the EIS001 module.

Once configured and connected to its IEC 104 Client(s), the EIS001 will exchange data automatically per its configuration and that of its Clients.

RX3i CPU memory needed for IEC 104 Server data can optionally be configured into the EIS001 module using a single startup COMMREQ, as documented in 0. The Server configuration is permitted to use %I, %AI, %Q, %AQ, %R, %W, %M, %T and %G memory types,

as documented in 0. Ranges should be selected to accommodate the amount of data involved, but not overflow the end-point of the memory type.

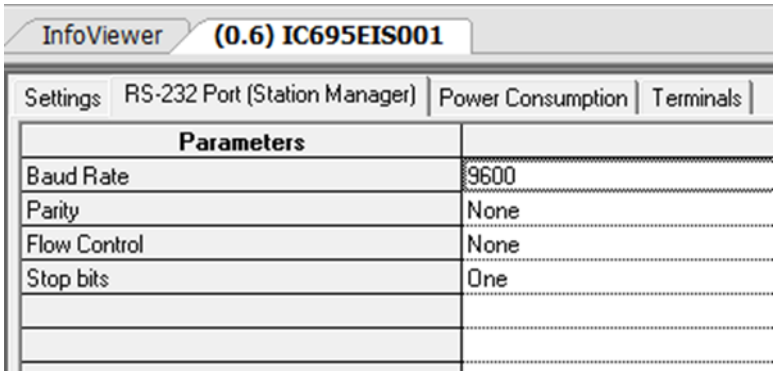
The Server configuration file also includes parameters to define an area of Controller memory for Client station-Server communication status, if required. The Parameters for Server Status Space is defined in Section 6.4.3.

As mentioned above, the EIS001 may be connected to separate LANs using its two Ethernet Ports (marked Port 1A and Port 1B). The two ports are independent and should be connected to the same LAN. Whenever both ports are connected to active LANs, the Clients on one LAN will typically impose different real-time demands on the EIS001 than the Clients on the alternate LAN. Nonetheless, all traffic is handled per the Configuration of IEC 104 Server Parameters Using COMMREQ instruction detailed in 0.

3.7 Station Manager Configuration

Use the RS-232 Port (Station Manager) tab in PAC Machine Edition to set up the Station Manager port on the EIS001 module.

Figure 10: Station Manager Configuration Tab (Showing Defaults)



Refer to PACSystems TCP/IP Ethernet Communications Station Manager User Manual, GFK-2225.

Details on the EIS001-specific Station Manager commands may be found in Appendix B:. For all common Station Manager commands, use ETM001 as a reference and refer to PACSystems TCP/IP Ethernet Communications Station Manager User Manual (GFK-2225). The EIS001 module is constructed on the ETM001 platform.

Section 4: System Operation

This chapter provides a System Overview and describes:

- Communications
- Redundancy
- I/O Scans
- Alarms
- Station Manager

4.1 System Overview

4.1.1 Communications

The EIS001 is a self-standing communication processor. During normal operation, it handles asynchronous requests from its IEC 104 Client and exchanges corresponding data with the host RX3i CPU at designated portions of the CPU scan. It performs all these tasks without burdening the CPU beyond the windows designated for data exchange.

On power-up or reset it will await the COMMREQ from the user application environment to set parameters and put it into operation. Once it receives the parameters, the module scans the RX3i for data, based on its configuration. It detects and registers data changes within its host Controller. It also services asynchronous IEC 104 Client requests for polling (such as reading of Controller data) and writing of data to Controller memory.

Because the module is self-standing, it polls the CPU during the CPU background scan window for data, per its configuration. The module detects and records all corresponding data changes internally. Whenever a Client writes to it, the module must wait for the CPU to allow it to write the corresponding information into the Controller memory during the same window.

All Ethernet traffic is asynchronous to the RX3i CPU scanning operation, so the module can service many different requests without burdening the CPU with processing them.

4.1.2 Redundancy

There are no restrictions that apply to an EIS001 when installed in a redundant RX3i CPU. The polling of event and integrity data will occur as if it were in a simplex system.

The EIS001 can take advantage of the Redundant IP feature of a Redundant CPU system, allowing two EIS001 modules in two racks to appear as one module.

*Note: The Write Operations and ADSU will be processed by the active controller only. A Client connected to an RX3i CRU system that uses Redundant IP can experience a bump, or loss of communication in the event of a role switch at the IEC 104 Client station. This is mainly due to the way the Client and its host Operating system processes the change in end station whenever the RX3i switches roles. The Client application, as well as the RX3i Controller application must be developed to withstand a likely bump in the connection during a role switch and not act inappropriately. This depends on the client tolerance and AUP File parameters (**wkal_idle, wkal_cnt, wkal_intvl**) needs to be adjusted depending on the network hops to get an optimized performance for role switch operation.*

4.1.3 I/O Scans

The EIS001 module for IEC 104 data exchange does not use a specific I/O Scan Set as defined in the PAC Machine Edition processor Settings tab and in the Ethernet tab for the EIS001 Module.

STOP Mode

In Stop Mode, the IEC 104 Server will respond to General Interrogation requests. The requests will be serviced with current state data; however, the data will be marked as non-topical to the Client Station. In STOP Mode, write operations will return a failure to the Client Station.

RUN IO Disable

In RUN IO Disable Mode, the IEC 104 Server will respond as documented for Stop Mode, but the not topical flag will not be present on the data.

CRU Local Active OFF

In CRU Local Active OFF Mode, (where the client is connected to the IP of the module, not the redundant IP) the IEC 104 Server will respond as documented for Stop Mode, but the not topical flag will not be present on the data.

Note: Refer to

Option Parameters for more details.

⚠CAUTION

There is no interlock between BIT or WORD functions of individual EIS001 modules. They can reference the same memory space and can accept contrary commands from various Client stations.

4.1.4 Alarms

The EIS001 generates faults which are logged into the Fault table. A given fault may relate to the Ethernet interface, or may be specific to the IEC 104 Server functionality. Refer to PACSystems RX7i & RX3i TCP/IP Ethernet Communications User Manual, GFK-2224 for a description of ETM001-related alarms.

4.1.5 Station Manager

The RS-232 port on the EIS001 module is set up to be used as a Station Manager. Typically, this is used for trouble-shooting and administrative purposes.

In addition to standard Station Manager commands, the EIS001 module responds to specific Stat and Tally Station Manager commands for IEC 104 information. The formats are:

- stat a. Response displays various operating status. Note the response for technical support.
- tally a. Response displays various operating counters. Note the response for technical support.

See Appendix B: for examples of these two commands.

For all other commands and responses, refer to PACSystems TCP/IP Ethernet Communications Station Manager User Manual, GFK-2225.

Each EIS001 will log many conditions to its own Station Manager Log, as well as to RX3i Controller table as part of Fault Group 0x16.

Section 5: Diagnostics

This chapter describes:

- Status Data
- Module LED Indicators
- Power-up
  - Module Restart
  - Problems During Power-up and Reset
  - Transitioning from Firmware Update Mode to Normal Operating Mode

5.1 Status Data

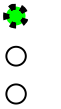
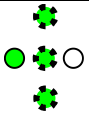
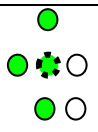
The EIS001 produces a total 100 words to supply status information to the controlling RX3i CPU. As part of the COMMREQ instruction to parameterize the EIS001 module, a 100-word region can be specified for real time diagnostics on the module.

For each bank of 32 status bits, a default beginning reference (the next available %I) for the status bits is automatically assigned by PAC Machine Edition. These assignments may be changed by clicking on the EIS001 and keying in different %I reference, or by switching the module to variable mode, and using symbolic addresses.

Refer to Appendix A: for more details on diagnostic information.

5.2 Light-Emitting Diode (LED) Indications

The three LEDs in the module header provide a visual indication of the EIS001 module status. Additionally, each RJ-45 port is equipped with a pair of LEDs to indicate the status of the corresponding port.

LED	State			Indicates
ETHERNET OK LAN OK LOG EMPTY		Fast Blink Off Off		Performing Diagnostics
ETHERNET OK LAN OK LOG EMPTY		Slow Blink Off Off		Waiting for Ethernet configuration from CPU
ETHERNET OK LAN OK LOG EMPTY		Slow Blink* On/Traffic/Off Slow Blink*	(* EOK and STAT blink in unison)	Waiting for IP Address
ETHERNET OK LAN OK LOG EMPTY		On On/Traffic/Off On/Off		Operational

LED	State			Indicates
ETHERNET OK LAN OK LOG EMPTY		Blink error code Off Off		Hardware failure, refer to PACSystems RX7i & RX3i TCP/IP Ethernet Communications User Manual, GFK-2224, section 12.4 for blink code definitions.
ETHERNET OK LAN OK LOG EMPTY		Slow Blink* Slow Blink* Slow Blink*	(* All LEDs blink in unison)	Firmware Update (pattern is the same for awaiting or performing load)
Port LEDs (one pair for Port 1A, second pair for Port 1B)				
100 Mbps		On Off		100 Mbps Active 100 Mbps Not Achieved
LINK		Rapid Blink Off		Traffic Detected on Port No Traffic Detected on Port

5.3 Power-Up

5.3.1 Problems during Power-Up

Certain conditions can prevent the module from powering up and becoming operational or entering firmware update mode:

Problem	Indication	Action
Hardware failure	All Indicator LEDs off. Module unresponsive.	Contact Technical Support to arrange for repair and replacement
Invalid boot image		
Invalid firmware image	Power LED is ON but OK LED is off or Power LED alternates Green & Amber	Perform firmware update

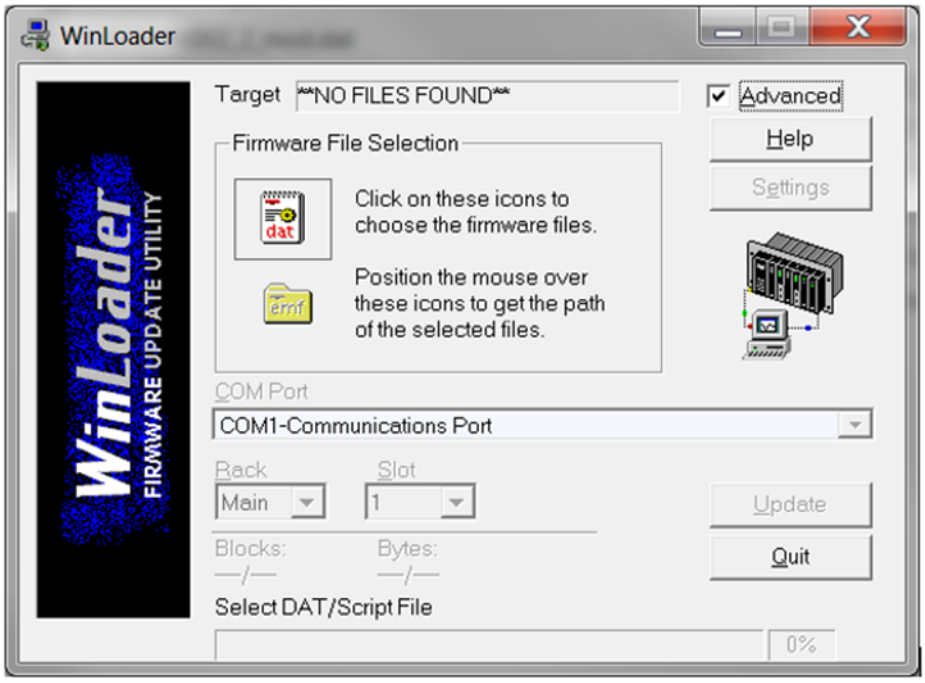
5.3.2 Firmware Update Mode

The EIS001 firmware consists of the ETM001 firmware plus the IEC 104 Server specific firmware, and an Emerson installed license.

Each firmware upgrade may be obtained from the Emerson support web-site as a uniquely-identified ZIP file. The ZIP file must be downloaded to a computer which can be connected to the host RX3i CPU. Each ZIP file includes instructions specific to the target product.

The updated firmware may then be passed to the EIS001 through the host RX3i CPU using the WinLoader utility. The CPU must be in STOP mode in order to deliver the firmware upgrade through the Serial port on the CPU.

Figure 11: WinLoader Utility Screen-Shot



After new firmware has been successfully downloaded to the EIS001 module, and the CPU has been switched to RUN mode, the EIS001 module will reboot using the new firmware. In order to initialize and resume IEC 104 Server operation, it is necessary to activate the Configuration of IEC 104 Server Parameters Using COMMREQ command detailed in 0 in order to provide the module with its IEC 104 Server profile.

Refer to the EIS001 firmware update LED pattern above This pattern is displayed between the time the firmware download is initiated by the CPU and until such time as the module is able to return to normal operation.

5.4 Module Faults in the RX3i I/O Fault Tables

Powering up or down, pressing the Ethernet Restart push-button, or connecting/disconnecting the EIS001 from its Ethernet LANs has effects on both the CPU and on the affected LANs.

If the EIS001 module fails, the RX3i CPU will record a Loss of Device fault particular to the EIS001 module at the corresponding rack/slot location. If the rack in which the EIS001 is located loses Power, and is not the same rack as the CPU, the RX3i CPU will record a Loss of Device for all devices in that rack, including for the EIS001 module(s) located there.

Adding an EIS001 to an RX3i rack causes the RX3i CPU to register an Addition of Device fault for the corresponding EIS001 and indicate the rack/slot location involved. Powering up a rack containing an EIS001 causes the RX3i CPU to register an Addition of Device fault for all devices in the rack, including the EIS001.

Pressing the Ethernet Restart push-button has no effect on the Fault Table in the RX3i CPU. However, all traffic on both LANs ceases to be processed by the EIS001 until such time as the Ethernet service has been re-established internal to the module. During this time, the

EIS001 module continues to read data from the RX3i CPU memory, per its IEC 104 Server configuration. Since no new data is available to be written to the CPU during the Ethernet reset period, the EIS001 presents no new data to the RX3i CPU.

Disconnecting an RJ-45 connector from Port 1A or Port 1B will disrupt Ethernet traffic on the corresponding port. The EIS001 continues to attempt transmission and reads data from the RX3i memory per its IEC 104 Server configuration in order to have fresh data available for transmission. Since no new IEC 104 data is received during this period, the EIS001 presents no new data to the RX3i CPU. Once the RJ-45 connector is re-connected, data exchanges per IEC 104 Server configuration will resume automatically.

5.4.1 Typical Fault Messages during Power-Up

The following messages may display in the RX3i CPU Fault Table during a typical power-on sequence:

Figure 12: Typical Power-Up Controller Fault Table Entries Originated by EIS001

Controller Fault Table (Displaying 6 of 6 faults, 0 Overflowed)

Loc	Fault Description	Date/Time
0.3	LAN system-software fault; resuming	01-01-2002 00:28:07
	Error Code: 402 | Group: 16 | Action: 2:Diagnostic | Task Num: 6	
	Fault Extra Data: 1a 00 01 00 01 00 01 00 63 03 91 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
0.3	LAN system-software fault; resuming	01-01-2002 00:28:07
	Error Code: 402 | Group: 16 | Action: 2:Diagnostic | Task Num: 6	
	Fault Extra Data: 1a 00 01 00 01 00 01 00 02 02 f3 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
0.3	LAN system-software fault; resuming	01-01-2002 00:28:06
	Error Code: 402 | Group: 16 | Action: 2:Diagnostic | Task Num: 6	
	Fault Extra Data: 1a 00 00 c1 42 01 00 00 01 01 51 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
0.3	LAN system-software fault; resuming	01-01-2002 00:28:06
	Error Code: 402 | Group: 16 | Action: 2:Diagnostic | Task Num: 6	
	Fault Extra Data: 1a 00 00 00 00 00 04 d6 e6 02 7f 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
0.3	Reset of option module	01-01-2002 00:27:59
0.3	Loss of option module - Reset requested by SVC_REQ	01-01-2002 00:27:59

Typical Fault Messages during Power-Up details the normal start-up sequence of the EIS001 module. These annunciations are to be expected. In chronologic order, starting at the bottom line and moving up, you will see:

a. The EIS001 is operating, and the check of the license has been performed. In this example the module is licensed, starting in value 2 and 3, the different license checks return in values 4 to 7 and in values 8 and 9 is D6 E6.

b. The EIS001 firmware Revision is being displayed. In the example at value 4, C1 42 01 00, this is also the message before waiting for configuration.

c. The EIS001 module has been configured and is operating.

d. The EIS001 module is not entering the main loop and has registered the module online.

* In Demo mode more messages will be present indicating the lack of a license.

Refer to Appendix C: for more details, or other log messages.

5.4.2 Using Status Data for Troubleshooting

There are three main types of status data available to the RX3i application program:

1. **FT Output of the COMMREQ Function Block:** This output is set if there is a programming error in the COMMREQ Function Block itself, if the rack and slot specified in the COMMREQ SYSID parameter is not configured to contain an Ethernet interface, or if the data block length specified in the Command Block is out of range. This output may also indicate that no more COMMREQ functions can be initiated in the ladder program until the Ethernet interface has time to process some of the pending COMMREQ functions.

   If the FT Output is set, the CPU does not transfer the Command Block to the Ethernet interface. Under these circumstances, the other status indicators are not updated for this COMMREQ.

2. **Status Bits:** The status bits are updated by the Ethernet interface in the RX3i CPU reference table once each Controller scan. These bits are generally used to prevent initiation of a COMMREQ function when certain errors occur or to signal a problem on an established channel. The status bits include the LAN Interface Status bits and the Channel Status bits. The starting location of these bits is set up when the module is configured.

3. **The LAN Interface Status (LIS) Bits** monitor the health of the Ethernet interface itself, such as the LAN Interface OK bit.

4. **Communications Status Word**: The COMMREQ Status word (CRS word) provides detailed information on the status of the COMMREQ request. The communications status word is not updated in the CPU each scan as are the status bits. They are generally used to determine the cause of a communication error after the COMMREQ function has been initiated. The cause is reported in the form of an error code. The COMMREQ Status word (CRS word) is returned from the Ethernet interface to the RX3i CPU immediately if the Command Block contains a syntax error or if the command is local. The location of the CRS word is defined in the Command Block for the COMMREQ function. Refer to Section 5.13.

5.4.3 Clearing the RX3i Fault Tables

Clearing the RX3i CPU and/or I/O Fault Tables has no effect on the EIS001, nor does it clear the EIS001 log information. This action merely clears the I/O Fault Table temporarily.Configuration of IEC 104 Server Parameters Using COMMREQ

This chapter describes the configuration parameters used to set up the IEC 104 Server aspects of the EIS001 module. The COMMREQ used to convey the parameters from the user's application program to the EIS001 is typically found in a structured text (ST) programming block in ladder logic. This chapter contains segments of ladder logic to illustrate how various parameters are passed to the EIS001 module, and what the user's options are. The values supplied throughout the chapter are examples and may not relate to the way you wish your IEC 104 Server to be configured. Ladder logic examples can be found on the Emerson Support web-site https://www.emerson.com/Industrial-Automation-Controls/support.

Look for developer documents DD315 and DD317 for original ETM001 (IEC 104 Server) related collateral and EIS001 (IEC 104 Server) related collateral respectively.

mComreq_Setup [xx] appears throughout this chapter. mComreq_Setup [] is an array containing the parameter data the user wishes to move to the IEC 104 Server module through the COMMREQ instruction. [xx] is the index into that array.

5.5 Overview

The EIS001 module is set up as an IEC 104 Server using an ST block, which is executed once in a standard ladder logic program. The purpose of the ST block is to configure the EIS001 module with the parameters required for the user's application.

A typical user application might be trying to set up the IEC 104 Server as follows:

Table 3: Sample IEC 104 Server Memory Setup

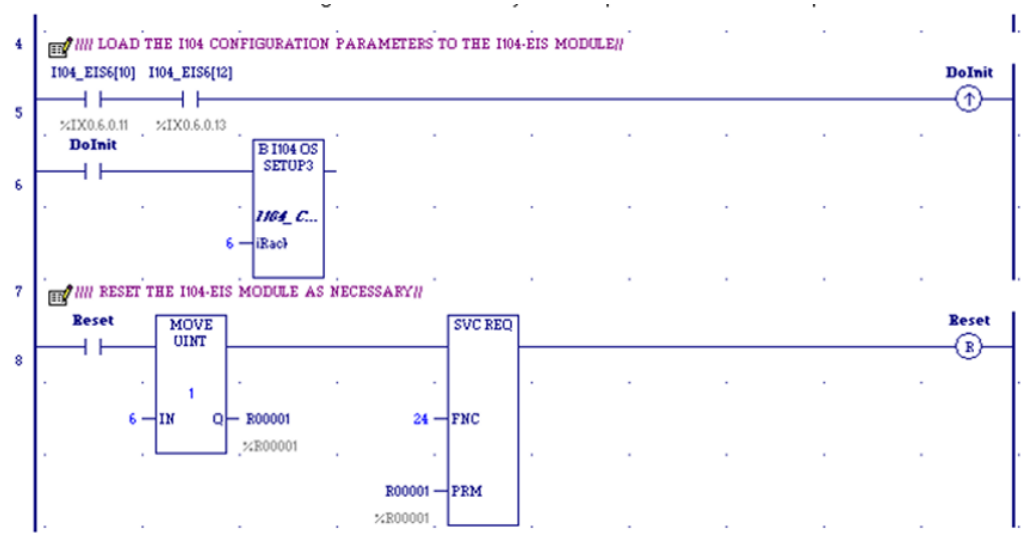
Sample User Requirement	RX3i CPU Memory Assignment	Range
COMMREQ Status Word	%R00001	1 word
Server Status Space	%W00001	100 words
M_SP (16 objects)	%I00001	%I00001-%I00016
M_DP (16 objects)	%Q00001	%Q00001-%Q00016
M_ST (4 objects)	%R00011	%R00011 - %R00015
M_ME_NA (4 objects)	%AI00001	%AI00001-%AI00004
M_ME_NC (4 objects)	%AQ00001	%AQ0001-%AQ0008

An ST block simplifies the mechanics of the COMMREQ instruction which, when used to initialize the IEC 104 Server, conveys 114 configuration parameters from the user's application program to the EIS001 Module. It contains both required and optional parameters for IEC 104 Server functionality. Note that any change to the values must be re-sent through COMMREQ to a freshly started EIS001 module. Resetting the EIS001 can be

accomplished by using Service Request 24 (refer to PACSystems RX7i and RX3i CPU Programmer's Reference Manual, GFK-2950).

In the following ladder example, a one-shot is employed to ensure the ST block is executed only once following power-up or following a restart of the CPU. Before downloading the parameters, the logic waits until the EIS001 module signals that it is ready to accept its IEC 104 Server parameters.

Figure 13: Ladder Logic Used to Configure IEC 104 Server Parameters



The IEC 104 Firmware version can be checked in the word as defined in the COMMREQ configuration for Server status space described in section 6.3.3, Parameters for Server Status Space.

The details of the Status areas space is defined in Definition of the Status Area, in Appendix A: The Major and Minor version for IEC 104 Firmware are available in the offset 1 (Ver_1word) and 2 (Ver_2word) respectively.

The following is a capture of IEC 104 Firmware version as per the sample IEC 104 server requirement.

Figure 14

+9902	+0	+0	+9901	+0	+29478	-2039	16#0100	16#C142	+1863	%W00001
+0	+9904	+0	+0	+0	+9903	+0	+0	+2	+44	%W00011

Alternatively, the IEC 104 firmware version can also be checked using Station Manager Command – stat a as shown in Appendix B:.

The ETM001 firmware version can be found using online command as:

Target---> Online Commands --->Show Status...----->Details

5.6 Required Configuration Parameters

The ten parameters outlined in sections 5.6.1 and 5.6.2 are required for all RX3i IEC 104 Server configuration files. These parameters set a basic configuration in the IEC 104 Server module that allows connection to an IEC 104 Client station. All configuration parameter values should be entered in decimal format. Refer to the parameter description to determine valid input values for application-based, or user-defined, parameter settings. Set values for these parameters as required by the application.

Note: *Reserved parameters always have a value of zero (0).*

5.6.1 Standard COMMREQ Command Block Parameters

Parameter	Default Value	Description
mComreq_Setup [00]	87	COMMREQ Data Length(Index of the last used parameter in the COMMREQ - 5). Note: The maximum parameters supported for the COMMREQ is 92. Therefore, this is set to default (92-5) = 87. For example, In case you do not choose to use “Memory translation” in your application, then you can set this to (74-5 = 69), as Memory translation configuration starts from index 75. Alternately you can retain this to 87, and still disable Memory translation by setting Read and Command Translation table offset values to ‘0’ .Refer section 5.7 for Memory Translation Configuration parameters.
mComreq_Setup [01]	0	WAIT/NOWAIT Flag, always 0
mComreq_Setup [02]	m-type value	Memory Type for COMMREQ Status Word (CRS) Value: 8-%R, 10-%AI, 12-%AQ, 196-%W.
mComreq_Setup [03]	offset value	Memory Address Offset for COMMREQ Status Word (CRS). Zero-based offset into memory: value = address – 1 for example, %R1 requires offset 0, %R100 requires offset 99.
mComreq_Setup [04]	0	Reserved
mComreq_Setup [05]	0	Reserved

5.6.2

5.6.3 Parameters for Client Station-Server Connection

Parameter	Defaul tValue	Description
mComreq_Setup [06]	1240	Server Command Number, always 1240.
mComreq_Setup [07]	2404	TCP/IP Port Number for IEC104 Data Connection, typical 2404.
mComreq_Setup [08]	3	Base Sector Address Value: 1 to 255, typically 3
mComreq_Setup [09]	1	Number of Sessions / Number of Client Connections Value: 1 to 8. This parameter gets overridden with optional parameter. Refer to the section Option Parameters – Bit5 and Bit6 of optional parameter - mComreq_Setup [66].
mComreq_Setup [10]	1	Number of Segments Value: 1

5.7 Memory Translation Feature Configuration Parameters

The Optional Configuration Parameters listed in Section 5.8 are optional for RX3i IEC 104 Server configuration files. The Memory Translation feature can be configured using the parameters as described in this section.

All configuration parameter values should be entered in decimal format. Refer to the parameter description to determine valid input values for application-based, or user-defined, parameter settings.

Note: *Reserved parameters always have a value of zero (0).*

Unambiguous Addressing Scheme for Legacy 104 SCADA Clients

The addressing scheme for EIS001 release 1.00 supports ambiguous addressing, i.e. offset-based addressing for ADSUs. Some legacy SCADA clients (like CPELE/SAGE) may require unambiguous addressing (Unique addressing) for each ADSU object. The Memory Translation Feature Configuration Parameters support unambiguous Object Addressing.

5.7.1 Parameters for Read Translation Table

Parameter	Value	Description
mComreq_Setup [75]	0 to 32000	Read Translation Table MSP
mComreq_Setup [76]	0 to 32000	Read Translation Table MDP
mComreq_Setup [77]	0 to 32000	Read Translation Table MST
mComreq_Setup [78]	0 to 32000	Read Translation Table MBO
mComreq_Setup [79]	0 to 32000	Read Translation Table MMENA
mComreq_Setup [80]	0 to 32000	Read Translation Table MMENB
mComreq_Setup [81]	0 to 32000	Read Translation Table MMENC
mComreq_Setup [82]	0 to 32000	Read Translation Table MEPTB
mComreq_Setup [83]	0 to 32000	Read Translation Table MEPTC

5.7.2 Parameters for Command Translation Table

Parameter	Value	Description
mComreq_Setup [84]	0 to 32000	Command Translation Table MSP
mComreq_Setup [85]	0 to 32000	Command Translation Table MDP
mComreq_Setup [86]	0 to 32000	Command Translation Table MST
mComreq_Setup [87]	0 to 32000	Command Translation Table MBO
mComreq_Setup [88]	0 to 32000	Command Translation Table MMENA
mComreq_Setup [89]	0 to 32000	Command Translation Table MMENB
mComreq_Setup [90]	0 to 32000	Command Translation Table MMENC
mComreq_Setup [91]	0 to 32000	Command Translation Table MEPTB
mComreq_Setup [92]	0 to 32000	Command Translation Table MEPTC

5.7.3 Configuration Examples for Address Translation

Case 1: Configuring Translation Memory Tables with two Different Offset Values and CPO with a Non-Zero Value

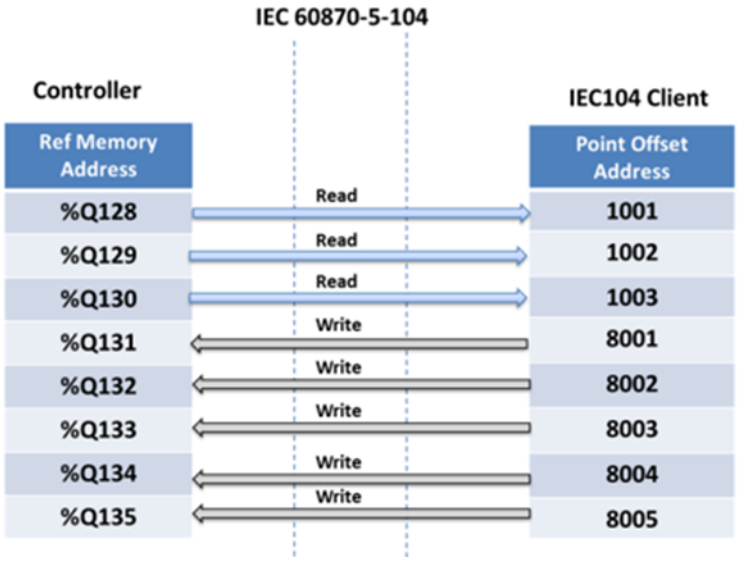
Figure 15: COMMREQ Parameters & Corresponding Read/Write Permissives (Case 1)

```
          // MSP_cfg    -   001 Singe Point data (bit)
mComreq_Setup[ 18] := 72;        // Mem Type bit 72 - %Q
mComreq_Setup[ 19] := 128;      // Mem Address (must be word bounded +1)
mComreq_Setup[ 20] := 8;       // Total points, 1 bit  per point (must be a byte bounded value)
mComreq_Setup[ 21] := 4;      // Control Point Offset
mComreq_Setup[ 75] := 1000;   // Read Translation Table MSP
mComreq_Setup[ 84] := 8000;   // Command Translation Table MSP
```

ADSU Type	Ref Memory Address	Point offset Address	Point Type	Translation offset Address
MSP	% Q128	1	Read Only	1001
MSP	% Q129	2	Read Only	1002
MSP	% Q130	3	Read Only	1003
MSP	% Q131	4	Read / Write	8001
MSP	% Q132	5	Read / Write	8002
MSP	% Q133	6	Read / Write	8003
MSP	% Q134	7	Read / Write	8004
MSP	% Q135	8	Read / Write	8005

- Points > = CPO are configured for Read / Write operations.
- Points < CPO are Configured for Read only.

Figure 16: Red/Write Interaction between Controller and IEC104 Client (Case 1)



- Master requesting (read & write commands) for corresponding point offset address should be synchronized with translation memory offset address

Case 2: Configuring Translation Memory Offset with Zero and CPO with Non-Zero Value

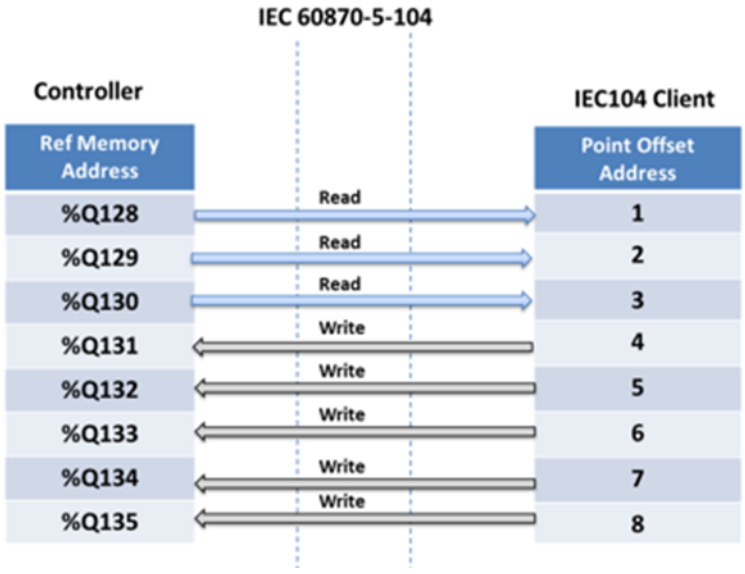
Figure 17: COMMREQ Parameters & Corresponding Read/Write Permissives (Case 2)

```
// MSP_cfg   -  001 Singe Point data (bit)
mComreq_Setup[ 18] := 72;       // Mem Type bit 72 - %Q
mComreq_Setup[ 19] := 128;      // Mem Address (must be word bounded +1)
mComreq_Setup[ 20] := 8;        // Total points, 1 bit  per point(must be a byte bounded value)
mComreq_Setup[ 21] := 4;        // Control Point Offset
mComreq_Setup[ 75] := 0;        // Read Translation Table MSP
mComreq_Setup[ 84] := 0;        // Command Translation Table MSP
```

ADSU Type	Ref Memory Address	Point offset Address	Point Type	Translation offset Address
MSP	% Q128	1	Read Only	1
MSP	% Q129	2	Read Only	2
MSP	% Q130	3	Read Only	3
MSP	% Q131	4	Read / Write	4
MSP	% Q132	5	Read / Write	5
MSP	% Q133	6	Read / Write	6
MSP	% Q134	7	Read / Write	7
MSP	% Q135	8	Read / Write	8

Translation memory offsets are disabled when both the Read and Command offset values are set to 0.

Figure 18: Red/Write Interaction between Controller and IEC104 Client (Case 2)



- Points < CPO are Read only
- Point >= CPO are Read / Write

Case 3: Configuring Different Translation Memory Offsets and CPO as a Zero

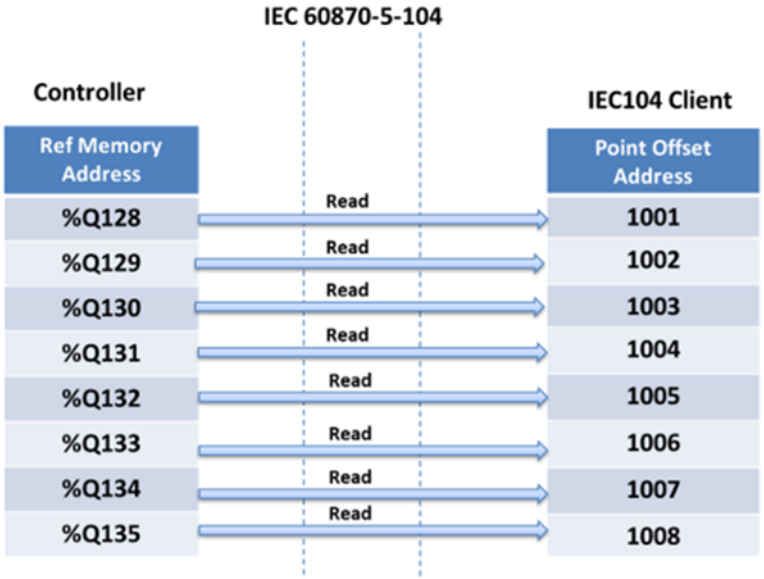
Figure 19: COMMREQ Parameters & Corresponding Read/Write Permissive (Case 3)

```
// MSP_cfg    -  001 Singe Point data (bit)
mComreq_Setup[ 18] := 72;       // Mem Type bit 72 - %Q.
mComreq_Setup[ 19] := 128;      // Mem Address (must be word bounded +1)
mComreq_Setup[ 20] := 8;        // Total points, 1 bit  per point(must be a byte bounded value)
mComreq_Setup[ 21] := 0;        // Control Point Offset
mComreq_Setup[ 75] := 1000;     // Read Translation Table MSP
mComreq_Setup[ 84] := 8000;     // Command Translation Table MSP
```

ADSU Type	Ref Memory Address	Point offset Address	Point Type	Translation offset Address
MSP	% Q128	1	Read Only	1001
MSP	% Q129	2	Read Only	1002
MSP	% Q130	3	Read Only	1003
MSP	% Q131	4	Read Only	1004
MSP	% Q132	5	Read Only	1005
MSP	% Q133	6	Read Only	1006
MSP	% Q134	7	Read Only	1007
MSP	% Q135	8	Read Only	1008

- For CPO = 0, all corresponding Points are configured as Read-Only.

Figure 20: Red/Write Interaction between Controller and IEC104 Client (Case 3)



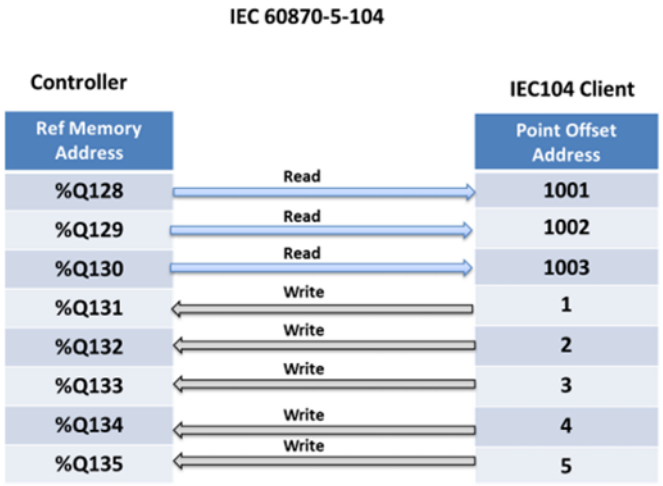
Case 4: Configuring Command Translation Memory Offsets to Zero and CPO as Non-Zero Value

Figure 21: COMMREQ Parameters & Corresponding Read/Write Permissives (Case 4)

```
// MSP_cfg    -  001 Singe Point data (bit)
mComreq_Setup[ 18] := 72;       // Mem Type bit 72 - %Q
mComreq_Setup[ 19] := 128;      // Mem Address (must be word bounded +1)
mComreq_Setup[ 20] := 8;        // Total points, 1 bit  per point(must be a byte bounded value)
mComreq_Setup[ 21] := 4;        // Control Point Offset
mComreq_Setup[ 75] := 1000;     // Read Translation Table MSP
mComreq_Setup[ 84] := 0;        // Command Translation Table MSP
```

ADSU Type	Ref Memory Address	Point offset Address	Point Type	Translation offset Address
MSP	% Q128	1	Read Only	1001
MSP	% Q129	2	Read Only	1002
MSP	% Q130	3	Read Only	1003
MSP	% Q131	4	Read / Write	1004
MSP	% Q132	5	Read / Write	1005
MSP	% Q133	6	Read / Write	1006
MSP	% Q134	7	Read / Write	1007
MSP	% Q135	8	Read / Write	1008

Figure 22: Red/Write Interaction between Controller and IEC104 Client (Case 4)



- Since Command Translation offset is configured to 0 and read translation offset is non-zero, there is a problem from the client end in synchronizing these two offsets, as shown in the above communication.
- This type of configuration is not recommended.

Case 5: Configuring same Offsets for both Translation Memories and CPO as Non-Zero Value

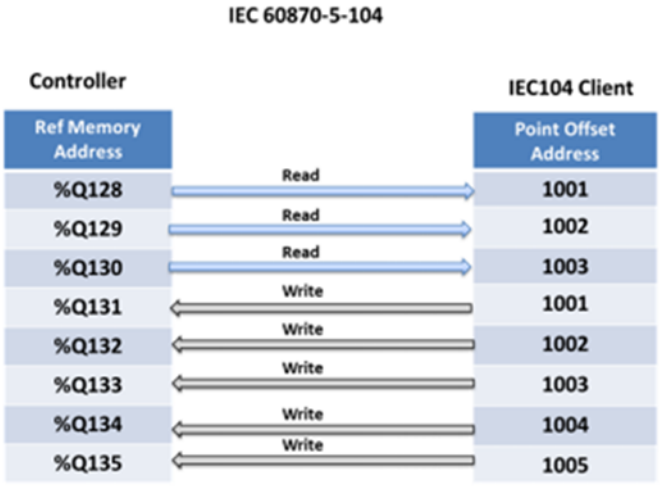
Figure 23: COMMREQ Parameters & Corresponding Read/Write Permissives (Case 5)

```
// MSP_cfg    -  001 Singe Point data (bit)
mComreq_Setup[ 18] := 72;        // Mem Type bit 72 - %Q
mComreq_Setup[ 19] := 128;       // Mem Address (must be word bounded +1)
mComreq_Setup[ 20] := 8;         // Total points, 1 bit  per point(must be a byte bounded value)
mComreq_Setup[ 21] := 4;         // Control Point Offset
mComreq_Setup[ 75] := 1000;      // Read Translation Table MSP
mComreq_Setup[ 84] := 1000;      // Command Translation Table MSP
```

ADSU Type	Ref Memory Address	Point offset Address	Point Type	Translation offset Address
MSP	% Q128	1	Read Only	1001
MSP	% Q129	2	Read Only	1002
MSP	% Q130	3	Read Only	1003
MSP	% Q131	4	Read / Write	1001
MSP	% Q132	5	Read / Write	1002
MSP	% Q133	6	Read / Write	1003
MSP	% Q134	7	Read / Write	1004
MSP	% Q135	8	Read / Write	1005

- Change of Data with Redundant point offset may be observed on client, which leads to ambiguity.
- This type of configuration is not recommended.

Figure 24: Red/Write Interaction between Controller and IEC104 Client (Case 5)



- Communication between controller and IEC104 client with translation memory offsets

Note:

1. *Point offset address is assigned with respective configured translation Offset + 1 to their address.*
2. *CPO > Number of configured points will have the same effect as CPO = Number of configured points: this configures all the points for Read / Write Operation.*
3. *Translation Offset address for Read and Command should not be equal for non-zero values.*
4. *Care should be taken during configuration of Read and Command Translation: do not allow their respective offsets to overlap*

5.8 Optional Configuration Parameters

The parameters listed in Section 5.8are optional for RX3i IEC 104 Server configuration files. The optional parameters are application-based, or user-defined, configuration parameters that determine the Server functionality and the responses to Client station requests. All configuration parameter values should be entered in decimal format. Refer to the parameter description to determine valid input values for application-based, or user-defined, parameter settings.

Note: Reserved *parameters* always have a value of zero (0).

5.8.1 Parameters for Filter Times

Parameter	Value	Description
mComreq_Setup [11]	0 to 65530	Input Change Filter Time, default is 10 ms, typical [3x Controller Sweep]. The Input Change Filter is a shutter on the data intake by the module from the Controller. If value configured is less than 10, then the value is internally clamped to 10 ms by the EIS001 firmware. If value configured is greater than 65530, then the value is internally clamped to 65530 ms by the EIS001 firmware.
mComreq_Setup [12]	0 to 65530	Report by Exception Shutter Time, default is 25ms. The RBE filter time is not a holding time. It is a general shutter to control the flow of data back to the Client. If value configured is less than 25, then the value is internally clamped to 25 ms by the EIS001 firmware. If value configured is greater than 65530, then the value is internally clamped to 65530 ms by the EIS001 firmware.

Note: *There is no interlock between the filter times.*

5.8.2 Parameters for Short and Long Pulse Durations

Parameter	Value	Description
mComreq_Setup [13]	0 to 65530	Short Pulse Duration, default 250 ms Valid range 10 to 65530 ms. If value configured is less than 10, then the value is internally clamped to 150 ms by the EIS001 firmware. If value configured is greater than 65530, then the value is internally clamped to 65530 ms by the EIS001 firmware.
mComreq_Setup [14]	0 to 65530	Long Pulse Duration, default 500ms Valid range 10 to 65530 ms. If value configured is less than 10, then the value is internally clamped to 500 ms by the EIS001 firmware. If value configured is greater than 65530, then the value is internally clamped to 65530 ms by the EIS001 firmware.

5.8.3 Parameters for Server Status Space

The Server Status Space is a 100-word data table that contains the current operational status of the Client station-Server connection. Set appropriate values for the constituent parameters as required by the application. The Controller memory location assigned to contain the Server Status Space is defined by the user, as follows:

Parameter	Value	Description
mComreq_Setup [15]	m-type value	Memory Type for Status Table Word Value: 8-%R, 10-%AI, 12-%AQ, 196-%W, 0-unused
mComreq_Setup [16]	address value	Memory Address Value 1-Based, low word for example, %R1 requires offset 1, %R100 requires offset 100
mComreq_Setup [17]	0	Memory Address Value 1-Based, high word High word only used for accessing %W memory above 65535

Note: *by setting the Memory Type parameter to 0, the corresponding feature is disabled. For more information on Status Space 100-word data table refer to Definition of the Status Area, Appendix A:.*

5.8.4 IEC 104 Polled Object Parameters, and CPO Setting for ADSUs

The following parameters are optional configurations for RX3i IEC104 outstation configuration. The optional parameters are application-based, or user-defined, configuration parameters that determine the outstation functionality and the responses to Client station requests. All configuration parameter values should be entered in decimal format. Refer to ADSU Supported in General Interrogation for a description of the mnemonics. Use the parameter descriptions in this section to determine valid input values for application-based, or user-defined, parameter settings.

Control Point Offset Configuration

The Control Point Offset (CPO) provides a mechanism to separate a given ADSU object into a Read-Only segment and a Read/Write segment. The CPO configuration should be understood in the context of the Length and address translation tables.

Each ADSU has CPO and Length parameters. For example, the Length and COP parameters for MSP ADSU are configured in mComreq_Setup [20] and mComreq_Setup [21] respectively.

The CPO value determines which portion of the ADSU object is Read-Only, and which is Read/Write as shown below:

CPO = 0	All ADSUs are Read-Only.	
CPO = Length	All ADSUs are Read-Only.	Non-zero Length
CPO < Length	ADSUs in range [1 to (CPO-1)] are Read-Only; ADSUs in range [CPO to Length] are Read/Write.	Non-zero Length
CPO > Length	All ADSUs in the range [1 to Length] are Read-Only.	Non-zero Length

Refer to Memory Translation Feature Configuration Parameters, Section 5.7.

The example below shows the MSP ADSU object layout for a configured Length = 8 and CPO = 4:

Figure 25: Example of CPO Splitting ADSU into Read-Only and Read/Write Segments

ADSU Type	Ref Memory Address	Point offset Address	Point Type	Translation offset Address
MSP	% Q128	1	Read Only	1
MSP	% Q129	2	Read Only	2
MSP	% Q130	3	Read Only	3
MSP	% Q131	4	Read / Write	4
MSP	% Q132	5	Read / Write	5
MSP	% Q133	6	Read / Write	6
MSP	% Q134	7	Read / Write	7
MSP	% Q135	8	Read / Write	8

MSP Configuration

M_SP ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [18]	m-type value	Memory Type for SP Objects Value: 70-%I, 72-%Q, 76-%M, 74-%T, 68-%G, 0-unused
mComreq_Setup [19]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [20]	Length	Number of ADSU Objects
mComreq_Setup [21]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4.

MDP Configuration

M_DP ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [22]	m-type value	Memory Type for DP Objects Value: 70-%I, 72-%Q, 76-%M, 74-%T, 68-%G, 0-unused
mComreq_Setup [23]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [24]	Length	Number of ADSU Objects
mComreq_Setup [25]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4.

MST Configuration

M_ST ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [26]	m-type value	Memory Type ST Objects Value: 8-%R, 10-%AI, 12-%AQ, 196-%W, 0-unused
mComreq_Setup [27]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [28]	Length	Number of ADSU Objects
mComreq_Setup [29]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4.

Note: *The step ranges from 0 to 63. The IEC 104 Client can step the ADSU object(s) from 0 to 63. The step increments above 63 from IEC 104 Client does not result in the increment of value above 63. The step decrement below 0 from IEC 104 Client does not result in the decrement of value below 0.*

MBO Configuration

M_BO ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [30]	m-type value	Memory Type for BO Objects Value: 70-%I, 72-%Q, 76-%M, 74-%T, 68-%G, 0-unused
mComreq_Setup [31]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [32]	Length	Number of ADSU Objects

Parameter	Value	Description
mComreq_Setup [33]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4.

MMENA Configuration

M_ME_NA ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [34]	m-type value	Memory Type for ME_NA Object Value: 8-%R, 10-%AI, 12-%AQ, 196-%W, 0-unused
mComreq_Setup [35]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [36]	Length	Number of ADSU Objects
mComreq_Setup [37]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4

MMENB Configuration

M_ME_NB ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [38]	m-type value	Memory Type for ME_NB Object Value: 8-%R, 10-%AI, 12-%AQ, 196-%W, 0-unused
mComreq_Setup [39]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [40]	Length	Number of ADSU Objects
mComreq_Setup [41]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4.

MMENC Configuration

M_ME_NC ADSU COMMREQ Configuration

Parameter	Value	Description
mComreq_Setup [42]	m-type value	Memory Type for ME_NC Object Value: 8-%R, 10-%AI, 12-%AQ, 196-%W, 0-unused
mComreq_Setup [43]	address value	Memory Address for ADSU object Value: 1 to maximum (based on memory type)
mComreq_Setup [44]	Length	Number of ADSU Objects *Note Each object is 2 words representing an IEE Float
mComreq_Setup [45]	CPO	Refer to Control Point Offset Configuration discussion in Section 5.8.4

MEPTB Configuration

*Future M_EP_TB ADSU COMMREQ Configuration does not scan the Controller memory, you must use Point Push interface for this ADSU.

Parameter	Value	Description
mComreq_Setup [46]	m-type value	unused
mComreq_Setup [47]	address value	unused
mComreq_Setup [48]	Length	unused
mComreq_Setup [49]	CPO	unused

MEPTC Configuration

*Future M_EP_TC ADSU COMMREQ Configuration does not scan the Controller memory, you must use Point Push interface for this ADSU.

Parameter	Value	Description
mComreq_Setup [50]	m-type value	unused
mComreq_Setup [51]	address value	unused
mComreq_Setup [52]	Length	unused
mComreq_Setup [53]	CPO	unused

5.8.5 Option Parameters

Parameter	Value	Description
mComreq_Setup [66]	0 / 1	Bit 1 – Clock Validity lasts for 1 hour Bit 2 – Clock Validity lasts for 24 hours *Note if Bit 1 and 2 are OFF, clock is valid forever; this is used when there is a time synch to the Controller such as IRIG-B. Bit 3 – Do Not accept time synch from a client Bit 4 - 1 : CPU Time is taken for Event Time tagging 0 : EIS001 Module Time is taken for Event Time tagging Bit 5 & Bit 6 – Multiple Client Connection Configuration
mComreq_Setup [67]	0 / 1	Bit 1 – When 1 SOE Disabled for M_SP Bit 2 – When 1 SOE Disabled for M_DP Bit 3 – When 1 SOE Disabled for M_ST Bit 4 – When 1 SOE Disabled for M_BO Bit 5 – When 1 SOE Disabled for M_ME_NA Bit 6 – When 1 SOE Disabled for M_ME_NB Bit 7 – When 1 SOE Disabled for M_ME_NC [Note: The SOE events are generated only when the Controller is in RUN I/O Enable state when the Bit 1 to Bit 7 is set to 1 for individual ADSUs. If Bit 1 to Bit 7 are all set to 0, then SOE events are generated irrespective of the Controller state (like STOP, Run Output Disable, Run I/O Enable).] Bit 8 – reserved Bit 9 – reserved The Firmware Release 1.40 and above provides enhancement to enable Report by Exception of analog data without time stamp through ASDU13 spontaneously instead of ASDU36, this enhancement makes use of this bit as described below. Bit 10 – When set to 1, M_ME_NC_1 (ADSU Type 13) - Measured value, scaled value (Short Float) (without Time Tag) is sent as “Spontaneous” or “RBE” response instead of M_ME_TF_1 (ADSU Type 36) - Measured value, scaled value with time tag CP56Time2a. Bit 10 – Default is set to 0, In such case, M_ME_TF_1 (ADSU Type 36) - Measured value, scaled value with time tag

Parameter	Value	Description
		CP56Time2a is sent as “Spontaneous” or “RBE” response and M_ME_NC_1 (ADSU Type 13) - Measured value, scaled value (Short Float) (without Time Tag) is only sent as response to “General Interrogation” or “Polling” command from Client. Bits 11 to 13 - Unused Bit 14 – When 1: Do Not Mark Points as Substituted when point push value is being used Bit 15 – When 1: Do Not Mark Points as Non-Topical when CPU is in STOP Bit 16 – When 1: Do Not Mark Points as Non-Topical when CRU is not Local Active
mComreq_Setup [72]	Integer	Queue Depth Override for Digital Points, 0 to 2000 If value is 0, then queue depth is set to 1024. If value is greater than equal to 2000, then the queue depth is clamped to 2000 by the EIS001 firmware.
mComreq_Setup [73]	Integer	Queue Depth Override for Analog Points, 0 to 2000 If value is 0, then queue depth is set to 512. If value is greater than equal to 2000, then the queue depth is clamped to 2000 by the EIS001 firmware.
mComreq_Setup [74]	0 / 1	Bit 2 – If value is 1, then do Not Accept Point Push Data whenever master is absent or disconnected Bit 1 – If value is 1, then do Not Accept Point Push Data when the queues are full

Multiple Client Connection Configuration

The Bit5 and Bit6 of the optional parameter -mComreq_Setup [66] is used to define the multiple Client Connection configuration. This feature is used in conjunction with a special Communication request block- COMMREQ (Command number -1242). The table below defines the bit configuration.

Bit6	Bit5	Configuration
0	0	Default – This fixes configuration to only one Client connection associated with Port#2404, supporting both “Polling” and “RBE”. ***Note:*** *This overrides the parameter “mComreq_Setup [09] -No of Client connections”.*
0	1	All of Client connections configured as per mComreq_Setup [09] shall be associated with unique port numbers. The Port numbers will be mComreq_Setup [07] + i; (typically 2404+i). All the configured Client

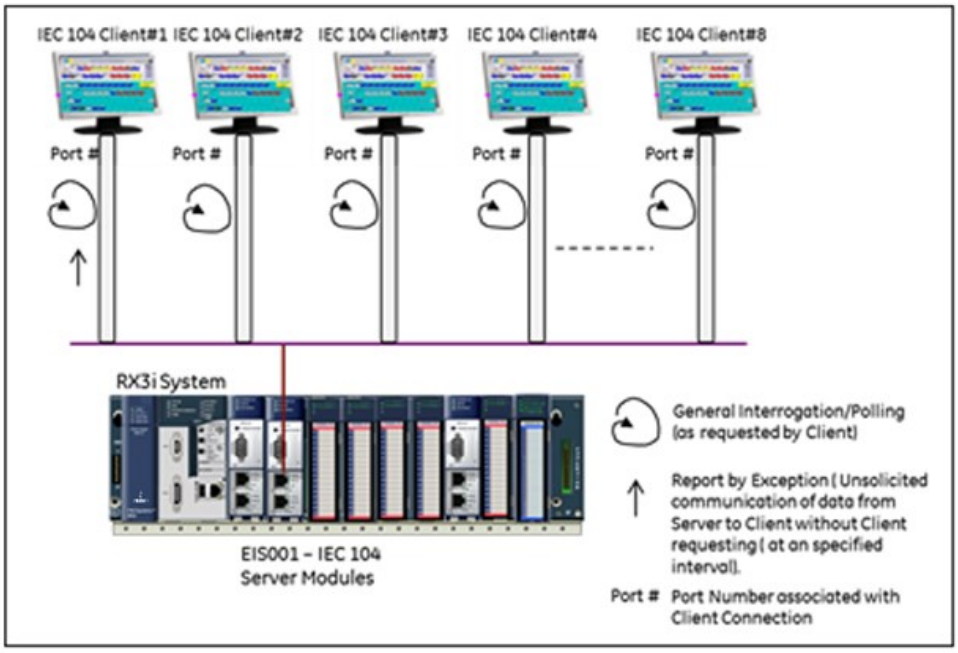
Bit6	Bit5	Configuration
		connections will support “Polling”. By default, the “RBE” feature will only be enabled on one connection as configured in mComreq_Setup [07] (typically 2404). The “RBE” feature will be disabled in all other client connections. To shift “RBE” to different Client connections during runtime, issue a “CommReq cmd 1242” with a parameter – Target Client Connection port number. In Multiple Client configuration, the "Point Push" works only on Client connection associated with port number configured in mComreq_Setup [07] (Typically 2404). Refer to the section: COMMREQ –Shift RBE on Client Connection Associated with a Specified Port Number
1	0	All of Client connections configured as per mComreq_Setup [09] shall be associated with Port# (as configured in mComreq_Setup [07], typically 2404). All Client connections shall support only “Polling” and “RBE” will be Disabled for all Client connections.
1	1	Default – (Same as Configuration with Bit5 & Bit6 set to 0).

COMMREQ –Shift RBE on Client Connection Associated with a Specified Port Number

The following are important aspects of Multiple Client connections for an IEC 104 Server module: -

1. All Client connections in multiple Client configuration will support Polling or General Interrogation
2. Only one Client connection in multiple Client configurations will support RBE (Unsolicited data reporting). I.e. Server module will report RBE to only Client connection with specified Port Number.
3. The Multiple Client configuration is depicted in the following illustration

Figure 26



The Shift RBE COMMREQ requests that the RBE be shifted from one Client connection to other Client connection associated with specified Port number. This COMMREQ can be triggered via positive edge trigger. On event of failure of the existing Client connection (which has RBE), the RBE can be shifted in runtime to another Client connection using this COMMREQ. The Status bit “Client connection XX” as defined in the Status Area in Appendix A.

The COMMREQ Status Word (CRS) indicates the success or failure of this COMMREQ. If the COMMREQ requests an invalid Client Connection Port number, then the COMMREQ fails and the CRS is set to a non-zero value to identify the failure.

See the section “The Communications Request” in the document GFK-2224 for general description of CCOMMREQ configuration

Command 1242 Example

Shift the RBE (Report by Exception/Unsolicited Response) to client connection associated with a specified Port number. Return the COMMREQ Status word to %R10.

	Dec (Hex)
Word 1	00008 (0008) Length of Channel command Data Block
Word 2	00000 (0000) Always 0 (no-wait mode request)
Word 3	00008 (0008) Memory type of CRS word (%R)
Word 4	00009 (0009) CRS word address minus 1 (%R10)*
Word 5	00000 (0000) Reserved
Word 6	00000 (0000) Reserved

Word 7 01242 (2332) Shift RBE on Client Connection associated with a specified Port Number

Word 8 02404 (0964) Client Connection Port number

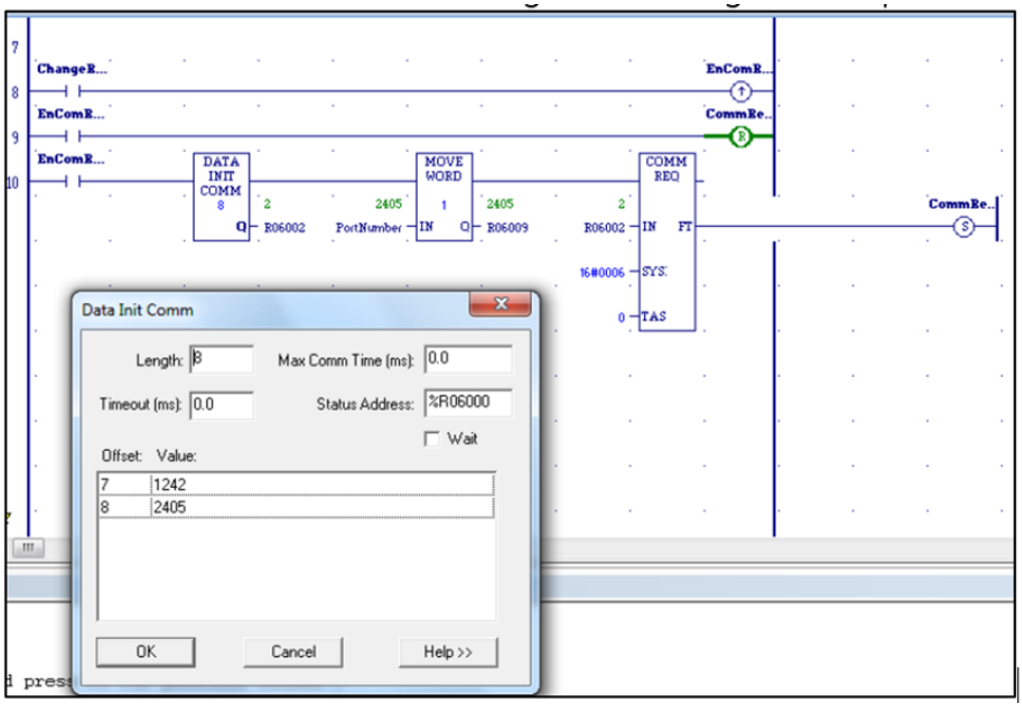
- Word 4 (CRS word address) is the only zero-based address in the Command Block. Only this value requires subtracting 1 from the intended address.

(Word 7) Channel Command Number: Word 7 is the command id for a Shift RBE on selected Client Connection (#Port) COMMREQ. If successful, RBE is shifted to the Client Connection associated with the specified port number in Word 8.

(Word 8) Client Connection Port Number: Word 8 specifies the specific port number of Client connection to which user intends to Shift the RBE feature.

The snapshot below shows the COMMREQ logic for shifting the RBE port during runtime.

Figure 27



5.9 Point Push Interface Definition

Point Push is an IEC 104 Server feature used to manually enter IEC 104-point data, date and time, and/or flags information into the internal database of the EIS001 module. This feature is available in either SOE mode, or NON-SOE Mode. It can be used to interface a Controller to an SOE or record-based system (local or remote) so that records containing information from the source can be transferred to the EIS001.

Point Push works by specifying a CPU memory interface region for the EIS001 to monitor. The memory space specified is formatted with a custom record format that will be used by the EIS001 to accept point push records.

5.9.1 Interface Specification

Set the value for the Point Push interface as required by the application.

Parameter	Value	Description
mComreq_Setup [68]	0 / 1	0 = Disable Point Push 1 = Enable Point Push Using Controller memory
mComreq_Setup [69]	m-type value	Memory Type for Point Push Table, Word Value: 8-%R, 10-%AI, 12-%AQ, 196-%W, 0-unused
mComreq_Setup [70]	address value	Memory Address Value for Point Push 1-Based, low word for example, %R1 requires offset 1, %R100 requires offset 100
mComreq_Setup [71]	0	Memory Address Value 1-Based, high word High word only used for accessing %W memory above 65535

5.9.2 Record Format

The Point Push Record Format consists first of a 3-word Header Section and a 13-word Record Section. The Record Section may be repeated up to eight times. Each iteration is concatenated to the preceding Record Section.

Header Section of the Record Format

Index	Value	Description
[000]	1237	Specific value the EIS001 will look for to start the record
[001]	1 ... 65534	A counter or changed variable that will signal the EIS001 that there is new data to be processed.
[002]	1 ... 8	Number of Record Sections to process

Note: *While the Point Push interface is operating, it continues to modify the header section. Note that it takes multiple scans to accomplish a Point Push.*

Record Section (may repeated up to 8 times)

Figure 28

IEC104 Point Push Memory Format
8 Point Push Records, with Header Information

	9	8	7	6	5	4	3	2	1	0
0x	Second (in 1000's)	Minute	Hour	Data[1]	Data [0]	Point Number	ADSU (1)	Number of Records	Sequence Number	Command Number "1237"
10x	Hour	Data[1]	Data [0]	Point Number	ADSU (2)	*unused*	*unused*	Year (assuming a Y2k base)	Day	Month
20x	Data [0]	Point Number	ADSU (3)	*unused*	*unused*	Year (assuming a Y2k base)	Day	Month	Second (in 1000's)	Minute
30x	ADSU (4)	*unused*	*unused*	Year (assuming a Y2k base)	Day	Month	Second (in 1000's)	Minute	Hour	Data[1]
40x	*unused*	Year (assuming a Y2k base)	Day	Month	Second (in 1000's)	Minute	Hour	Data[1]	Data [0]	Point Number
50x	Day	Month	Second (in 1000's)	Minute	Hour	Data[1]	Data [0]	Point Number	ADSU (5)	*unused*
60x	Second (in 1000's)	Minute	Hour	Data[1]	Data [0]	Point Number	ADSU (6)	*unused*	*unused*	Year (assuming a Y2k base)
70x	Hour	Data[1]	Data [0]	Point Number	ADSU (7)	*unused*	*unused*	Year (assuming a Y2k base)	Day	Month
80x	Data [0]	Point Number	ADSU (8)	*unused*	*unused*	Year (assuming a Y2k base)	Day	Month	Second (in 1000's)	Minute
90x		*unused*	*unused*	Year (assuming a Y2k base)	Day	Month	Second (in 1000's)	Minute	Hour	Data[1]

Notes:

####	This is the "Header" information to a point push record
	This is a Record (#) Odd Numbered
	This is a Record (#) Even Numbered

Note: *The field ADSU in the above record format can be set to the Type of ADSUs required for point push by using the ADSU number in the appropriate fields. Refer to ADSU Supported in General Interrogation.*

5.9.3 Interface Collection Mechanism

Based on the Record Format in section 5.9.2, the following is the process for pushing points into the EIS001:

- IF words [000] and [002] are non-zero, a point push is in operation is processing, or has ended in an error.
- IF words [000] and [002] are both 0 a point push can start.
  1. Fill the IEC 104 records into the table.
  2. In word [002] place the number of records to be pushed (1 to 8).
  3. In word [000] place the Number 1237.
  4. In word [001] place a non-zero number, that is not the same as the contents of status word 92. This is the trigger for the Point Push operation. NOTE: this word is an unsigned integer, so you can simply ADD_UINT 1 to the value in the status word, and if 0 add again.
- If words [000], [001], [002] are all -1 (65535), then a Point Push has been detected by the EIS001 and is in process. NOTE: Point Push works over many Controller scans, so the ladder logic can take up to three scans to complete.

- If words [000] and [002] are both 0, the push is complete. Word [001] will revert to the same sequence number pushed. A new Point Push record can now be initiated.
- The Point Push interface will HOLD if no event space is available and will not accept any point push records, the step where the three records are set to -1 will not occur, and the header information will remain the same as that entered by the user's application code.

You can retry a Point Push but be aware that some of the Point Push records may have transferred successfully to the EIS001 database, as the EIS001 Point Push interface checks the Point Push data as it processes. An invalid point number, or object, will terminate the Point Push when found.

5.9.4 Point Push for Digital and Analog Data

When using point push for Analog data, the following rules need to be observed for the data to be interpreted correctly by the EIS001 module code, as the variance specified, and the default variance have a correlation to the data interpretation.

The Variance for the point must be set using the following table:

ADSU	Data Size	Data Words being used.
M_SP (1)	16-bit Int	Use data word 0, Data [0]
M_DP (3)	32-bit Int	Use data word 0 and 1, Data [0],[1]
M_ST (5)	16-bit Int	Use data word 0, Data [0]
M_BO (7)	32-bit Int	Use data word 0 and 1, Data [0],[1]
M_ME_NA (9)	16-bit Int	Use data word 0, Data [0]
M_ME_NB (11)	16-bit Int	Use data word 0, Data [0]
M_ME_NC (13)	32-bit Float	Use data word 0 and 1, Data [0],[1] (DWORD Type: Real)
M_EP_TB	Event	Use data word 0, Data [0]
M_EP_TC	Event	Use data word 0, Data [0]

5.10 Required COMMREQ Function Block Parameters

The callout in the ST block defines and executes the standard COMMREQ function block as required for the configuration of the EIS001 module(s). Whenever more than one EIS001 module is installed, care must be exercised when defining parameters in the COMMREQ callout to ensure correct assignment and configuration of the Server parameters to the intended EIS001 modules.

```
// Execute the COMMREQ on the RX3i EIS001 module

//comm_req(IN := mComreq_Setup , SYSID := iRackSlot, Task := 0, FT =>
mComreq_CallSta,

ENO => mComreq_ENO);
```

The COMMREQ function block parameters are described in the table below. Set values for these parameters as required by the application.

Parameter	Value	Description
IN	mComreq_Setup	Location of the COMMREQ Command Block Parameters, always mComreq_Setup
SYSID	iRackSlot	Slot Location of the IEC 104 EIS001 module in RX3i Rack, always iRackSlot
TASK	0	Task Value, always 0
FT	mComreq_CallSta	Fault Output, always mComreq_CallSta
ENO	mComreq_ENO	Enable Output, always mComreq_ENO

5.11 Program Download

After parameters in the ST block have been set up as required by the application, the project can be downloaded to the RX3i controller for verification and operation.

5.12 IEC 104 Communications Start-up

The EIS001 module will power up and signal the user program through LIS bit 11 that it is ready to receive the configuration parameters as defined in the ST block. LIS bit 11 and LIS bit 13 (LAN OK) are used together in the user program to execute the one-shot signal to configure the module with its parameters.

LAN Interface Status (LIS) bits 10, 11, and 12 are reserved for use with Ethernet applications. Only LIS bit 11 is used with the IEC 104 Server; reference the status information below for operational details.

LIS bit 11	Description
0	IEC 104 Server is not executing.
1	IEC 104 Server is executing and is ready for configuration.

5.13 COMMREQ Status Word Codes

After power-up of the RX3i controller, the status of the IEC 104 Server can be checked in the COMMREQ Status Word. Refer to the table below for status code values and descriptions.

Status Code	Description
1	Successful configuration of the IEC 104 Server.
40592	Warning: The IEC 104 Server is already configured and

Status Code	Description
16#C090	Error: In a redundancy application an attempt was made to configure an IEC 104 Server in an inactive (backup) CRU-

5.14 Security

The IEC 104 protocol implemented in the EIS001 module is not explicitly secure; nor is the access to Controller memory explicitly secure. Steps must be taken to secure the network from unauthorized control, interception, or access to the IEC 104 communications. Steps must also be taken to secure the Controller from unauthorized access or control using the security features found in the latest released versions of PAC Machine Edition 8.5 Sim9 and PACSystems RX3i CPU firmware.

Emerson strongly recommends that the IEC 104 Write/control memory NOT be permitted to be directly connected to control devices. Such devices should also be protected from direct access using the security features found in the latest released versions of PAC Machine Edition and PACSystems RX3i CPU firmware. Consult Emerson technical support for more information.

Emerson also strongly recommends that the EIS001 modules, in all instances, be updated with the latest released version of EIS001 firmware to ensure all available security enhancements are present. Firmware updates may be obtained at https://www.emerson.com/Industrial-Automation-Controls/support.

Appendix A: Definition of the Status Area

A-1 General Table View

Figure 29: Status Area Contents and Layout

	9	8	7	6	5	4	3	2	1	0
0x	9902	Number if times PLC Write was blocked	PLC Write Task	9901	0	PLC Read Task Alive Counter	Main Task Alive Counter	Ver_2 Word	Ver_1 Word	CTR
10x	This EIS is in a CRU CPU	9904	Last Sequence Processed in Point Pus	Point Push Process State	Number of New Point Push buffers read	9903	Time is NOT Valid indicator when 1	0	Number of Times Client has updated PLC Clock	ms of time it is taking to read from PLC and Process
20x	Client Connection 07	Client Connection 06	Client Connection 05	Client Connection 04	Client Connection 03	Client Connection 02	Client Connection 01	9905	This EIS is in a Running CPU	This EIS is in a Active CPU
30x	Event Count MEPTC_IDX	Event Count MEPTB_IDX	Event Count MMENC_IDX	Event Count MMENB_IDX	Event Count MMENA_IDX	Event Count MBO_IDX	Event Count MST_IDX	Event Count MDP_IDX	Event Count MSP_IDX	Client Connection 08
40x		Status of Connection check, 9999 blocking, 1 not	Status of Que full check, 9999 blocking, 1 not	Number of times Auto Scan was blocked	Number of times Point Push was blocked	Number of Times Read Executed	Number of Times Read Triggered	9906	Analog Que Depth Setting	Binary Que Depth Setting
50x										
60x										
70x										
80x										
90x	CTR	9999								

Notes:	
CTR	This is the table update counter, when both word 0, and the word after the 9999 marker are equl, the table is stable to use
#	A Word that has a constant value in it
	Future counters and indicators space

Note: *The status representing the "Client Connection 01 to 08" in Status area are only applicable with Multiple Client connection configuration with RBE on one Client connection. [See Bit5/Bit6 of optional parameter -mCommreq_Setup [66]. The value (0x02) indicates "Client Connected" and value(0x03) indicates "Client Disconnected".*

A-2 Specific Areas of Status

A-2.1 Status of Read

The Time to read from PLC and process data is reported in indicator 10 and is in milliseconds. Indicators 43 to 48 indicate the capability of the module to process reading and point push.

A-2.2 Status of a Client Connection

Connected Clients will be indicated at indices 23, Connection indicators at 24 to 30 are future.

A-2.3 Point Push

Indices 15, 16, 17 are used to indicate the state and last point push occurrence information.

A-2.4 Events being stored

Indices 31 to 39 show the queue amounts for each of the supported ADSUs.

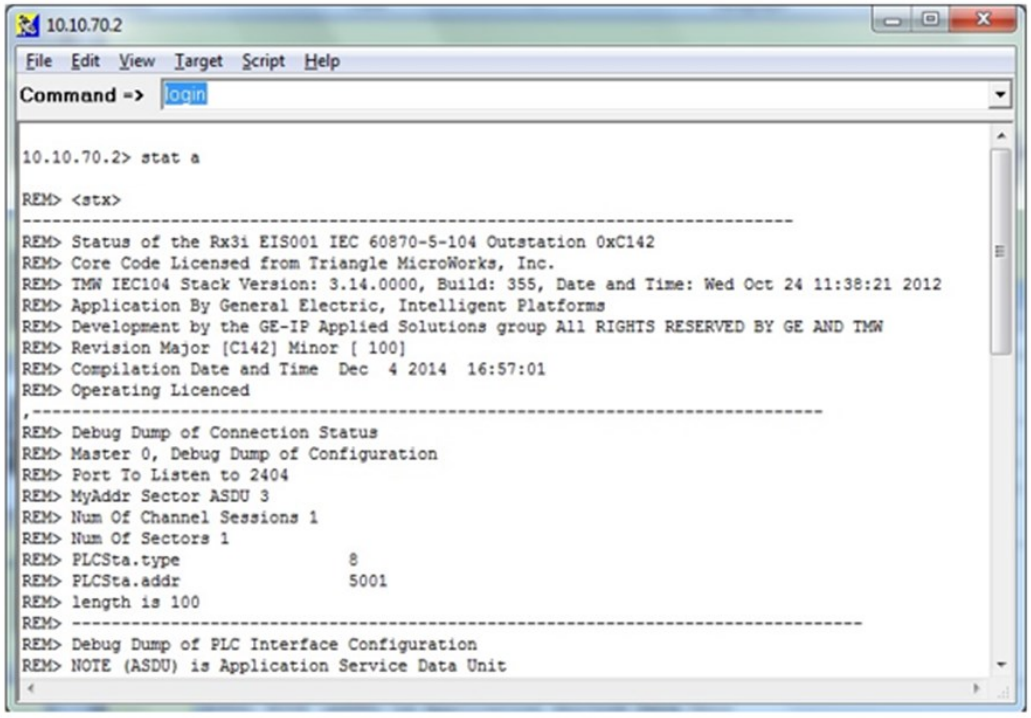
Appendix B: Station Manager Status

The EIS001 Station Manager interface supports an additional command switch A that can be used with the stat and tally commands to gather statistics and configuration settings from the module. Typically, these are for tech support to use, but they can be used to debug a system prior to engaging Emerson IP support. Below are examples of its usage in the STAT and Tally Commands

STAT a

The Stat a command is designed to be self-documenting in its output, it represents many of the configuration and operational parameters, settings, or status of the EIS001.

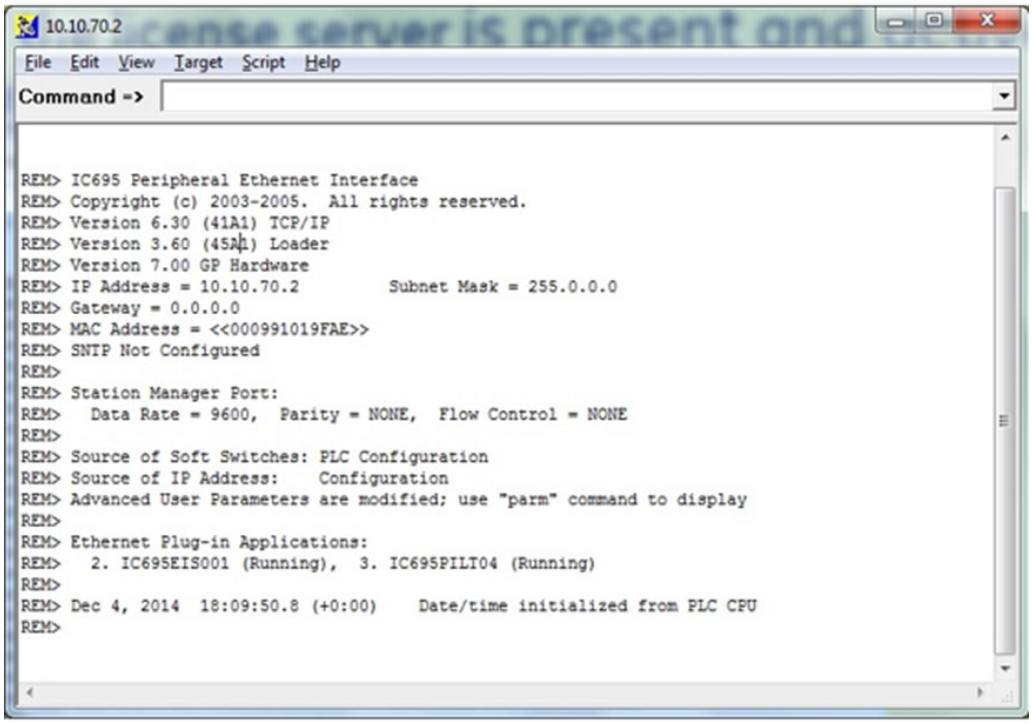
Figure 30: Response to *stat a* Command



NODE

The Node Command indicates the presence of the Plug-in communication modules.

Figure 31: Node Commands Showing Available Plug-in Communication Modules



Appendix C: Log Messages Table

All EIS001-specific faults are logged under Group 16. Other (ETM001-derived) module faults may also be logged under Group 16. The EIS001 module faults are:

Module	Word 2 and 3	Word 4 and 5	Word 6 and 7	Word 8 and 9
COMMREQ	16 # 10 10	16 # 22 22	Length of COMMREQ Sent	Length of COMMREQ Expected
Interpretation: The COMMREQ Sent by the Controller does not match the expected COMMREQ length, and is too long.				
COMMREQ	16# 10 10	16# 22 22	16# FF FF	16# 00 01
Interpretation: The COMMREQ Sent by the Controller is a NULL.				
MAIN	16# 00 00	Revision 1	Revision 2	16# 00 01
Interpretation: General Message of the Firmware Revision, and module waiting for COMMREQ				
MAIN	16# 00 01	16# 00 01	16# 00 01	16# 00 01
Interpretation: General Message of the EIS001 Module starting after COMMREQ.				
MAIN	16# 00 01	16# 00 01	16# 00 01	16# 00 66
Interpretation: General Message the EIS001 Module has initialized and the MAIN loop is starting.				
MAIN	16# FF FF	16# FF FF	16# FF FF	16# FF FF
Interpretation: EIS001 Module has exited the main loop and shut down.				
Demo	16# 00 0F	16# FF FF	16# FF FF	16# FF FF
Interpretation: EIS001 Demo Mode has started, 4 hours of operation remains.				
Startup	General Failure Code	License a Check	License b Check	16# D6 E6
Interpretation: For GCC support of a Module that has a license but is failing to start as if licensed.				

Appendix D: Device Profile

This Appendix is a copy of IEC 60870-5-104 Configuration/Interoperability Guide for IC695EIS001.

SOFTWARE DOCUMENTATION

IEC 60870-5-104 Configuration/Interoperability Guide for IC695EIS001

DOCUMENT VERSION 2.4, SEPTEMBER 27, 2010

D-1 Revision History

Document Version:	1.0
Date:	October 22, 2002
Reviser:	David A. Goughnour, Triangle MicroWorks, Inc.

- Original release.

Document Version:	2.0
Date:	July 15, 2004
Reviser:	Stephen P. McCoy, Triangle MicroWorks, Inc

- Updated

Document Version:	2.1
Date:	September 12, 2004
Reviser:	Stephen P. McCoy, Triangle MicroWorks, Inc.

- Added time types for COT 5 to Type identification and cause of transmission assignments table.

Document Version:	2.2
Date:	February 14, 2008
Reviser:	Stephen P. McCoy, Triangle MicroWorks, Inc.

- Updated for 60870-5-104 Edition 2.

Document Version:	2.3
Date:	October 8, 2009
Reviser:	Stephen P. McCoy, Triangle MicroWorks, Inc.

- Added comments to indicate where this functionality may be modified in Source Code Library (SCL). Added FSCNB functionality. Set Clock Sync boxes

•

Document Version:	2.4
Date:	September 27, 2010
Reviser:	Stephen P. McCoy, Triangle MicroWorks, Inc.

- Added Double Transmission Support

Document Version:	2.4.a
Date:	October 17, 2014
Reviser:	Daniel J. Bingham

- Modified for Emerson Support.

D-2 Introduction

The purpose of this document is to describe the specific implementation of the IEC 60870-5-104 Source Code Library, V3.

Uses the Triangle MicroWorks, Inc. IEC 60870-5-104 Slave Source Code Library Version 3.

This document and the documents listed below provide complete information on how to communicate via the IEC 60870-5-104 protocol.

- IEC 60870-5-104 = Companion standard for IEC 60870-5-101 over TCP/IP
- IEC 60870-5-101 = Companion standard for basic telecontrol tasks
- IEC 60870-5-101 A2 = Addendum 2 for IEC 60870-5-101
- IEC 60870-5-5 = Basic Application Functions
- IEC 60870-5-4 = Definition and Coding of Application Information Elements
- IEC 60870-5-3 = General Structure of Application Data

D-3 Interoperability

This companion standard presents sets of parameters and alternatives from which subsets must be selected to implement 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 text descriptions of parameters which are not applicable to this companion standard are struck-through (corresponding check box is marked black).

Note: *In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.*

The selected parameters should be marked in the white boxes as follows:

☐	Function or ASDU is not used
☒	Function or ASDU is used as standardized (default)
R	Function or ASDU is used in reverse mode
B	Function or ASDU is used in standard and

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.

A black check box indicates that the option cannot be selected in this companion standard.

D-3.1 System or device

(system-specific parameter, indicate the station's function by marking one of the following with '**X**')

☐	System definition
☐	Controlling station
☒	Controlled station

D-3.2 Network configuration

(network-specific parameter, all configurations that are used are to be marked 'X')

■	~~Point-to-point~~	■	~~Multipoint~~
■	~~Multiple point-to-point~~	■	~~Multipoint-star~~

D-3.3 Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked '**X**')

Transmission speed (control direction)

Unbalanced interchange	Unbalanced interchange	Balanced interchange
Circuit V.24/V.28	Circuit V.24/V.28	Circuit X.24/X.27

Standard

- ~~100 bit/s~~
- ~~200 bit/s~~
- ~~300 bit/s~~
- ~~600 bit/s~~
- ~~1 200 bit/s~~

Recommended if >1 200bit/s

- ~~2 400 bit/s~~
- ~~4 800 bit/s~~
- ~~9 600 bit/s~~

- ~~2 400 bit/s~~
- ~~4 800 bit/s~~
- ~~9 600 bit/s~~
- ~~19 200 bit/s~~
- ~~38 400 bit/s~~

- ~~56 000 bit/s~~
- ~~64 000 bit/s~~

Transmission speed (monitor direction)

Unbalanced interchange Circuit V.24/V.28

Standard

- ~~100 bit/s~~
- ~~200 bit/s~~
- ~~300 bit/s~~
- ~~600 bit/s~~
- ~~1 200 bit/s~~

Unbalanced interchange Circuit V.24/V.28

Recommended if >1 200bit/s

- ~~2 400 bit/s~~
- ~~4 800 bit/s~~
- ~~9 600 bit/s~~

Balanced interchange Circuit X.24/X.27

- ~~2 400 bit/s~~
- ~~4 800 bit/s~~
- ~~9 600 bit/s~~
- ~~19 200 bit/s~~
- ~~38 400 bit/s~~

- ~~56 000 bit/s~~
- ~~64 000 bit/s~~

D-3.4 Link layer

(network-specific parameter, all options that are used are to be marked '**X**'. Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

~~Frame format FT 1.2, single character 1 and the fixed time out interval is used exclusively in this companion standard.~~

Link transmission procedure

- ~~Balanced transmission~~
- ~~Unbalanced transmission~~

Address field of the link

- ~~not present (balanced transmission only)~~
- ~~One octet~~
- ~~Two octets~~
- ~~Structured~~
- ~~Unstructured~~

Frame length

- ~~Maximum length L (number of octets)~~

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

■ ~~The standard assignment of ASDUs to class 2 messages is used as follows:~~

Type identification	Cause of transmission
9, 11, 13, 21	<1>

■ ~~A special assignment of ASDUs to class 2 messages is used as follows:~~

Type identification	Cause of transmission

~~**Note:** (In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data *available).*~~

D-3.5 Application layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked 'X')

■ ~~One octet~~ ☐ X Two octets

Information object address

(system-specific parameter, all configurations that are used are to be marked '**X**')

■ ~~*One octet*~~ ☐ *Structured*

■ ~~*Two octets*~~ ☐ *Unstructured*

☐ *Three octets*

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked 'X')

■ ~~*One octet*~~ ☐ *Two octets (with originator address)*
Originator address is set to zero if not used

Length of APDU

(system-specific parameter, specify the maximum length of the APDU per system)

The maximum length of APDU for both directions is 253. It is a fixed system parameter.

[redacted]	Maximum length of APDU per system in control direction
[redacted]	Maximum length of APDU per system in monitor direction

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

X	<1>	: =	Single-point information	M_SP_NA_1
[redacted]	~~<2>~~	~~: =~~	~~Single-point information with time tag~~	~~M_SP_TA_1~~
X	<3>	: =	Double-point information	M_DP_NA_1
[redacted]	~~<4>~~	~~: =~~	~~Double-point information with time tag~~	~~M_DP_TA_1~~
X	<5>	: =	Step position information	M_ST_NA_1
[redacted]	~~<6>~~	~~: =~~	~~Step position information with time tag~~	~~M_ST_TA_1~~
X	<7>	: =	Bitstring of 32 bit	M_BO_NA_1
[redacted]	~~<8>~~	~~: =~~	~~Bitstring of 32 bit with time tag~~	~~M_BO_TA_1~~
X	<9>	: =	Measured value, normalized value	M_ME_NA_1
[redacted]	~~<10>~~	~~: =~~	~~Measured value, normalized value with time tag~~	~~M_ME_TA_1~~
X	<11>	: =	Measured value, scaled value	M_ME_NB_1
[redacted]	~~<12>~~	~~: =~~	~~Measured value, scaled value with time tag~~	~~M_ME_TB_1~~
X	<13>	: =	Measured value, short floating-point value	M_ME_NC_1
[redacted]	~~<14>~~	~~: =~~	~~Measured value, short floating-point value with time tag~~	~~M_ME_TC_1~~
[redacted]	~~<15>~~	~~: =~~	~~Integrated totals~~	~~M_IT_NA_1~~
[redacted]	~~<16>~~	~~: =~~	~~Integrated totals with time tag~~	~~M_IT_TA_1~~
[redacted]	~~<17>~~	~~: =~~	~~Event of protection equipment with time tag~~	~~M_EP_TA_1~~
[redacted]	~~<18>~~	~~: =~~	~~Packed start events of protection equipment with time tag~~	~~M_EP_TB_1~~
[redacted]	~~<19>~~	~~: =~~	~~Packed output circuit information of protection equipment with time tag~~	~~M_EP_TC_1~~
X	<20>	: =	Packed single-point information with status change detection	M_PS_NA_1
X	~~<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
■	~~<37>~~	~~: =~~	~~Integrated totals with time tag CP56Time2a~~	~~M_IT_TB_1~~
■	~~<38>~~	~~: =~~	~~Event of protection equipment with time tag CP56Time2a~~	~~M_EP_TD_1~~
X	<39>	: =	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
X	<40>	: =	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

In this companion standard only the use of the set <30> – <40> for ASDUs with time tag is permitted.

Process information in control direction

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

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_NB_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>	: =	Set point command, scaled value	C_SE_NB_1
	<59>	: =	Double command with time tag CP56Time 2a	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 CP56Time 2a	C_SE_TA_1
X	<62>	: =	Set point command, scaled value with time tag CP56Time 2a	C_SE_TB_1
X	<63>	: =	Set point command, short floating point value with time tag CP56Time 2a	C_SE_TC_1
X	<64>	: =	Bitstring of 32 bit with time tag CP56Time 2a	C_BO_TA_1

Either the ASDUs of the set <45> – <51> or of the set <58> – <64> are used.

System information in monitor direction

(station-specific parameter, mark with an "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions).

X	~~<70>~~	~~:=~~	~~End of initialization~~	~~M_EI_NA_1~~

System information in control direction

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

X	<100>	: =	Interrogation command	C_IC_NA_1
■	~~<101>~~	~~: =~~	~~Counter interrogation command~~	~~C_CI_NA_1~~
X	<102>	: =	Read command	C_RD_NA_1
X	<103>	: =	Clock synchronization command (option see 7.6)	C_CS_NA_1
X	<104>	: =	Test command	C_TS_NA_1
■	~~<105>~~	~~: =~~	~~Reset process command~~	~~C_RP_NA_1~~

■	~~<106>~~	~~: =~~	~~Delay acquisition command~~ ~~C_CD_NA_1~~
☒	<107>	: =	Test command with time tag CP56time2a C_TS_TA_1

Parameter in control direction

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

■	<110> :=	Parameter of measured value, normalized value	P_ME_NA_1
■	<111> :=	Parameter of measured value, scaled value	P_ME_NB_1
■	<112> :=	Parameter of measured value, short floating point value	P_ME_NC_1
■	<113> :=	Parameter activation	P_AC_NA_1

File Transfer

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

■	<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 {blank or X, only available in monitor (standard) direction}	F_DR_TA_1
■	<127> :=	Query Log – Request archive file	F_SC_NB_1

Type identifier and cause of transmission assignments

(station-specific parameters)

Shaded boxes are not required.

Black boxes are not permitted in this companion standard

Blank: functions or ASDU not used.

Mark Type Identification/Cause of transmission combinations:

'**X**' if only used in the standard direction

'**R**' if only used in the reverse direction

'**B**' if used in both directions

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 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		X	X		X						X	X		X					
<2>	~~M_SP_TA_1~~			■		■						■	■							
<3>	M_DP_NA_1		X	X		X						X	X		X					
<4>	~~M_DP_TA_1~~			■		■						■	■							
<5>	M_ST_NA_1		X	X		X						X	X		X					
<6>	~~M_ST_TA_1~~			■		■						■	■							
<7>	M_BO_NA_1		X	X		X									X					
<8>	~~M_BO_TA_1~~			■		■														
<9>	M_ME_NA_1	X	X	X		X									X					
<10>	~~M_ME_TA_1~~			■		■														
<11>	M_ME_NB_1	X	X	X		X									X					
<12>	~~M_ME_TB_1~~			■		■														
<13>	M_ME_NC_1	X	X	X		X									X					
<14>	~~M_ME_TC_1~~			■		■														
<15>	M_IT_NA_1			X												X				
<16>	~~M_IT_TA_1~~			■												■				
<17>	~~M_EP_TA_1~~			■																
<18>	~~M_EP_TB_1~~			■																
<19>	~~M_EP_TC_1~~			■																
<20>	M_PS_NA_1		X	X		X									X					
<21>	M_ME_ND_1	X	X	X		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							

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 to 36	37 to 41	44	45	46	47
<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~~																			
<38>	M_EP_TD_1			X																
<39>	M_EP_TE_1			X																
<40>	M_EP_TF_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

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 to 36	37 to 41	44	45	46	47
<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	X
<104>	~~C_TS_NA_1~~																			
<105>	C_RP_NA_1						X	X									X	X	X	X
<106>	~~C_CD_NA_1~~																			
<107>	C_TS_TA_1						X	X									X	X	X	X
<110>	~~P_ME_NA_1~~																			
<111>	~~P_ME_NB_1~~																			
<112>	~~P_ME_NC_1~~																			
<113>	~~P_AC_NA_1~~																			
<120>	~~F_FR_NA_1~~																			
<121>	~~F_SR_NA_1~~																			
<122>	~~F_SC_NA_1~~																			
<123>	~~F_LS_NA_1~~																			
<124>	~~F_AF_NA_1~~																			
<125>	~~F_SG_NA_1~~																			
<126>	~~F_DR_TA_1*~~																			
<127>	~~F_SC_NB_1*~~																			
* Blank or X only																				

D-3.6 Basic Application Functions

Station initialization

(station-specific parameter, mark 'X' if function is used)

■ ~~Remote initialization~~

Cyclic data transmission

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☐ Cyclic data transmission

Read procedure

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ Read procedure

Spontaneous transmission

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ Spontaneous transmission

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type 'X' where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object)

The following type identifications may be transmitted in succession caused by a single status change of an information object. The information object addresses for which double transmission is enabled are defined in a project-specific list.

☒ Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1

☒ Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1

☒ Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1

☒ Bit string of 32-bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)

☒ Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1

☒ Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1

☒ Measured value, short floating-point number M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station interrogation

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- [X] global

[ ] group 1	[ ] group 7	[ ] group 13
[ ] group 2	[ ] group 8	[ ] group 14
[ ] group 3	[ ] group 9	[ ] group 15
[ ] group 4	[ ] group 10	[ ] group 16
[ ] group 5	[ ] group 11	
[ ] group 6	[ ] group 12	

Information Object Addresses assigned to each group must be shown in a separate table

Clock synchronization

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- [X] Clock synchronization
- [X] Day of week used
- [X] RES1, GEN (time tag substituted/ not substituted) used
- [ ] ~~SU-bit (summertime) used~~

optional, see 7.6

Command transmission

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- [ ] ~~Direct command transmission~~
- [ ] ~~SU-bit (summertime) used~~
- [X] Select and execute command
- [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 outstation)
- [X] Long pulse duration (duration determined by a system parameter in the outstation)
- [■] ~~Persistent output~~
- [X] Supervision of maximum delay in command direction of commands and set point commands

Fixed 5sec Maximum allowable delay of commands and set point commands

Transmission of integrated totals

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ~~Mode A: Local freeze with spontaneous transmission~~
- ~~Mode B: Local freeze with counter interrogation~~
- ~~Mode C: Freeze and transmit by counter-interrogation commands~~
- ~~Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously~~
- ~~Counter read~~
- ~~Counter freeze without reset~~
- ~~Counter read~~
- ~~Counter freeze with reset~~
- ~~Counter reset~~
- ~~General request counter~~
- ~~Request counter group 1~~
- ~~Request counter group 2~~
- ~~Request counter group 3~~
- ~~Request counter group 4~~

Parameter loading

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- ~~Threshold value~~
- ~~Smoothing factor~~
- ~~Low limit for transmission of measured values~~
- ~~High limit for transmission of measured values~~

Parameter activation

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ~~Act/deact of persistent cyclic or periodic transmission of the addressed object~~

Test procedure

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- [X] Test procedure

File transfer

(station-specific parameter, mark '**X**' if function is used)

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

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- ~~Background Scan~~

Acquisition of transmission delay

(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

- ~~Acquisition of transmission delay~~

Definition of time outs

Parameter	Default value	Remarks	Selected value
t_0	30s	Time-out of connection establishment	Fixed
t_1	15s	Time-out of send or test APDUs	Fixed
t_2	10s	Time-out for acknowledges in case of no data messages $t_2 < t_1$	Fixed
t_3	20s	Time-out for sending test frames in case of a long idle state	Fixed

Maximum range of values for all time outs: 1 to 255 s, accuracy 1 s

Maximum number of outstanding I format APDUs k and latest acknowledge APDUs (w)

Parameter	Default value	Remarks	Selected value
K	12 APDUs	Maximum difference receives sequence number to send state variable	Fixed
W	8 APDUs	Latest acknowledge after receiving w I-format APDUs	Fixed

Maximum range of values k: 1 to 32767 (215-1) APDUs, accuracy 1 APDU

Maximum range of values w: 1 to 32767 APDUs, accuracy 1 APDU (Recommendation: we should not exceed two-thirds of k).

Portnumber

Parameter	Value	Remarks
Portnumber	2404	In all cases

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 must be chosen by the user of this standard.

☒ Ethernet 802.3

☐ Serial X.21 interface

☐ Other selection from RFC 2200:

List of valid documents from RFC 2200

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....

Appendix E: Control Functions

E-1.1 STARTDT & STOPDT

The STARTDT_ACT (Start Data Transfer Activation) command is sent by the controlling station /IEC104 Master to the controlled station /IEC10 Server- IC695EIS001 to indicate the data transfer after an established connection. The controlled station /IEC10 Server- IC695EIS001 responds/acknowledges the controlling station /IEC104 Master by sending a STARTDT_CON (Start Data Transfer Confirmation).

The STARTDT_ACT control function is typically done during the initiation of connections (during startup and/or during re-connection).

STOPDT is the default state when a connection is established. In this state, the controlled station does not send any data via this connection, except during unnumbered control functions and their confirmations.

Both of these commands can be used with the EIS modules. Figure 32 shows the typical handshake between Controlling station /IEC104 Master) to the Controlled station /IEC10 Server- IC695EIS001

Figure 32: STARTDT_ACT & STOPDT Command

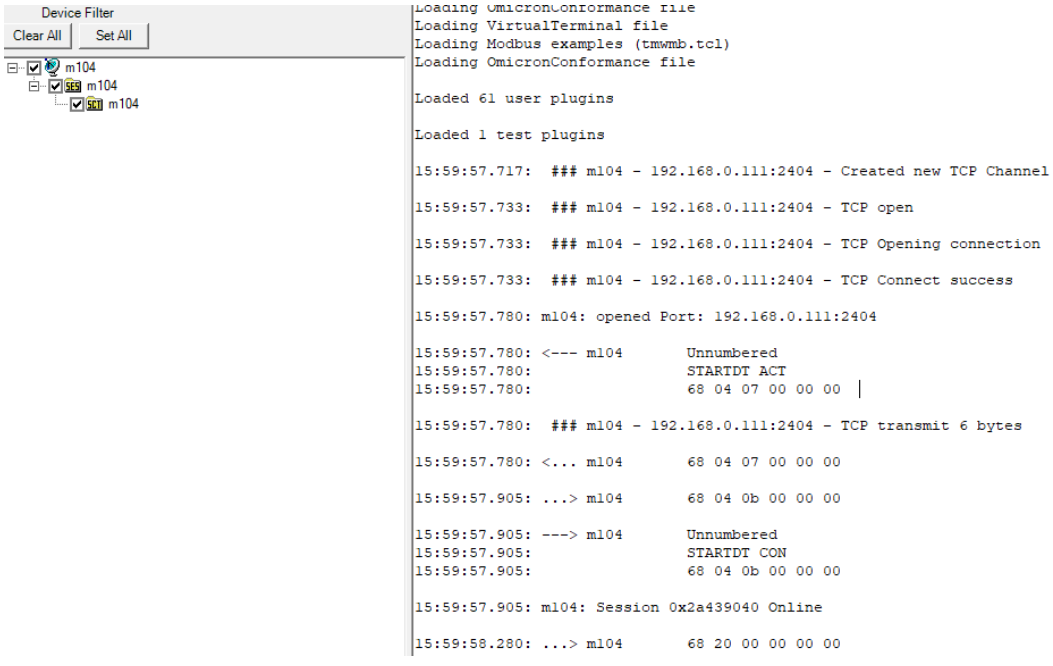
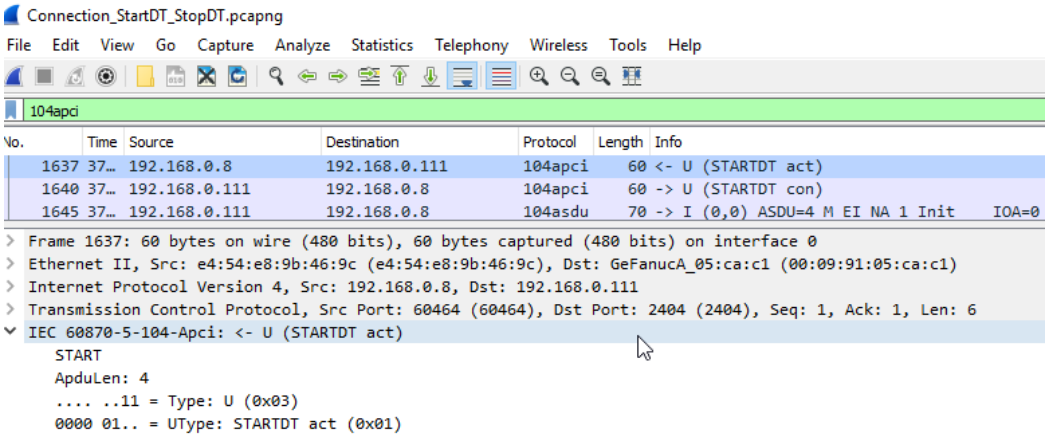


Figure 33 shows a Wireshark trace capturing these control functions during startup (U type).

Figure 33: Wireshark Trace of STARTDT Function



E-1.2 TESTFR

The TESTFR_ACT (Test Frame Activation) command is sent by the controlling station /IEC104 Master to the controlled station /IEC10 Server- IC695EIS001 at regular intervals to check the status of established connections. The controlled station /IEC10 Server- IC695EIS001 responds/acknowledges the controlling station /IEC104 Master) by sending a TESTFR_CON (Test Frame Confirmation).

Similarly, the TESTFR_ACT (Test Frame Activation) command is also sent by the controlled station /IEC10 Server- IC695EIS001 to controlling station /IEC104 Master) at regular intervals to check the status of established connections (like heart beat).The controlling station /IEC104 Master) responds/acknowledges to the controlled station /IEC10 Server- IC695EIS001 by sending TESTFR_CON (Test Frame Confirmation).

Both of these commands can be used with EIS modules.

Figure 34 demonstrates ; demonstrates typical handshake between Controlling station /IEC104 Master) to the Controlled station /IEC10 Server- IC695EIS001

Figure 34: Test Harness Tool

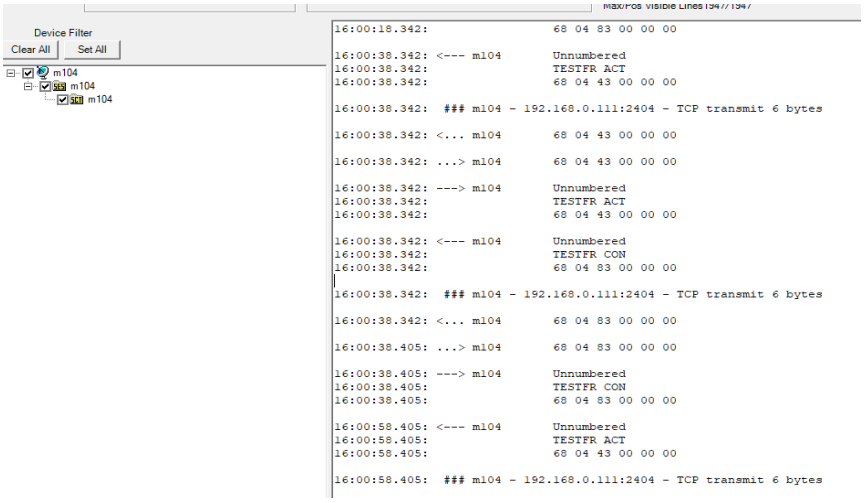
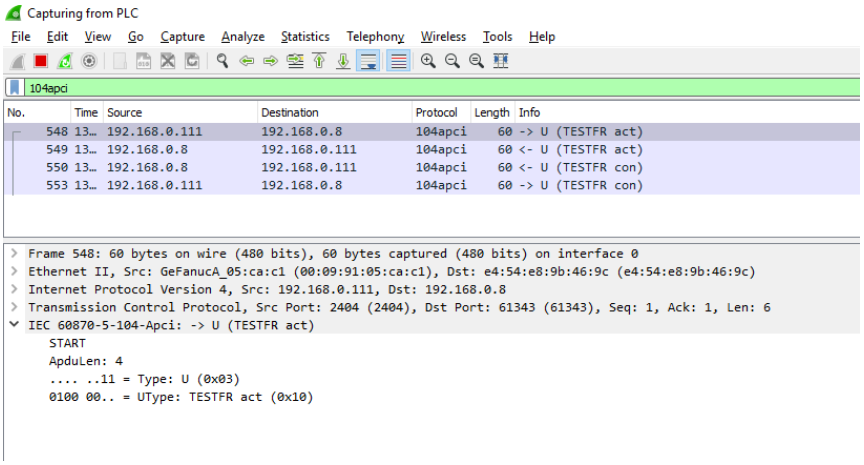


Figure 35 shows a Wireshark trace capturing these control functions during startup (U type). Please check the data packet for more details from the Master.

Figure 35:Wire Shark Trace for Control Commands



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Any escalation request should be sent to: mas.sfdcescalation@emerson.com

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